



UNIVERSIDADE ESTADUAL DE GOIÁS
Câmpus de Ciências Exatas e Tecnológicas
Programa de Pós-Graduação *Stricto Sensu* em Recursos Naturais do Cerrado

“SEM MORCEGO, NÃO TEM PEQUI”:
PERCEPÇÃO E CONHECIMENTO SOBRE OS SERVIÇOS
ECOSSISTÊMICOS PARA A CONSERVAÇÃO DO CERRADO

Anápolis

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FLÁVIA PEREIRA LIMA

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PERCEPÇÃO E CONHECIMENTO SOBRE OS SERVIÇOS
ECOSSISTÊMICOS PARA A CONSERVAÇÃO DO CERRADO**

Tese apresentada ao programa de Pós-Graduação *Stricto Sensu* em Recursos Naturais do Cerrado da Universidade Estadual de Goiás para obtenção do título de Doutora em Recursos Naturais do Cerrado.

Orientador: Prof. Dr. Rogério Pereira Bastos

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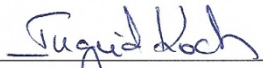
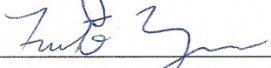


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ATA DE DEFESA PÚBLICA DE TESE Nº 72/2019

Aos 29 dias do mês de outubro do ano de 2019, às 13:30 horas, reuniu-se no auditório do bloco IV do Câmpus Anápolis de Ciências Exatas e Tecnológicas - Henrique Santillo da UEG, a banca Examinadora composta pelos: Prof. Dr. Rogério Pereira Bastos (UFG), Prof^ª. Dr^ª. Ingrid Koch (Unicamp), Prof. Dr. Fausto Miziara (UFG), Prof^ª. Dr^ª. Héliida Ferreira da Cunha (UEG) e Prof^ª. Dr^ª. Solange Xavier dos Santos (UEG) para sob a presidência do primeiro, procederem à “defesa de tese” intitulada: “Sem morcego, não tem pequi”: percepção e conhecimento sobre serviços ecossistêmicos para a conservação do Cerrado.”, de Flávia Pereira Lima, discente do PPG Recursos Naturais do Cerrado, nível doutorado. Foi realizada a avaliação oral no sistema de apresentação e defesa de tese de autoria do(a) discente. Terminada a avaliação oral, a Banca Examinadora reuniu-se emitindo os seguintes pareceres mediante as justificativas e sugestões abaixo:


Membro da Banca	Parecer (Aprovado/Reprovado)	Assinatura
Dr. Rogério Pereira Bastos (UFG)	APROVADO	
Dr ^ª . Ingrid Koch (Unicamp)	Aprovado	
Dr. Fausto Miziara (UFG)	Aprovado	
Dr ^ª . Héliida Ferreira da Cunha (UEG)	Aprovado	
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Justificativas e sugestões: _____

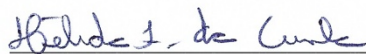
Após avaliação, a referida candidata foi considerada APROVADA na defesa de tese. Às 18:05 horas, o (a) Prof. Dr. Rogério Pereira Bastos, presidente da Banca Examinadora deu por encerrada a sessão e, para constar, lavrou a presente Ata:



Prof^ª. Dr^ª. Ingrid Koch
Membro Titular Externo



Dr. Fausto Miziara
Membro Titular Externo



Prof^ª. Dr^ª. Héliida Ferreira da Cunha
Membro Titular Interno



Prof^ª. Dr^ª. Solange Xavier dos Santos
Membro Titular Interno



Prof. Dr. Rogério Pereira Bastos
Presidente

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Esta tese é fruto da educação pública brasileira. Com exceção do ensino médio, toda a minha formação educacional foi realizada no sistema público de ensino. Considerando que o salário de professora de minha mãe custeou meus estudos no ensino médio, posso afirmar que até nesse período a escola pública estava presente. Fiz graduação e mestrado na Universidade Federal de Viçosa. O doutorado na Universidade Estadual de Goiás finaliza o meu processo de educação formal. Portanto, nada mais justa a minha gratidão às trabalhadoras e aos trabalhadores brasileiros que investem, por meio dos impostos pagos, na educação pública. Espero que o meu trabalho na Universidade Federal de Goiás, principalmente o exercido na educação básica, possa retribuir à sociedade brasileira esse investimento.

À primeira vista, minha formação acadêmica parece meio desconjuntada. Uma bióloga com mestrado em Extensão Rural e doutorado em Recursos Naturais do Cerrado. Além disso, que atua no ensino de ciências. Percebo que essa tese naturalmente refletiu essas múltiplas dimensões, culminando em um trabalho de percepção ambiental de proprietários rurais e como essa é afetada pela aprendizagem de conceitos científicos. As dimensões biológica, educacional e social se agregam num trabalho que me realiza como bióloga de gente (o que sempre disse que seria, desde a graduação). Muitas pessoas foram fundamentais na minha formação, desde a professora Marta Rust, com quem aprendi a ler pela palavra, ao professor Lúcio Campos, com quem aprendi que tudo em Biologia só faz sentido à luz da evolução. Ao agradecer aos dois, estendo minha gratidão a todas professoras e todos os professores que me ajudaram a ler o mundo sob as mais variadas lentes.

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“O Menino repetia-se em íntimo o nome de cada coisa. A poeira, alvissareira. A malva-do-campo, os lentiscos. O velame-branco, de pelúcia. A cobra-verde, atravessando a estrada. A arnica: em candelabros pálidos. A aparição angélica dos papagaios. As pitangas e seu pingar. O veado campeiro: o rabo branco. As flores em pompa arroxeadas da canela-de-ema. Essa paisagem de muita largura, que o grande sol alagava. O buriti, à beira do corquinho, onde, por um momento, atolaram. Todas as coisas, surgidas do opaco. Sustentava-se delas sua incessante alegria, sob espécie sonhosa, bebida, em novos aumentos de amor.”

*João Guimarães Rosa
Primeiras estórias*

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RESUMO

Proprietários rurais são atores sociais centrais nas discussões sobre a conservação da biodiversidade e manutenção dos serviços ecossistêmicos (SE) no Brasil, visto que 53,0% da vegetação nativa do país encontra-se em áreas privadas. Com o objetivo de compreender se proprietários rurais percebem as áreas protegidas públicas e privadas do bioma Cerrado como provedoras de SE, as seguintes hipóteses foram testadas nesta tese: i) a percepção dos SE é função de características pessoais (idade, gênero e nível educacional) e de descritores da propriedade (tamanho e tipo); ii) a intenção em recuperar áreas na propriedade é afetada pela atitude com relação a esse comportamento e do controle percebido (construtos da Teoria do Comportamento Planejado) e que a percepção dos SE, por sua vez, afeta diretamente a atitude e, indiretamente, a intenção avaliada; iii) a participação em atividade educacional, focada em demonstrar como os SE beneficiam as atividades rurais, afeta positivamente a percepção de áreas protegidas públicas e privadas. De acordo com os resultados dessa pesquisa, proprietários rurais percebem as áreas nativas como provedoras de SE e aqueles com maior escolaridade identificam mais a polinização e o controle biológico. A intenção em recuperar áreas na propriedade foi afetada pela atitude e, indiretamente, pela percepção dos SE. Proprietários que participaram da atividade educacional perceberam mais a polinização e aumentaram a percepção global dos SE. Os SE possuem uma dimensão pedagógica que potencializa a compreensão de como os processos ecológicos prestados pela biodiversidade impactam as atividades rurais e o bem-estar. É importante que o planejamento de ações conservacionistas integre as percepções dos proprietários rurais e promova ações educacionais para a construção de um conhecimento ecológico local ao qual se integre os SE.

Palavras-chave: percepção ambiental; serviços ecossistêmicos; proprietários rurais; áreas nativas; unidade de conservação; Cerrado; Teoria do Comportamento Planejado.

ABSTRACT

Landowners are key stakeholders in discussions of biodiversity conservation and maintenance of ecosystem services (ESs) in Brazil, since 53.0% of native vegetation is preserved on private areas. The aim of this study was to understand whether Brazilian landowners perceive public and private protected areas of the Cerrado biome as sources of ESs. The following hypotheses were tested in this thesis: i. ES perception is a function of personal characteristics (age, gender, formal education) and farm descriptors (size and type); ii) the intention to restore areas on the properties is influenced by attitude toward a behavior and perceived behavior control (Theory of Planned Behavior constructs), and ES perception directly impacts attitude and, indirectly impacts the evaluated intention; iii) participation in educational activities, focusing on demonstrating how ESs benefit rural activities, positively affects the perception of public and private protected areas. According to the results, landowners perceived native areas as sources of ESs, and those with more years of formal education perceived pollination and pest control better. The intention to restore areas on properties was affected by attitude and, indirectly, by ES perception. Landowners who participated in an educational activity perceived more pollination and increased their global perception of ESs. The ES framework has a pedagogical dimension that promotes the comprehension of how ecological processes rendered by native biodiversity impact rural activities and well-being. The design of conservation strategies needs to take landowners' perception into account and to promote educational events in order to integrate the ESs into local ecological knowledge.

Keywords: environmental perception; ecosystem services; farmers; native areas; public protected areas; Brazilian savanna; Theory of Planned Behavior.

INTRODUÇÃO

As políticas e as práticas de conservação são inerentemente fenômenos sociais, pois se baseiam na intrincada relação entre ser humano e a natureza (MASCIA et al., 2003). Nas últimas décadas as ações de conservação preocupam-se mais em inserir as dimensões humanas, no entanto, o corpo teórico e métodos das ciências sociais são ainda utilizados de forma superficial e, geralmente, integrados apenas ao final dos projetos (FOX et al., 2006; VISEU, 2015; BENNETT et al., 2017a). A perda de uma efetiva integração entre ciências naturais e sociais leva a construção de ações que desconsideram os contextos locais, comprometendo alcançar com eficácia os objetivos propostos (VAN VLEET; BRAY; DURÁN, 2016). A compreensão dos aspectos sociais e ecológicos na pesquisa da conservação demanda a configuração de equipes interdisciplinares, o uso de variados métodos de análises e integração conceitual (GUERRERO et al., 2018). A ciência da conservação, que no passado foi focada principalmente na biologia, precisa integrar as ciências sociais (KAREIVA; MARVIER, 2012).

Por mais distintas que sejam as abordagens conservacionistas elas buscam por meio de manejo, políticas e programas educacionais, a mudança de comportamento dos indivíduos (OSBALDISTON, 2013). A mudança de comportamento será mais efetiva quando: i. seleciona-se cuidadosamente o comportamento a ser mudado; ii. determina-se quais fatores causam o comportamento; iii. aplica-se intervenções bem delineadas para a mudança de comportamento; iv. avalia-se sistematicamente o efeito dessas intervenções (STEG; VLEK, 2009). Compreender esses fatores é essencial para o delineamento e implementação de projetos mais efetivos e as disciplinas sociais têm o aporte teórico e metodológico para isso. Esse conjunto de disciplinas sociais, com foco em conservação e manejo ambiental, é denominado de *Ciências Sociais da Conservação* (BENNETT et al., 2017b). Dentre as disciplinas está a *Psicologia da Conservação*, orientada para entender a relação entre seres humanos e o ambiente natural, buscando encorajar comportamentos conservacionistas (SAUNDERS, 2003). A partir do indivíduo ou do grupo, busca-se compreender atributos como valores, crenças, atitudes, normas, conhecimento e comportamentos relacionados às questões ambientais (SAUNDERS, 2003; BENNETT et al., 2017b). Apesar das similaridades com a psicologia ambiental, a ênfase da psicologia da conservação é na relação das pessoas como o ambiente natural, os efeitos dos seres humanos no ambiente, não o contrário, objeto de estudo da disciplina irmã (CLAYTON; SAUNDERS, 2012).

Definido como os benefícios que as populações humanas recebem da natureza (MEA, 2005), o conceito de serviços ecossistêmicos faz uma ligação direta entre a manutenção dos processos ecológicos e o bem-estar das populações humanas. A valoração desses serviços integra as dimensões ecológica, social e econômica (DE GROOT et al., 2010). Logo, o conceito de serviços ecossistêmicos é em sua essência interdisciplinar. Houve um aumento substancial de publicações científicas sobre serviços ecossistêmicos (NIETO-ROMERO et al., 2014; CHAUDHARY et al., 2015), no entanto, a predominância é de artigos disciplinares (MCDONOUGH et al., 2017). A dificuldade de se construir pesquisas interdisciplinares não diminuiu o potencial dos serviços ecossistêmicos integrarem as dimensões ecológicas e humanas da conservação. Tanto que o conceito está se difundindo para as esferas políticas e legais (ALTMANN; SILVA STANTON, 2018; BOUWMA et al., 2018), subsidiando processos decisórios (GRÊT-REGAMEY et al., 2017) e suportando ações de manejo ambiental e de uso da terra (DE JUAN; GELCICH; FERNANDEZ, 2017; CHEN et al., 2019), incluindo aquelas realizadas em áreas protegidas (ALLENDORF; YANG, 2013; MEIJAARD et al., 2013; GUERBOIS; FRITZ, 2017).

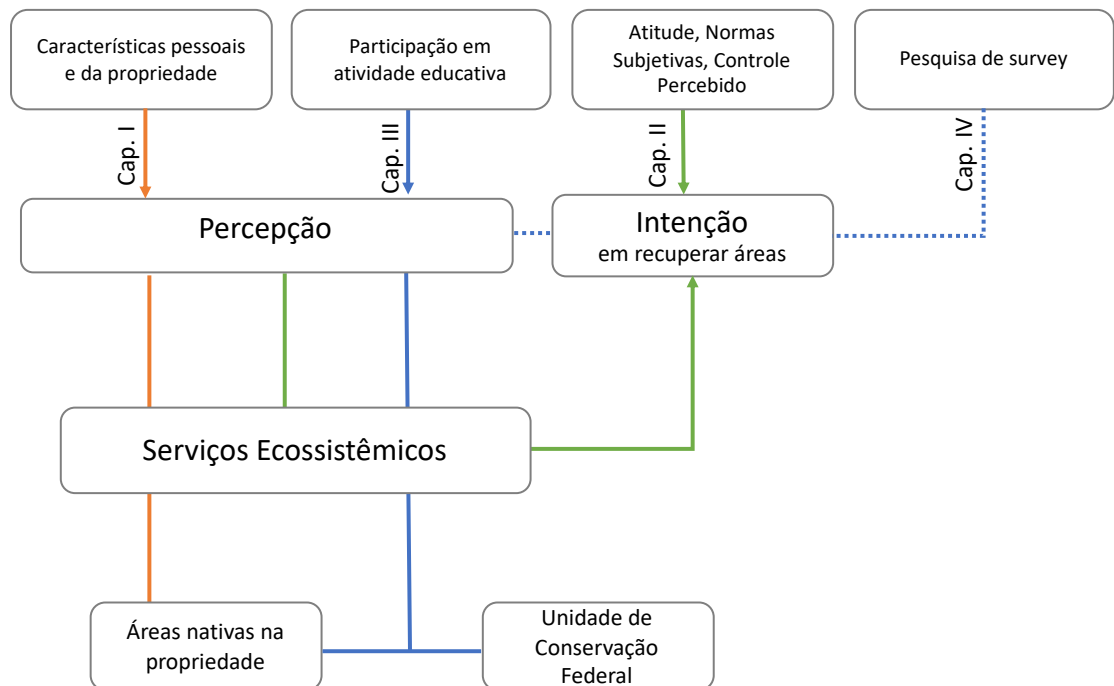


Figura 1: Estrutura organizacional da tese.

A partir do referencial teórico e metodológico da psicologia da conservação, nesta tese investigamos a percepção de proprietários rurais quanto aos serviços ecossistêmicos prestados pelas áreas nativas de Cerrado protegidas em suas propriedades e em uma unidade de conservação federal. Sob a premissa de que é necessário compreender os aspectos sociais de

populações locais antes de delinear e implementar ações de conservação, avaliamos: i) se a percepção é função de características individuais e da propriedade; ii) que fatores determinam a intenção de recuperar áreas na propriedade e se há influência da percepção dos serviços ecossistêmicos; iii) se a participação em atividade educacional, focada em demonstrar como os serviços ecossistêmicos beneficiam as atividades rurais, afeta positivamente a percepção de áreas protegidas. Cada um desses objetivos foi desenvolvido em um capítulo da tese (Figura 1) e a eles foi acrescentado um capítulo em formato de ensaio com algumas orientações sobre a pesquisa de *survey*, com ênfase na elaboração do questionário e realização da entrevista. Dessa forma, a tese está estruturada em quatro capítulos:

Capítulo 1: Artigo *Perceiving the invisible: formal education affects the perception of ecosystem services provided by native areas*. Este artigo apresenta a percepção de 75 proprietários rurais do entorno da Floresta Nacional (Flona) de Silvânia quanto aos serviços ecossistêmicos prestados pelas áreas protegidas de Cerrado inseridas em suas propriedades. Verificamos que os proprietários rurais percebem os benefícios gerados pelas áreas nativas de Cerrado, principalmente os serviços ecossistêmicos de regulação. Além disso, constatamos que aqueles proprietários com maior escolaridade foram capazes de perceber a polinização e o controle de pragas, serviços considerados menos observáveis e mais dependentes de conhecimento teórico para serem notados. Este artigo foi publicado no periódico *Ecosystem Services*.

Capítulo 2: Manuscrito *Perception of ecosystem services impacts landowners' intention to restore native areas*. A partir do referencial teórico da Teoria do Comportamento Planejado (AJZEN, 1985), analisamos a intenção de 75 proprietários rurais do entorno da Flona de Silvânia em realizar o comportamento de recuperar áreas na propriedade. Identificamos que a atitude com relação ao comportamento investigado diretamente afeta a intenção em realizá-lo. Por sua vez, a percepção dos serviços ecossistêmicos advindos de uma possível recuperação de áreas na propriedade afeta diretamente a atitude e, indiretamente, a intenção. Este artigo está submetido ao periódico *Ecosystem Services*.

Capítulo 3: Manuscrito *No bats, no gain: educational intervention increases farmers perception of ecosystem services*. Este artigo apresenta o impacto de intervenção educativa na percepção de serviços ecossistêmicos de proprietários rurais do entorno da Flona de Silvânia. Para isso, delineamos um experimento clássico por meio da aplicação de pré-testes e pós-testes a um grupo experimental (que participou de atividade educativa) e de um grupo controle (que não participou). Verificamos que os proprietários do grupo de intervenção identificaram mais

as atividades desenvolvidas na Flona, perceberam mais a polinização e relataram mais serviços ecossistêmicos após a atividade educativa com relação àqueles do grupo controle. Este manuscrito foi escrito de acordo com a normas do *International Journal of Agricultural Sustainability*.

Capítulo 4: Ensaio *Entrevista é mais do que fazer perguntas: 10 dicas sobre o que fazer — e o que não fazer— numa pesquisa de survey*. Este capítulo distingue-se dos demais por ter uma abordagem metodológica. Ele surge do interesse em compartilhar reflexões e orientações sobre a pesquisa de *survey*, no intuito de auxiliar pesquisadores em formação no delineamento desse tipo de pesquisa e na elaboração de questionários mais efetivos.

Gratidão a você que lê esta tese, seja porque está avaliando-a, porque se interessou pelo tema, ou mesmo porque esbarrou com ela na internet.

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CAPÍTULO I

PERCEIVING THE INVISIBLE: FORMAL EDUCATION AFFECTS THE PERCEPTION OF ECOSYSTEM SERVICES PROVIDED BY NATIVE AREAS

Flávia Pereira Lima; Rogério Pereira Bastos

Abstract

Landowners' decisions reshape landscapes, affecting the distribution and maintenance of ecosystem services (ESs). In Brazil, 53% of all remaining native vegetation is on private farms, reinforcing the importance of these stakeholders. The aim of this study was to identify landowners' perceptions of the native areas on their properties as sources of ESs, to support future conservationist management strategies. We tested whether personal variables (gender, age and years of formal education), and farm characteristics (type and size) were determinant in their perceptions. We interviewed 75 landowners in the Brazilian savanna region, using a questionnaire and paired images strategy (e.g., pictures of soybean cultivation with and without native forest vegetation). Our analyses revealed that landowners perceive native areas as providing ESs. Gender, age and size of farm did not affect the landowners' perceptions of ESs. However, we observed that years of formal education increased the chance of perceiving ESs which are more difficult to observe (pollination and pest regulation). Those services may require more scientific background to be understood. These results highlight with regard to perception of some ESs, education is a stronger factor than experience based on land-use activities.

Keywords

Cerrado biome; agricultural areas; environmental perception; stakeholder perception; biodiversity

1. Introduction

The ecosystem service (ES) framework has demonstrated its potential to promote communication and collaboration among scientists, decision-makers and various stakeholders (Dick et al., 2018; Koo et al., 2018; Lescourret et al., 2015) in order to promote more effective environmental policy and management strategies (De Vreese et al., 2016; Granek et al., 2010; Guerry et al., 2015). Defined as the multiple benefits that people obtain from ecosystems (MEA, 2005), the ES is more than a theoretical concept. It is an operational tool that facilitates the integration of social, economic and ecological perspectives, linking ecosystem processes to human welfare (Jax et al., 2018; Nakaoka et al., 2018). Moreover, it has a pedagogical dimension since the discussion of ES makes nature's benefits more visible, allowing people to understand the relationship between biodiversity, ecosystem functions, ecosystem services and human well-being (Fisher et al., 2009; Peterson et al., 2010). The Millennial Ecosystem Assessment (MEA) was an initiative to promote this pedagogical dimension proposing a comprehensible definition and accessible classification. The ES as a pedagogical tool promotes a conceptual knowledge use that influences new beliefs and values, affecting how the ES framework can be used in decision-processes (Beery et al., 2016). Despite the fact that the ES is well established for academic researchers, with increasing number of papers in this research area (Chaudhary et al., 2015; McDonough et al., 2017, Nieto-Romero et al., 2014), it is still a challenge to bring the ES concept to different stakeholders (Fisher et al., 2009; Hauck et al., 2013; Kleijn et al., 2018).

The value of ESs can be understood in terms of three domains, ecological, socio-cultural and economic (de Groot et al., 2010). While economic and ecological values of a given ES can be quantified more or less directly (e.g. Bianchi et al., 2018; De Marco and Coelho, 2004), socio-cultural values are assigned based on people's perceptions, preferences, demands, and the perceived qualities from natural ecosystems benefiting human well-being (Bryan et al., 2010; van Riper et al., 2012). A way to access this socio-cultural domain is to understand stakeholders' perceptions of ESs and their benefits (Iniesta-Arandia et al., 2014; Rodríguez-Caballero et al., 2018), since understanding the social context and the importance of natural resources for the users is a necessary condition in studies of socio-ecological systems (Ostrom, 2009). For the purposes of this research we accept the definition of perception as a sensory experience of the environment, involving the processing of stimuli and the actions derived from it (Gregory et al., 2009). Additionally, beyond direct sensory input, perception is also a construction based on secondhand information obtained from science, other people and public

media, among other sources (Gregory et al., 2009). Therefore, access to information and established knowledge influences the way people perceive the world, just as perception also affects cognition and is reflected in how knowledge is assimilated (Tacca, 2011). Environmental perception is a multifactorial construct that can also be influenced by individual characteristics, social norms, personal attitudes, and local culture (Allendorf et al., 2006; Allendorf and Yang, 2013; Vodouhê et al., 2010), and which can contribute to decision-making processes (Gregory et al., 2009). Thus, the perception of ESs is mediated by a range of social, institutional and economic contexts (Cebrián-Piqueras et al., 2017; Hicks and Cinner, 2014).

Agricultural lands provide food, fiber, and biofuels to society, and are also dependent on several ESs such as water provision, erosion regulation, crop pollination (Martinelli and Filoso, 2009). Nevertheless, inadequate management practices, such as excessive use of pesticides and fertilizers, undermine ecosystem functions, harming health and human welfare (Smith and Sullivan, 2014). Landowners play a central role in the discussion about the management and conservation of ESs. It is through their choices and decisions that landscapes are altered, affecting ES delivery and maintenance (Bretagnolle et al., 2018; Nicholson et al., 2017). The decision-making processes of these stakeholders are based on government policies, social norms, market forces, knowledge, perceptions, and personal aims and attitudes, as well as natural and technological constraints (Chin et al., 2016; Lalani et al., 2016; Poppenborg and Koellner, 2013; Vuillot et al., 2016). Furthermore, landowners are important due to the conservation potential of their lands. In Brazil, for example, 53% of remaining native vegetation is present on private rural properties (Soares-Filho et al., 2014). Studying landowners' perceptions can provide information on the interaction between social and ecological components in the production and distribution of ESs for different stakeholders (Bennett et al., 2015; Lamarque et al., 2014).

Landowners are not uniform in relation to their perceptions of ESs, and can be distinguished by several variables, such as personal characteristics and land-use types (Caceres et al., 2015; Kelemen et al., 2013; Zhang et al., 2016). Demographic and socio-economic characteristics affect landowners' ES perception in different ways. For example, Wartenberg et al. (2018) found that gender did not affect the cocoa farmers' perception of ESs in Indonesia, while Xun et al. (2017) discovered that male farmers were more aware of ESs in China. Zúñiga et al. (2013) found that gender influences the perception of Colombians about earthworms: women perceived the benefits associated with gardens while men were more cognizant of those related to agricultural activities. Education is also a usual variable used in the evaluation of

farmers' ESs perception. Studies show that farmers with more years of formal education are capable of perceiving more ESs (Chen et al., 2018; Xun et al., 2017). However, other studies have demonstrated that formal education did not influence rural peoples' perception of ESs (Wartenberg et al., 2018; Zhang et al., 2016). Age is an additional demographic variable with distinct impact on farmers' perception. Young Chinese farmers are more aware of ESs (Xun et al., 2017), while Indonesian farmers' age was not important in explaining ES perception (Muhamad et al., 2014). There is also evidence that small family farmers can identify more ESs, and their perception is more complex compared to large scale farmers (Caceres et al., 2015; Teixeira et al., 2018).

In this research, we analyzed the perceptions of landowners who are entitled to make decisions regarding ES associated with the remnants of native Brazilian savanna on their properties. Those remnants are usually related to Legal Reserves and Permanent Preservation Areas, categories covered by the Native Vegetation Protection Law of Brazil (Brasil, 2012). Our objective was to investigate whether personal characteristics (age, gender and education) and farm descriptors (size and type of property) affect landowners' ES perception. Our assumptions are that direct work on farms promotes better opportunities for landowners to gain more experience with ecological processes and perceive more ESs. Besides, formal education may increase cognitive abilities, improving the perception of surroundings, and affecting the ability to comprehend existent relations. This whole process favors the perception of ESs. Thus, we hypothesized that older male landowners, with a high level of formal education, involved in work on family farms, have more perception of ESs provided by native areas. For this purpose, we verified: i. which ecosystem services landowners associated with native areas; ii. how they perceived the impacts of native areas in land-use activities; iii. how they perceived the impacts of native areas in the maintenance of environmental processes; iv. how landowners explain these impacts.

2. Methods

2.1. Study Area

The study area encompasses a region around a remnant of the Brazilian savanna biome (Cerrado) designated a sustainable-use public protected area in 2001 (MMA, 2015a), the Silvânia National Forest (SNF), which is located in the state of Goiás, Brazil. The original vegetation includes open savanna, typical cerrado, woodland cerrado, semi-deciduous seasonal forest, and gallery forests, which is still observed within the SNF (MMA, 2015a). The SNF is

surrounded by a landscape dominated by agricultural activities (Figure 1). We chose to study rural properties vicinity of this conservation area mostly due to its major role in the discussion of the importance of managing and maintaining ecosystems services in the region. Studies to evaluate the delivery and maintenance of ESs are also being done in the SNF region, and a law has been enacted to promote a program for payment of ecosystem services (Silvânia, 2018). Otherwise, this region is an example of the loss of the Cerrado native areas because of agricultural expansion.

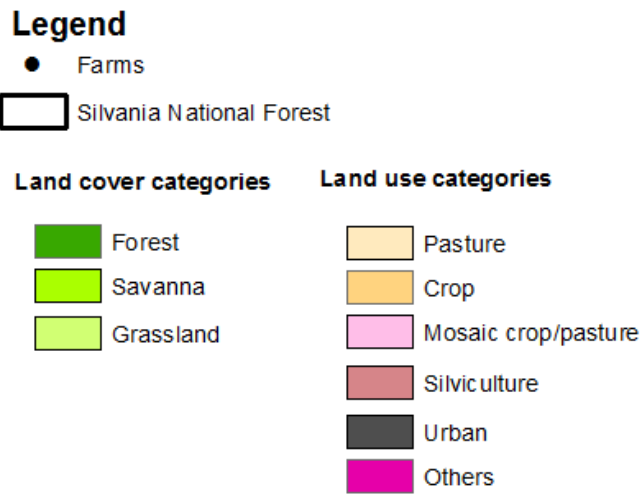
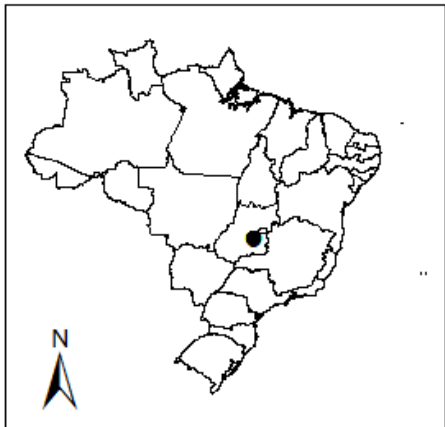


Figure 1: Location of landowners' properties interviewed in this study (n=75). Source: MapBiomias (mapbiomas.org)

2.2. Sample strategy

Considering that one of our objectives is to assess how landowners perceive the impact of vegetation in land-use activities, we limited the scope of our study to rural properties with documented production such as soy/corn cultivation, horticulture, and cattle raising activities. According to this criterion, we identified, using Google Earth images and information from SNF staff, 104 rural properties no more than 6 km from the border of the SNF. Within this perimeter, we included properties inside the proposed SNF buffer zone, whose southern limit is roughly 6 km (MMA, 2015b), and avoided the inclusion of urban areas.

We personally visited each farm to find the landowner who is entitled to make decisions. In some properties we found a couple and they decided who would participate in the interview. Because we were not able to find all landowners (e.g. six of them leased their lands), and the interviews were refused by five, we interviewed the remaining 75 (72% of all possible respondents, Figure 1). The farms of these landowners occupy an area of 7.295 ha. Most of them (77.3%) are 100 ha or smaller, corresponding to 19.3% of the total area covered by this study. The 17 farms (22.7%) larger than 100 ha occupy the remaining 80.7%. A total of 36.0% of the properties the activities are designated to own consumption, selling only surplus production; on 48.0%, the main activity is cattle raising; on 28.0% it is commodities cultivation, primarily soybean and corn; 22.7% pursue other commercial activities, such as apiculture or vegetable cultivation; 28% lease some area to soybean farmers or livestock ranchers.

2.3. Landowner interviews

All interviews were performed by the same researcher (FPL) during visits occurring from May to July 2017. At the beginning of each conversation, the interviewer presented of the objective of research to the participant. If the landowner decided to contribute, the researcher started with the ethics procedures (the participant agreed to the terms of the survey and signed the consent form). After this, the interviewer started the face-to-face interview with the landowners using a questionnaire. Each conversation was recorded for further analysis. This research was evaluated and approved by the Human Ethics Committee of the State University of Goiás (#66096317.5.0000.8113).

In the interviews we used only open questions and landowners had the necessary time to answer (see the questions in the Supplementary Material A). We used the following information collected during the conversation:

i. Personal information — gender, age and education. Those variables are frequently used in ES perception studies (e.g. Chen et al., 2017; Dou et al., 2019; Smith and Sullivan, 2014), and they are easily provided by respondents, not causing any discomfort.

ii. Property information — size, agricultural activities, products sold, presence of employees, if the farm had protected areas of native vegetation, such as Legal Reserves, Permanent Preservation Areas (required by Brazilian law) and other areas;

We also used questions to evaluate the landowners' perception of ESs provided by native areas protected on their properties. For this, we had questions to assess:

iii. General perception of ESs provided by native areas — assessed by two redundant questions, one asked at the beginning of the interview and another at the end: “Do protected native areas on farms bring any advantages?” and “What would change if native areas did not exist on the farm?” to encourage respondents to think about native areas from different perspectives. With this topic, we could verify those ESs that bring benefits to property and well-being.

iv. Perception of how ESs provided by native areas impact rural productive activities — we measured the perception of ESs in production activities using three sets of paired images: a. a soybean plantation beside a native area/the same plantation without the native area; b. cattle beside a native area/the same cattle without the native area; c. an orchard beside a native area/the same orchard without the native area (Supplementary Material B). The images were digitally manipulated, and in each pair the only difference was the presence or absence of native vegetation. During the interview, the respondent analyzed the pair of images and answered whether the production would be the same or different. The researcher explained that the landowner could think in terms of activities developed on his/her property, such as raising corn or dairy cattle, to enable respondents to use their personal expertise in the answers. The landowners were encouraged to explain the reasons for the differences. This approach allowed us to understand the ESs related to native vegetation and benefiting rural activities, as well as possible negative impacts.

v. Perception of how ESs provided by native areas affect environmental maintenance — we used the same strategy, showing a picture of a stream with riparian vegetation/the same picture without riparian vegetation and asking about the differences. Following that, we showed a pair of pictures of a rural property with a house and forest/the same picture without the forest, asking if a spring would be the same in both cases.

vi. Comprehension of the ES concept — we asked if landowners had already heard of ecosystem services. Those answering affirmatively were asked to explain the term. During the conversation, the interviewer did not use the word “benefits,” associated with the formal ES concept, to prevent any bias in the answers to the last question.

2.4. Data tabulation

We carefully listened to each interview recorded and analyzed the speeches of landowners to classify their answers according to the MEA ES categories. In general, there were some keywords or key-phrases more easily identified with MEA ESs, and the contexts of the interviews also helped in the process of codification. In the Supplementary Material C we presented those statements with their corresponding ESs according to our interpretation. For example, one answer to the question about the advantages of native areas was “There is an advantage, otherwise the water will dry. There is water on the farm because of the forest”. We classified this answer as presence of provisioning of fresh water.

The ESs identified in answers were classified according to the four categories from MEA — provisioning, regulating, supporting, and cultural services. In relation to the definition of ES, we compared the landowners’ answers with the MEA ES concept, which emphasizes the benefits that humans receive from ecosystems.

2.5. Statistical analyses

The interview of each landowner was considered one sample and the variables represent categorization of individual aspects of the answers. To examine the landowners’ perceptions of ESs, we used a series of statistical analyses using personal variables (gender, age and years of formal education), and property variables (size and type) as explanatory variables. The years of formal education were calculated according to the structure of the Brazilian education system: four years of elementary school, four years of middle school and three years of high school, beyond which we standardized figures for university studies to four years for undergraduate and two years for graduate degrees (the highest degree attained was a master’s). Based on production activities and farm labor management, we divided properties into three categories similar to Teixeira et al (2018): i. traditional family farms (labor is performed by family members and the production is intended primarily for their consumption, only the surplus being sold); ii. conventional family farms (labor is performed by family members, but in some cases, employees are contracted, and the production is intended primarily for sale; landowners who are responsible for some rural activities and lease parts of the area to others are also included

here); iii. conventional farms (labor is performed by contracted employees and the production is intended for sale). Considering the high variation in the size of farms, we used the log of this variable in analyses.

For a descriptive and comparative perspective, we summarized the frequencies of each ES interpreted from landowners' answers about the benefits provided by native areas. We organized these frequencies into three categories: i. General perception of ESs; ii. Perception of how ESs impact rural productive activities — crop, cattle, orchard; iii. Perception of how ESs affect environmental maintenance — streams and springs. We also assessed the frequency of landowners' perception of at least one ES each category, that we termed as "Perception of benefits" in Table 2.

We evaluated the general perception of ESs provided by native areas assessing the total number of ESs inferred from two complementary answers of each landowner. If the same inferred ES was present in both answers, we considered it a single occurrence. The analysis of perceptions of ESs impacting rural productive activities was done separately for crop cultivation (soybeans, corn), cattle raising, and fruit production in orchards. The impact of native vegetation on production was categorized as 0 (when the landowner indicated that there would be no difference/a negative difference, or stated that he/she did not know) or 1 (when he/she indicated that there would be a positive difference). For the relation of native areas affecting environmental maintenance, we did not present a statistical analysis due to the near unanimity of their responses. We also evaluated the perception of landowners using the total number of ESs mentioned during the interview and their classifications — provisioning, regulating, supporting and cultural — according to the MEA (2005). Because of the low frequency of cultural services, we categorized them as present or absent. The supporting services were very rarely identified in landowners' answers, and we presented them only in descriptive analysis.

We used Generalized Linear Models (GLM) to test how personal and farm variables affect the landowners' perception of ES provided by native areas. We apply binomial regression (logit link with binomial error structure) to binary categorical response variables, and a Poisson regression (log link with a Poisson error structure) in those cases when the dependent variable was count data (Chatterjee and Hadi, 2006). The collinearity between independent variables was evaluated using Variance Inflation Factor (VIF). A high VIF values (5) denotes high collinearity. We also chose to evaluate the significance of individual effects using a Likelihood

Ratio Test (LRT). All statistical analyses were done using the package `glmulti` (Calcagno, 2013) in R software (R Core Team, 2017).

Effect sizes for GLM results were presented based on odds ratios (Hosmer and Lemeshow, 2000). Considering the variability in the range of our variables, the interpretation of the results may depend on the analysis of specific increases in the independent variables. We choose those values according to their significance to the overall discussion. For instance, as formal education in Brazil is divided in sets of approximately 4 years, it was useful to evaluate the effects of four-year increases on our dependent variables. To do so, we followed the equations of Hosmer and Lemeshow (2000) to estimate the odds ratio (*OR*) to individual constant effect (*c*) according to the following equation, where β is the slope of the fitted logistic regression:

$$OR(c) = OR(x + c, x) = e^{c\beta}$$

As collinearity among independent variables affects model interpretation, we evaluated the relationship between the log of property size and the type of farm. We found that conventional farms occur on properties at least 5 times larger than the others ($F_{2,72} = 40.831$; $p < 0.01$). Traditional family farms are those of smaller size, averaging 12.1 ha. Conventional family farms are a little larger, with size roughly 33.2 ha. Conventional farms are the largest properties, with an average of 279.4 ha. Due to collinearity between the type of farm and log of property size, we chose to use only the last variable in analyses, because it captures the productive and labor arrangements in the studied properties.

2.6. Sample characteristics

Our sample consisted of 85.3% men and 14.7% women, similar to the gender distribution reported by the latest census of owners of rural properties in Silvânia municipality (IBGE, 2018). Most of them (62.6%) were between the ages of 50 and 69 years old, 26.6% had completed high school, and 30.7% had higher education (Table 1). The distribution of years of formal education in relation to the age of the landowners is relatively uniform (Supplementary Material D).

Table 1: Personal characteristics of landowners interviewed (N= 75).

Personal variables	Respondents (%)
Gender	
Female	14.7
Male	85.3
Age	
30-39 years old	6.7
40-49 years old	18.7
50-59 years old	33.3
60-69 years old	29.3
70-74 years old	12.0
Formal Education	
No formal education	2.7
Elementary school	28.0
Middle school	12.0
High school	26.6
Higher education	30.7

3. Results

Based on landowners' answers, we identified 17 ESs recognized as benefits from Cerrado native areas on their properties (Table 2). Of these, 10 were regulating services, three provisioning, three cultural, and only one supporting service (Table 2). One respondent did not present any ES during the conversation.

Table 2: Frequency (%) of ecosystem services perceived by landowners to be provided by Cerrado native areas present on their properties (n = 75).

Ecosystem Service	General	Crops	Cattle	Orchard	Streams	Springs
Perception of benefits	93.3	56.0	82.7	64,9	95.9	98.6
<i>Provisioning</i>						
Fresh water	72.0		13.3	2.7		98.6
Cattle feed			12.0			
Honey	1.3					
<i>Regulating</i>						
Climate regulation: precipitation	12.0	9.3		2.7		
Climate regulation: temperature	25.3	2.7	80.0	8.1		
Air quality regulation	14.7					
Erosion regulation	12.0	2.7		6.8	87.8	
Stream silting regulation					28.4	
Wind break	6.7	14.7	4.0	2.7		
Pest regulation	1.3	29.3		10.8		
Soil humidity		18.7		12.2		
Pollination				17.6		
Water purification						6.8
<i>Supporting</i>						
Soil fertility	5.3		5.3			
<i>Cultural</i>						
Inspiration (presence of biodiversity)	30.7					
Aesthetic value	21.3					
Cultural heritage	2.7					

3.1. General perception of ESs provided by native areas

The majority of respondents (93.3%, Table 2) indicated that protected areas on their properties brought some advantage. The provision of fresh water is the benefit most often

perceived (72.0%), followed by inspiration (30.7%), which in our research corresponded to the appreciation of native biodiversity, mainly birds and mammals, and temperature regulation (25.3%). As a disadvantage of native areas, 10.1% indicated the loss of area to production. Neither the personal variables (age, gender, years of formal education), nor the size of property affected the general perception of ecosystem services provided by native areas (Table 3).

3.2. Perception of ESs provided by native areas impacting rural activities

In relation to land-use activities, 56.0% of respondents indicated that native areas improve crop production, and the main reason cited was pest regulation (29.3%), followed by the increase of soil humidity (18.7%, Table 2). We identified from landowners' answers six ESs related to crop cultivations, with an average of 1.4 services per respondent. The perception of benefits is high in cattle raising (82.7%), and temperature regulation was the ES most identified in landowners' answers (80%, Table 2), since they connected the shade of the trees with cattle welfare. A total of five ESs were related to cattle husbandry, with an average of 1.4 per interviewee. According to 64.9% of the landowners, orchards near to native areas would produce more fruit, and the main reason identified was the increase of pollination (17.6%, Table 2), an ES that appeared exclusively in this context. Here, we identified eight ESs, with an average of 1.0 per respondent. The personal variables and the size of property did not affect the perception of ESs impacting crop production (Table 3), milk/beef production (Table 3), or fruit production (Table 3).

We also evaluated the perception of pollination and pest regulation services as related to personal variables and the size of property. These two ESs are more dependent on scientific knowledge to be perceived. Soil fertility and water purification are similar in this respect, but they did not occur frequently enough to merit quantitative analysis. Education affected the perception of pollination and pest regulation. With every four-year increase in formal education (equivalent to one level of formal education in Brazil), the chance of perceiving pollination increased by 2.3 times (Table 3), and the chance of perceiving pest regulation increased by 1.7 times (Table 3), that is, the more years of formal education the landowner had, the greater is the chance that he/she associated the pollination and pest regulation with native areas.

We can also identify some disservices performed by Cerrado native areas in respondents' answers. Seven of them explained that native areas damage crops due to the higher incidence of harmful insects and parasites, shading, and the consumption of crop nutrients. Four

respondents reported that orchards are hampered by native areas because they promote shade, increase incidence of harmful insects, and absorb nutrients from the soil.

3.3. Perception of ESs provided by native areas affecting environmental maintenance

Most of the landowners perceived that the native areas affected the maintenance of stream banks (95.9%, Table 2). We identified in landowners' answers that they clearly associated the presence of trees and their roots with erosion regulation (87.8%, Table 2), and in a smaller proportion with stream silting regulation (28.4%, Table 2). They also had the perception that native areas affected springs (98.6%, Table 2), increasing the provisioning of fresh water (98.6%, Table 2). In a few landowners' answers we identified the role of native vegetation in water purification (6.8%, Table 2).

3.4. Perception of the provisioning, regulating, supporting, and cultural ESs

We identified an average of 7.2 ESs per landowner interview. Age, gender, years of formal education and the size of property did not affect the total number of ESs inferred from landowners' answers (Table 4). The mean incidence per interview by category were: provisioning services, 2.11; regulating services, 4.47; cultural services, 0.6; and supporting services, 0.11. The personal variables and the size of property also did not affect the amount of provisioning and regulating services perceived by respondents (Table 4). But, a four-year increase in formal education raised the chances of a landowner perceiving cultural ESs by 2.2 times (Table 4). We inferred a supporting service in only 10.7% of respondents' answers we interpreted a supporting service.

3.5. Comprehension of the ES concept

The majority of respondents (55.4%) stated that they had already heard the term "ecosystem service" in television programs or on radio. However, only 18.7% presented some definition and none of them was close to the idea of benefits provided by nature. In fact, landowners had the opposite notion: "ecosystem services" for them were the actions that people or institutions perform to protect nature, as in these statements "It is preservation, leaving trees on the banks of the rivers, reforesting where it is deforested, fencing off springs and restricting the cattle"; "Human work for the benefit of fauna and flora" and "It means government services for the environment".

Table 3: Evaluation of the effects of personal variables and the size (log) of property on landowners' perception of the ES provided by Cerrado native areas: general perception; benefiting crop; benefiting milk/beef production; benefiting fruit production; perception of pollination; perception of pest regulation. The GLM value estimated parameters and their standard error (in brackets) are presented.

Variables	General	Crop	Cattle	Fruit	Pollination	Pest regulation
Intercept	0.560 (0.502)	-2.417 (1.550)	3.143 (2.182)	0.554 (1.547)	-3.837 (2.087)	-3.202 (1.629)
Age	-0.004 (0.007)	0.035 (0.023)	-0.054 (0.033)	-0.018 (0.023)	-0.013 (0.030)	0.018 (0.024)
Education	0.016 (0.022)	0.029 (0.062)	0.007 (0.076)	0.018 (0.062)	0.204 (0.106)*	0.137 (0.068)*
Gender	-0.257 (0.230)	1.107 (0.714)	1.028 (0.777)	0.571 (0.714)	0.505 (1.195)	0.188 (0.774)
Size (log)	0.123 (0.064)	-0.151 (0.194)	0.210 (0.268)	0.121 (0.200)	0.052 (0.241)	0.008 (0.196)

Asterisks indicate significant results.

VIF (Variance Inflation Factor), LRT (Likelihood Ratio Test) and p-values are in the Supplementary Material E1 and E2.

Table 4: Evaluation of the effects of personal variables and the size (log) of property on landowner's perception of the ES provided by Cerrado native areas: the total of ES identified during all interview; the total of provisioning services; the total of regulation services; the total of cultural services. (Group 4). The GLM value estimated parameters and their standard error (in brackets) are presented.

Variables	Total	Provisioning	Regulating	Cultural
Intercept	1.944 (0.271)	1.028 (0.498)	1.461 (0.346)	-3.070 (1.626)
Age	-0.004 (0.004)	-0.003 (0.007)	-0.004 (0.005)	0.012 (0.023)
Education	0.005 (0.011)	-0.018(0.020)	0.001 (0.014)	0.195 (0.069)*
Gender	0.095 (0.131)	-0.105(0.225)	0.238 (0.174)	0.053 (0.770)
Size (log)	0.028 (0.034)	0.049(0.064)	0.020 (0.043)	0.066 (0.199)

Asterisks indicate significant results.

VIF (Variance Inflation Factor), LRT (Likelihood Ratio Test) and p-values are in the Supplementary Material E3.

4. Discussion

Environmental perception investigation is a way of understanding local people's perspectives, including their knowledge and values related to the use and management of ESs (Brancalion et al., 2014; Meijaard et al., 2013). Complementing other social, ecological, and economic approaches, it provides a set of information essential for designing and implementing conservation strategies that are more realistic and more suited to local requirements (Quintas-Soriano et al., 2016; Rey-Valette et al., 2017). Our main findings here indicate that landowners have realized the benefits of ESs provided by protected savanna native areas on their lands. This is similar to the findings of other studies assessing rural people's perceptions of ESs provided by forest fragments (Caceres et al., 2015; Hartter, 2010; Silvano et al., 2005). Regulating services are noted more frequently, mainly those easily observed. Landowners with more education were more likely to perceive the less obvious ESs, like pollination and pest control, confirming that social contexts affect the perception of nature.

Several studies have demonstrated that rural people perceive and value ESs provided by their surroundings (Al-Assaf et al., 2014; Bernués et al., 2016; Caballero-Serrano et al., 2017; Caceres et al., 2015; Campos et al., 2012; Chen et al., 2017; Da Ponte et al., 2017; Dou et al., 2019; Greenland-Smith et al., 2016; Smith and Sullivan, 2014; Teixeira et al., 2018; Temesgen and Wu, 2018; Wartenberg et al., 2018; Xun et al., 2017; Zhang et al., 2016). In our research, landowners perceived that ESs positively impact land-use activities and human welfare. Regulating services were the most frequently identified in interviews, a result already observed in studies with farmers and rural people (Al-Assaf et al., 2014; Bernués et al., 2016; Campos et al., 2012; Sodhi et al., 2010). Few provisioning services were recognized, compared to other studies in which rural people are dependent on forest resources (Caballero-Serrano et al., 2017; Da Ponte et al., 2017; Zhang et al., 2016). Supporting services were rarely identified in the interviews, as already observed in other studies (Lamarque et al., 2011; Lewan and Soderqvist, 2002; Lugnot and Martin, 2013; Silvano et al., 2005), probably because they impact people only indirectly and require some degree of ecological knowledge to be understood. Cultural services were uncommon in landowners' responses and the main association was with the presence of native biodiversity on properties. Landowners enjoy seeing these animals and like to tell people that their properties preserve native species as a way of affirming that property is well preserved. In some agricultural areas, the cultural ESs are more valuable because agriculture itself is embedded in social and cultural traditions (Tekken et al., 2017). Nevertheless, this does not appear to occur in our study system.

Lewan and Soderqvist (2002) identified that some ESs are more easily perceivable than others. The visible ESs are those readily observed, accessed by the senses, dependent on knowledge based on experience. The invisible ones are difficult to observe and require a theoretical background to be understood. This classification allowed us to better understand the landowners' perceptions in relation to their social and economic contexts. Of the 17 ESs identified in landowners' interviews, 13 (fresh water, cattle feed, honey, precipitation, temperature, air quality, erosion and silt stream regulation, wind break, soil humidity, inspiration, esthetic value and sense of place) could be classified as visible, and four (pest regulation, pollination, water purification and soil fertility) as invisible. In fact, the visible services were the most noticed and most frequently identified in landowners' responses. This explanation fits our results well and also effectively explains the differences observed in the appearance of the major categories of regulating, supporting and cultural services. If dependency on a more detailed ecological background limits the perception of some important supporting ESs, strategies for promoting the value of forest remnants in human-dominated areas may be less efficient without well-programed educational support. Otherwise, biased perception of ecosystem services may also foster an underestimation of the importance of forest remnants, reducing the public's awareness of the topic and its support for conservation programs.

During the interviews, we realized that most landowners claimed to perceive the benefits of native areas. We noted that landowners had a clear association between native areas and the maintenance of water supply, rainfall and soil humidity, and many of them accuse the conversion of natural areas into soybean plantations as a cause of reduced precipitation in the region. Water is essential to all kind of human activity and there is an expected association between native areas and water-related ES (Caballero-Serrano et al., 2017; Teixeira et al., 2018). This category of ES plays an essential role in discussions with stakeholders and can serve as an umbrella for others. Nevertheless, it is necessary to expand beyond it because it does not capture the set of ecological process essential to ecosystem balance. For example, in our study we verified that pollination — an ES that directly affects production — was reported by few respondents, exclusively in the orchard question, and its frequency was closely associated with education. Similar results were found by Sodhi et al. (2010) studying the importance of parks as a source of ESs for rural people. Despite the fact that it is possible to observe bees visiting flowers, farmers are not aware of the key role of these insects in food production (Munyuli, 2011). The lack of scientific knowledge about ecological processes may contribute to the adoption of intensive practices, such as reduction of crop diversification and

use of pesticides (Nicholson et al., 2017), which are commonly reinforced by government economic incentives and market drivers.

Education level, gender and age are frequently used variables in studies of ES perception of rural people (Chen et al., 2017; Dou et al., 2019; Smith and Sullivan, 2014; Xun et al., 2017). In a revision, Bragagnolo (2016) also demonstrated that gender, age and education were the most important factors to understand the local people's perceptions of benefits provided by protected areas. Based on existing literature, we predicted that older male landowners, with more years of formal education, who are involved in land-use activities on their small family farms, should have increased perception of ESs (Caceres et al., 2015; Teixeira et al., 2018; Xun et al., 2017). Our results, however, refute most of those predictions, with the exception of the influence of education. Contrasting with other studies that found greater perception among traditional family farmers (Caceres et al., 2015; Teixeira et al., 2018), our investigation concludes that education as a determinant factor influencing ES perception is stronger than experience based on land-use activities. The direct work on farms allowed landowners to perceive those visible ESs easily accessed by senses. However, it is possible that cognitive abilities developed in formal education potentiate the perception of the invisible ESs. Thus, formal education has allowed landowners to develop a broader perception of ESs provided by native areas. Gender was not a factor affecting ES perception in our study, as was also observed by Wartenberg et al. (2018) investigating cocoa farmers in Indonesia. Both men and women are directly involved in land-use activities, enabling them to observe and experience similar effects of native areas on their properties and their well-being. Other social-demographic variables and socioeconomic factors are used to assess ES perception by rural people, such as ethnicity (Allendorf and Yang, 2013; Dou et al., 2019), immigration status (Xun et al., 2017), monthly/yearly income (Al-Assaf et al., 2014; Xun et al., 2017), and agricultural area managed (Chen et al., 2017; Xun et al., 2017). In our study, variation of ethnicity and immigration status did not exist, whilst income is a variable difficult to access among farmers.

Despite several institutional initiatives such as the Millennial Ecosystem Assessment (MEA, 2005), and The Economics of Ecosystems Biodiversity (TEEB, 2010), that strive to disseminate scientific knowledge about ecosystem services, the ES concept is not widely owned by landowners or the general public (Bernués et al., 2016; Lamarque et al., 2011). In our study, the few definitions presented by landowners stated that ES were actions performed by humans to preserve nature. This result is also found by Bernués et al. (2016), analyzing the perceptions of farmers and non-farmers in an agriculture region in Spain. The ES concept seems to be simple, but it is not intuitive to landowners. It is necessary to develop scientific knowledge to

make the concept more concrete and bring it closer to the reality of the general public. In contexts where farmers have little schooling, it is necessary to invest in initiatives that promote scientific knowledge through informal education (Chen et al., 2018; Yu, 2014). Educational strategies, such as environmental education and extension projects, can help farmers develop more critical thinking and careful observation of natural processes. Understanding scientific concepts, such as energy flux and species interaction (e.g. pollination), influences how they perceive and interpret the ESs. A broader understanding of the relationship between biodiversity conservation and the maintenance of ESs can affect management decisions (Henderson et al., 2016; Lamarque et al., 2014; Wartenberg et al., 2018), and be a strong motivating force for conservation practices adoption (Kross et al., 2018).

The Cerrado biome is a biodiversity hotspot recognized for its rich and endemic biodiversity (Myers et al., 2000). Around 46% of Cerrado native areas have been converted into agriculture (Strassburg et al., 2017), causing habitat fragmentation, biodiversity reduction and the loss of several ES (Carvalho et al., 2009; Furquim et al., 2017; Klink and Machado, 2005). The weak protection of Cerrado (only 7.5% is protected in public areas) and recent legislation changes put this biome at higher risk (Vieira et al., 2018). Both the extension of the Cerrado network of public protected areas as well as investment in strategies to restore private areas (Strassburg et al., 2017) are essential. Also it is necessary to promote policies, such as programs for payments for ESs, to incentivize landowners to adopt sustainable practices and valorize those that already contribute to the conservation (Farinha et al., 2019). Otherwise, generalizing the results based on this region to the entire Cerrado is problematic. Our results may only be generalizable to regions with similar landscapes where crops cultivation and cattle raising are the predominant land uses. In other situations where rural people are more dependent on the provision of ecosystem services, or have cultural links to nature, or even where activities such as agroforestry and organic cultures are dominant, the results could be different, since the perception of ES is strongly dependent on social context (Hicks and Cinner, 2014). Therefore, it is necessary to regionalize ES studies, incorporating local contexts and values into conservation strategies and decision processes (Ninan and Inoue, 2013) with the goal of increasing stakeholder involvement to enhance the quality and effectiveness of conservation decisions (Reed, 2008).

5. Conclusion

This study assessed landowners' ESs perception related to native areas of Brazilian savannah, a biodiversity hotspot highly threatened by agricultural expansion. Our findings revealed that landowners perceived that native areas were sources of ESs, positively impacting land-use activities and their well-being. Gender, age and the size of property did not affect landowners' perceptions. However, those landowners with more years of formal education perceived more pollination and pest crop regulation, ESs more dependent on scientific background to be identified in nature. Such landowners also perceived more cultural services. Our results points to the direction that any conservation endeavor should prioritize educational initiatives, such as environmental education or extension projects, to promote scientific knowledge of ESs. This knowledge can be a force for overcoming educational constraints, helping landowners to perceive the native areas of Cerrado as essential to agriculture and human well-being.

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Supplementary Material

A - Questionnaire used in face-to-face interviews.

PERSONAL INFORMATION
Name:
Age:
Education:
INFORMATION ABOUT THE RURAL PROPERTY
Name of the rural property:
How long have you had the rural property?
Size of rural property:
What are the agricultural activities carried out on the property?
Which of your agricultural products do you sell?
Who works on the property? Do you have employees?
Does the property have areas of native forest/cerrado? Are there legal reserves and/or permanent preservation area?
ECOSYSTEM SERVICES AND NATIVE AREAS
<i>(General perception of ESs)</i> Do protected native areas on the farm bring any advantages/disadvantages?
<i>(ESs and rural production)</i> In these two pictures there are soybean plantations. Will the two plantations have the same or different production? Why?
<i>(ESs and rural activities)</i> In these two pictures there are cattle in the pastures. In the two pictures will the cattle have the same or different production of milk/beef? Why?
<i>(ESs and rural activities)</i> In these two pictures there are orchards. Will the two orchards have the same or different fruit production? Why?
<i>(General perception of ESs)</i> What would change if native areas did not exist on the farm?
<i>(ESs and environment maintenance)</i> In these two pictures there are streams and their banks. After a heavy rain, will the consequences in those areas be the same or different?
<i>(ESs and environment maintenance)</i> In these two pictures there are streams near the houses. Are these springs the same or different? Why?
<i>(General perception of ESs)</i> What would change if native areas did not exist on the farm?
<i>(ES concept)</i> Have you heard about ecosystem/environmental services? Could you explain what they are?

B. Paired pictures used in the interviews

Paired pictures used to evaluate the perception of ESs provided by native areas impacting rural activities.



A1. Soybean plantation

Source of image used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/1/1d/Cultivo_de_soja.jpg



A2. Soybean plantation with nearby native vegetation

Source of images used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/1/1d/Cultivo_de_soja.jpg
https://cdn.pixabay.com/photo/2014/09/23/17/47/horizon-457991_960_720.jpg



B1. Cattle in the pasture

Source of images used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/9/94/Gado_Nelore_em_aten%C3%A7%C3%A3o_-_panoramio.jpg
<https://pxhere.com/pt/photo/591425>



B2. Cattle in the pasture near to native vegetation

Source of image used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/9/94/Gado_Nelore_em_aten%C3%A7%C3%A3o_-_panoramio.jpg



C1. Orchard

Source of image: personal archive



C2. Orchard near to native vegetation

Source of images used in edited picture:
Personal archive
https://upload.wikimedia.org/wikipedia/commons/3/3f/Cerrado_Parque_Estadual_dos_Pirineus.jpg

Paired pictures used to evaluate the perception of ESs provide by native areas affecting environmental maintenance



D1. Spring on property with little native vegetation

Sources of images used in edited picture:
<https://images.pexels.com/photos/1638383/pexels-photo1638383.jpeg?cs=srgb&dl=aerofotografia-agricultura-ao-ar-livre-1638383.jpg&fm=jpg>
https://www.webharas.com.br/painel/core/fotos/foto_44026.jpg



D2. Spring in the property with lots of native vegetation

Source of image used in edited picture:
<https://images.pexels.com/photos/1638383/pexels-photo1638383.jpeg?cs=srgb&dl=aerofotografia-agricultura-ao-ar-livre-1638383.jpg&fm=jpg>



E1. Stream without riparian vegetation

Source of image used in edited picture:
[http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar\(3\).jpg](http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar(3).jpg)



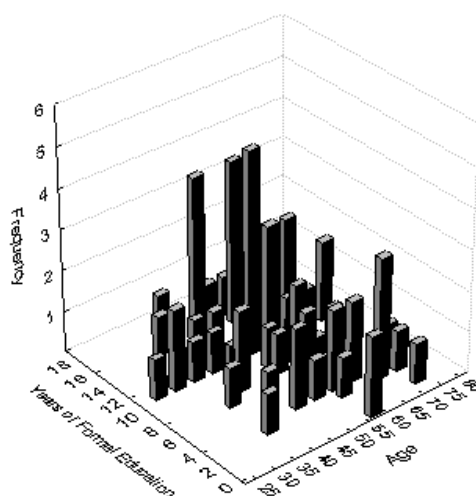
E1. Stream with riparian vegetation

Sources of images used in edited picture:
[http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar\(3\).jpg](http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar(3).jpg)
https://upload.wikimedia.org/wikipedia/commons/c/c/C%C3%B3rrego_Piraju%C3%A7ara_1.JPG
<https://s3.amazonaws.com/igui-ecologia/wp-content/uploads/2017/04/mata-ciliar.jpg>
https://www.jornalspnorte.com.br/enviados/2015/07/3107_corrego-tremembe.jpg

C. Codification of ESs from landowners' answers during the interview.

Statements about native forest perception presented by landowners during the interviews	Correspondent Ecosystem Service identified based on MEA approach
	<i>Provisioning</i>
production of water, preserves water, there is more water, protects water, protects the source of the streams, without the forest the spring dries up, farm with more moisture, where there is a forest the water doesn't dry up	Fresh water
food for cattle, the cattle eat leaves from the forest, complements the cattle feed	Cattle feed
helps in the production of honey	Honey
	<i>Regulating</i>
more rain, helps the rain, rains more in the region, less forest is causing lack of rain, attraction of rain, brings the rain, greater rainfall	Climate regulation: precipitation
shade, cooler, cattle look for shade, cattle like shade, cattle need shade, refreshing the land	Climate regulation: temperature
cleaner air, purer air	Air quality regulation
erosion, rain pulls down the ravine, rain washes the land, rain comes strong and removes the soil, rain carries the soil, the roots of the trees fix the soil, it will damage the bank of the river, the ravine will be eaten away	Erosion regulation
sedimentation, clogs the stream, the stream becomes shallow	Stream silting regulation
barrier against the wind, less wind, protected from the wind	Wind break
natural enemies, insects instead of going to the plantation go to the forest, helps to control pests, critters stay in the forest, pests stay in the forest, the forest absorbs the pests, protect from the arrival of the insects, barrier against insects	Pest regulation
moister soil, soil stays less dry, keeps water in the soil	Soil humidity
pollination, bees come to pollinate, bees takes the pollen from one plant to another	Pollination
cleaner water, purer water	Water purification
	<i>Supporting</i>
more fertile soil, soil stays better	Soil fertility
	<i>Cultural</i>
native animals cited beautifying the farm, native animals that appear on the farm and are admired, maintenance of native animals, native plants found, I like to see the native animals or plants in the forest on farm, forests bring animals, enjoy the native animals eating in the woods	Inspiration (presence of biodiversity)
more beauty, more beautiful farm, the region is more beautiful, the forest is a charm, I like the scenery	Aesthetic value
the farm and its forest have been in the family for years, the conserved forest is an inheritance, the forest will benefit the children and grandchildren	Cultural heritage

D. Distribution of years of formal education in relation to landowners' age.



Frequency distribution of years of formal education in relation to landowners' age.

E1. Variance Inflation Factor (VIF), Likelihood Ratio Test Evaluation (LRT), and p-value of the effects of personal variables and the size (log) of property on landowners' perceptions of ES provided by Cerrado native areas – general perception, benefiting crop production, benefiting milk/beef production, and benefiting fruit production.

Variables	General			Crop			Milk/beef			Fruit		
	VIF	LRT	p	VIF	LRT	p	VIF	LRT	p	VIF	LRT	p
Age	1.006	0.335	0.562	1.012	2.411	0.120	1.008	2.960	0.085	1.002	0.601	0.438
Education	1.593	0.569	0.451	1.561	0.225	0.636	1.416	0.008	0.928	1.487	0.082	0.774
Gender	1.065	1.192	0.275	1.078	2.531	0.112	1.070	1.672	0.196	1.054	0.635	0.426
Size (log)	1.658	3.705	0.054	1.612	0.613	0.434	1.432	0.616	0.433	1.546	0.368	0.544

E2. Variance Inflation Factor (VIF), Likelihood Ratio Test Evaluation (LRT), and p-value of the effects of personal variables and the size (log) of property on landowners' perceptions of pollination and pest regulation.

Variables	Pollination			Pest regulation		
	VIF	LRT	p	VIF	LRT	p
Age	1.066	0.173	0.677	1.006	0.588	0.443
Education	1.444	4.466	0.035	1.459	4.437	0.035
Gender	1.046	0.193	0.660	1.050	0.060	0.806
Size (log)	1.431	0.047	0.828	1.506	0.002	0.968

E3. Variance Inflation Factor (VIF), Likelihood Ratio Test Evaluation (LRT), and p-value of the effects of personal variables and the size (log) of property of total ESs perceived by landowners, provisioning services, regulating services, and cultural services.

Variables	Total of ESs			Provisioning			Regulating			Cultural		
	VIF	LRT	p	VIF	LRT	p	VIF	LRT	p	VIF	LRT	p
Age	1.004	0.812	0.368	1.009	0.203	0.653	1.004	0.790	0.374	1.007	0.273	0.601
Education	1.531	0.177	0.674	1.555	0.783	0.376	1.525	0.008	0.931	1.379	9.051	0.003
Gender	1.053	0.535	0.464	1.063	0.212	0.645	1.047	1.965	0.161	1.062	0.005	0.945
Size (log)	1.578	0.703	0.402	1.603	0.592	0.442	1.568	0.206	0.650	1.432	0.111	0.740

CAPÍTULO II

PERCEPTION OF ECOSYSTEM SERVICES IMPACTS LANDOWNERS' INTENTION TO RESTORE NATIVE AREAS

Flávia Pereira Lima; Rogério Pereira Bastos

Abstract

Understanding landowners' intentions to voluntarily engage in conservation initiatives is essential to designing more realistic projects and interventions. In this study, we use the Theory of Planned Behavior to identify the psychological constructs underlying landowner intentions to restore areas of native vegetation on their properties. As background factors, we investigated whether ecosystem service perception, age, number of springs, and size of property affect the intention to restore. We interviewed 75 landowners whose properties are in the surrounding of a public protected area in Brazil. We applied structural equation modeling to build the latent variables of intention, attitude toward a behavior, subjective norms, perceived behavior control and ecosystem service perception. The results indicate that landowners' intention to restore areas is explained by attitude toward a behavior. Furthermore, perception of ecosystem services provided by native vegetation areas, and the number of springs on a given property, are two factors which directly affect attitude and indirectly affect the intention. Younger landowners are more willing to restore. These results suggest that understanding the benefits of conserving biodiversity within farmland affects management practices. Investing in educational initiatives to promote more knowledge about ecosystem services will increase the involvement of more landowners in future conservation programs.

Keywords: Theory of Planned Behavior; conservation behavior; restoration; Cerrado biome; structural equation modeling

1. Introduction

Throughout its evolutionary history, the human species has interacted with nature benefiting from the provision of water, food and fiber. Recently that relationship has expanded to include psychological, cognitive, physiological, aesthetic, cultural and social benefits reflected in well-being (Cox et al., 2017; Keniger et al., 2013; Shanahan et al., 2015). These benefits were extensively discussed under the ecosystem service approach (MEA, 2005). The perception of those services is the initial step toward valuing them and establishing pro-environmental behavior (Gregory et al., 2009). Several studies have already demonstrated that students (Torkar and Krašovec, 2019), farmers (Ahammad et al., 2019; Teixeira et al., 2018), fishermen (Blayac et al., 2014; Mahajan and Daw, 2016), local community (Affek and Kowalska, 2017), and other stakeholders (Garrido et al., 2017) effectively perceive ecosystem services. However, the lower perception of less direct ecosystem services, such as supporting services (Lugnot and Martin, 2013; Zhang et al., 2016), can indicate a lack of deeper comprehension of ecosystem processes and their indissociability from biodiversity. As consequence, people do not understand the central role that nature plays in supporting human society and continue to negatively impact it, causing loss of health and quality of life (Cox and Gaston, 2018; Sandifer et al., 2015) (Cox and Gaston, 2018; Sandifer et al., 2015). Because of this, the remnants of native biomes are of increasing value for their potential to provide benefits. Although Protected Areas (PAs) are created with the main purpose of biodiversity conservation, they have an important role in protecting ecological processes, ecosystem services, cultural values and traditional practices (Chape et al., 2005; Flavien et al., 2016; Gray et al., 2016). Around the globe, PAs represent the last remnants of native vegetation surrounded by a fragmented landscape dominated by human activities (Defries et al., 2005; Newmark, 2008). Furthermore, PAs achieve more positive conservation outcomes when social and economic contexts are considered (Oldekop et al., 2016). Complex ecological and social landscapes develop around PAs, and individual or collective actions can affect biodiversity conservation and human well-being (Barlow et al., 2016; Lovejoy, 2006).

Conservation approaches are diverse, but their common aim is to change behaviors through management, policies, and educational programs (Osbaldiston, 2013). Understanding stakeholders' motivations for engaging or not engaging in conservation activities is essential to designing more realistic projects with a greater chance of solving environmental problems (Ban et al., 2013; Raymond et al., 2013). Conservation psychology is an emerging discipline that studies the relationship between humans and nature, both at the individual and group levels, in

order to understand cognitions, values, beliefs, attitudes, norms, and behaviors related to conservation issues (Clayton and Saunders, 2012; Saunders, 2003). Conservation psychology provides a means to take human dimensions into account in approaches to conservation (Bennett et al., 2017; Saunders et al., 2006). One psychological theory applicable to conservation issues, mainly to understand why people engage in conservation behavior, is the Theory of Planned Behavior (TPB) (Osbaldiston, 2013). Proposed by Ajzen (1985), it is based on the idea that most human behaviors are goal-directed and require some level of planning. TPB assumes that intention embodies motivational factors for performing a behavior, although there are other factors like opportunities, knowledge, ability and resources that also influence the execution of behavior (Ajzen, 1991). According to TPB, intention is the immediate determinant of behavior: the stronger the intention to engage in a behavior, the more likely the person is to take action. The intention is a function of three constructs: i) *attitude toward a behavior*, personal evaluation of the specific behavior as positive or negative; ii) *subjective norms*, perceived social pressures to perform or not perform the behavior; iii) *perceived behavior control*, perceived facilities or difficulties in performing the certain behavior, reflecting pertinent abilities, previous experiences and possible obstacles. The relative importance of these determinants varies according to the intention under investigation (Ajzen, 2005, 1991, 1985). *Attitudes*, *subjective norms* and *perceived behavior control* are functions of personal beliefs — behavioral beliefs, normative beliefs, and control beliefs respectively — which can be affected by background factors such as age, gender, emotions, experience, knowledge and media exposure, elements that represent the social context of the given individual. These background factors are not part of TPB but can complement it (Ajzen, 2005). Several researchers have been using TPB in conservation contexts, including conservation practices (Borges and Oude Lansink, 2016; Chin et al., 2016; Meijer et al., 2016; Werner et al., 2017a), climate change strategies (Niles et al., 2016) (Niles et al., 2016), water management (Pino et al., 2017; Yazdanpanah et al., 2015), and participation in conservation contracts (Greiner, 2015).

Conservation in agricultural areas is a social challenge. Understanding the behaviors, perceptions and decision-making processes of landowners with regard to conservation issues is essential to designing collaborative actions (de Snoo et al., 2013; Lokhorst et al., 2011). Brazil has a strategic position in conservation issues, with its megabiodiversity and 28.9% (about 2.5 million km²) of its territory under official protection (UNEP-WCMC and IUCN, 2018). These areas are classified as full-protection PAs (intended for conservation and limited to indirect

use), and sustainable-use PAs (integrating conservation with sustainable uses of natural resources) (Brasil, 2004). Despite this, relaxation of environmental laws, expansion of agricultural regions, conflicts with the private sector, mining activities and infrastructure projects such as hydroelectric dams and roads, are threatening protected areas in Brazil (Bernard et al., 2014; De Marques and Peres, 2015; Villén-Pérez et al., 2018). Additionally, native vegetation remnants are protected on private rural properties (Soares-Filho et al., 2014). Among these areas are permanent preservation areas (protected areas with environmental functions such as preserving water resources, soil, gene flow and well-being of the human population), and legal reserves (areas with native vegetation dedicated to biodiversity conservation, but available for sustainable economic use), mandatorily protected by the Native Vegetation Protection Law of Brazil (Brasil, 2012). Brazilian landowners are legally required to maintain the native vegetation on their properties, and noncompliance is punishable by fines as well as civil, administrative and penal sanctions (Brancalion et al., 2016).

Understanding how rural landowners perceive restoration efforts (attitude toward a behavior), the opinions of their families, friends and neighbors (subjective norms), and their ability to perform the actions (perceived behavior control), can provide information essential to engaging landowners in the adoption of sustainable practices (Lalani et al., 2016; Menozzi et al., 2015). The involvement may be more effective if the landowners understand that the ecosystem services provided by native vegetation are environmentally and economically beneficial to their properties (Lamarque et al., 2014). This perception of ecosystem services may affect how the landowner assesses the protected areas on their properties, therefore ecosystem service perceptions could affect the attitude and intention to restore areas, according to TPB. This intention may be related to age, because young landowners are more open to make changes in their properties and to engage in environmental behaviors (Wang et al., 2018). Property characteristics like size can also affect intention to restore areas, given that landowners need to demonstrate adequate maintenance of legally protected areas in order to obtain public financial assistance (Assunção et al., 2013). The number of springs on properties may also affect the intention to restore areas, since water provision is an ecosystem service highly valued by landowners as essential for agriculture and human well-being (Quintas-Soriano et al., 2014).

The purpose of this study is to understand how the landowners' intention to restore areas on rural properties can be explained by the TPB determinants attitude toward a behavior, subjective norms and perceived behavior control. Thus, we tested the basic aspects of this theory by the following hypotheses:

H1. Attitude toward a behavior is positively related to landowners' intentions to restore areas on their properties.

H2. Subjective norms do not affect landowners' intentions to restore. This pressure is exerted by Brazilian law, which obligates landowners to maintain native protected areas on their properties.

H3. Perceived behavior control is positively related to landowners' intention to restore.

We also evaluated if background factors such as ecosystem service perception, age, property size and number of springs can contribute to better understanding the intention to restore, by testing the following hypotheses:

H4: Ecosystem service perception affects the attitude, thus indirectly impacting the landowners' intentions to restore.

H5: The number of springs is positively related to attitude and indirectly affects landowners' intentions to restore.

H6. Landowner age affects attitude, subjective norms, perceived behavior control and, indirectly, intention. Younger landowners have more intention to restore.

H7. Size of property is related to attitude, subjective norms, perceived behavior control and, indirectly, intention. Landowners with larger properties have more intention to restore.

2. Methods

2.1. Overview

We operationalized the TPB framework using a Structural Equation Modeling Partial Least Square (SEM-PLS) approach. The latent variables intention (INT), attitude toward behavior (AB), subjective norms (SN), perceived behavior control (PBC), and ecosystem service perceptions (ESP) were derived from indicators presented in a questionnaire answered by each landowner. SEM-PLS is a statistical method that allows to understand the relationship between latent variables, measured indirectly from observed indicators of the phenomena, the manifest variables (Shipley, 2016).

2.2. Study Area

A portion of the Brazilian savanna (7.5%) is located in public PAs (Strassburg et al., 2017), including the Silvânia National Forest (SNF), a sustainable-use PA located 7km from Silvânia, a municipality in the state of Goiás, Brazil. The SNF is a 486.6-hectare remnant of

Brazilian savanna surrounded by private rural properties whose main activities are commodity agriculture (soy and corn) and cattle raising (Figure 1). This is an important remnant of the original vegetation of the Cerrado biome encompassing a mosaic of phytophysiognomies including open savanna, typical cerrado, woodland cerrado, semi-deciduous seasonal forest, and gallery forests. SNF lacks robust connections to nearby private PAs, which compromises the maintenance of local biodiversity. One planned management action is to increase the connection of vegetation through restoring areas on rural properties (MMA, 2015), but this requires the voluntary participation of landowners.

The research was performed in the 6-km zone around the SNF, within its purposed buffer zone (MMA, 2015). Within this perimeter, we counted 104 properties which exhibit some productive activity, excluding those only used for living or leisure. Of the farmers using those properties, six do not live in Goiás State and lease their lands, three were not found despite several attempts, and five declined participation in this research. Our final sample consisted of 75 landowners or 72.0% of the possible interviewees (Figure 1).

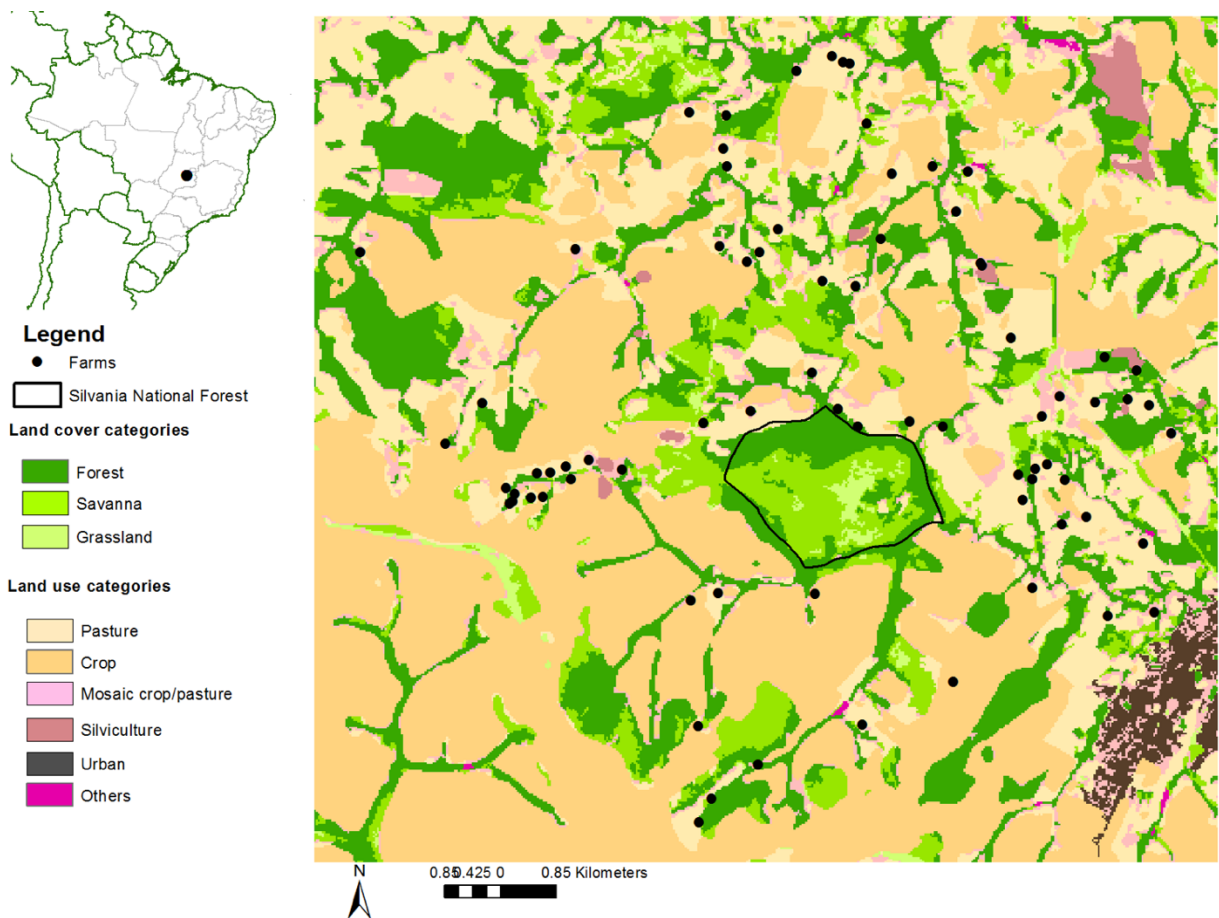


Figure 1: Properties of landowners interviewed around Silvânia National Forest and land cover and land use categories in landscape. Source: Mapbiomas (www.mapbiomas.org).

2.3. Survey development and data collection

The first section of the questionnaire includes personal questions (e.g. age, education) and property information (e.g. size, number of springs, core activities). The second section consists of statements related to TPB constructs. We define the behavior under investigation according to its target, action, context, and time: “to restore areas with native vegetation on her/his properties over the next three years” (Ajzen, 2010, 2002). The overall constructs were investigated using a set of statements in the questionnaire written according to Ajzen recommendations (Ajzen, 2002): intention (INT) and attitude toward a behavior (AB) – 4 questions each; subjective norms (SN) and perceived behavior control (PBC) – 3 questions each; ecosystem service perception (ESP) – 5 questions, all of them rated on a 7-point Likert scale (from 1 = strongly disagree to 7 = strongly agree, or other wording appropriate to the topic; Table 1). The questionnaire was approved by the Human Ethics Committee of the State University of Goiás (#66096317.5.0000.8113). We did a pilot test with six farmers in May 2017 to assess the clarity of the questions. From May to July 2017, 75 farmers entitled to make decisions concerning their properties were interviewed by the same researcher (FPL). The majority of landowners interviewed were males (85.4%). The average age was 56 years old (ranging from 30 to 74 years); 2.7% of landowners had no education; 28.0% completed elementary school; 12.0% had middle school; 26.6% completed high school; and 30.7% had undergraduate studies. The majority of respondents (80%) had small properties (up to 120 ha); 12% had medium properties (from 121 ha to 450 ha); and 8% have large properties above 450 ha.

Table 1: Statements and scale used to measure intention, attitude toward a behavior, subjective norms, perceived behavior control, and ecosystem service perception.

Item	Statements	Scale (1-7)
INT1	<i>Intention</i> Do you intend to restore areas on your property over the next three years?	definitely not definitely yes
INT2	How strong is your intention to restore areas on your property in the next three years?	very weak very strong
INT3	Will you try to restore areas on your property over the next three years?	definitely not definitely yes
INT4	Do you plan to restore areas on your property over the next three years?	definitely not definitely yes
AB1	<i>Attitude toward a behavior</i> The restoration of areas on your property over the next three years is...	extremely damaging extremely beneficial
AB2	The restoration of areas on your property over the next three years is...	extremely disadvantageous extremely advantageous
AB3	The restoration of areas on your property over the next three years is...	extremely unnecessary extremely necessary
AB4	The restoration of areas on your property over the next three years is...	extremely unimportant extremely important
SN1	<i>Subjective norms</i> Most of the people who are important to you think that you should restore areas on the property over the next three years.	strongly disagree strongly agree
SN2	People in your life whose opinion you value would approve of your restoring areas on your property over the next three years.	very unlikely very likely
SN3	Most landowners in this region will restore areas on their property over the next three years.	very unlikely very likely
PBC1	<i>Perceived Behavior Control</i> If you wanted, could you restore areas on the property over the next three years?	definitely not definitely yes
PBC2	If you wanted to, would you have sufficient resources to restore areas on the property over the next three years?	definitely false definitely true
PBC3	How confident are you about restoring areas on the property over the next three years?	completely unconfident completely confident

Continuing Table 1.

Item	Statements	Scale (1-7)
ESP1	<i>Ecosystem Service Perception</i> Restoring areas on the property over the next three years may increase crop production.	definitely false definitely true
ESP2	Restoring areas on the property over the next three years may increase milk/beef production.	definitely false definitely true
ESP3	Restoring areas on the property over the next three years may increase the quantity and quality of water in your property.	definitely false definitely true
ESP4	Restoring areas on the property over the next three years may improve soil quality.	definitely false definitely true
ESP5	Restoring areas on the property over the next three years may increase the beauty of your property.	definitely false definitely true

2.4. Data analysis

All procedures and methodological choices here are based on Hair et al. (2017). We estimate the results of Structural Equation Model using a variance-based partial least square (PLS) approach, which maximizes the proportion of explained variance of the endogenous latent variables through a sequential interactive estimation of partial relationships using ordinary least squares regressions (Hair et al., 2012). The exogenous latent variables are the constructs that explain other constructs in the model, and the endogenous latent variables are the explained constructs (Hair et al., 2017).

SEM-PLS has two elements: the structural or inner model that represents the relationship between the constructs being evaluated, and the measurement or outer model that displays the construct formation from indicators. In this research, the latent variables were derived from reflective measures, since the indicators represent the manifestation of construct, and the causality flows from construct to indicators (Coltman et al., 2008). The measurement model evaluation provides evidence of reliability and validity through the following criteria: i) internal consistency reliability, evaluated using composite reliability (composite reliability ≥ 0.7 shows that different indicators are similar in capturing the latent variable); ii) convergent validity, evaluated using outer loadings of the indicator (indicator loadings ≥ 0.7 show that the question captured the latent variable; ESP2 has a loading of $<0,7$, but its removal did not change the composite reliability, and it was retained) and Average Variance Extracted (AVE ≥ 0.5 , the

latent variable captures at least 50% of each indicator's variance); iii) discriminant validity, evaluated using cross-loadings (the indicator loading should be higher with its construct than with other constructs) and the heterotrait-monotrait ratio (HTMT) of the correlations (HTMT <0,9) (Hair et al., 2017, 2014).

The assessment of the structural model reveals its predictive capabilities and the relationships between latent variables. Initially we examined the structural model for collinearity using Variance Inflation Factor Analysis ($VIF \geq 5$ implies a potential collinearity issue). Construct relationships representing the work hypothesis were tested using the path coefficient and path significance (t-value, p-value, confidence interval 95%) derived from a bootstrapping procedure (75 cases and 5,000 subsamples). The coefficient of determination (R^2), which represents the amount of explained variance of each latent variable, is the measure of model predictive power; values of 0.25, 0.50 and 0.75 are described, respectively, as weak, moderate and substantial. The effect size of exogenous construct on the endogenous construct (f^2) was measured, and 0.02, 0.15 and 0.35 represent small, medium, and large effects respectively. The predictive relevance (Q^2) allows measurement of how well the path model can predict observed values. It was obtained by using a blindfolding procedure ($Q^2 > 0$ indicates that the model has predictive relevance for a specific endogenous construct). The relative predicted relevance of exogenous latent variables (q^2 effect size) was also measured, and 0.02, 0.15 and 0.35 represent small, medium, and large predictive relevance respectively (Hair et al., 2017, 2014). SEM-PLS was performed using SmartPLS3 software (Ringle et al., 2015).

3. Results

Our measurement models were found valid and reliable, and the constructs were well measured by indicators (Table 2), supporting their use in interpreting the construct relationships. Thus, the intention of landowners to restore (INT) is positively related to attitude toward a behavior (AB), with a large effect size and predictive relevance, confirming H1 (Table 3). Subjective norms (SN) is not related to intention, confirming H2 (Table 3). The perceived behavior control (PBC) does not affect intention to restore, refuting H3 (Table 3).

In relation to the background factors, ecosystem service perception (ESP) positively affects AB with large effect size and large predictive relevance (Table 3), and ESP indirectly affects INT (Table 3), supporting H4. The number of springs positively influences AB, but with small effect size and small predictive relevance (Table 3), and indirectly affects INT (Table 3),

supporting H5. The youngest landowners have more AB, SN, and indirectly INT, all of them with small effect size and small predictive relevance (Table 3). These results partially support H6, because PBC does not differ between ages (Table 3). The property's size does not affect any variable, refuting H7 (Table 3). Detailed results of measurement evaluations can be found in supplementary material A.

According to VIF results, the model does not have collinearity issue (supplementary material B). More than half of the variance in landowners' intentions to restore areas can be explained by AB ($R^2=0.577$; Table 4). ESP explained 46% of the AB variance ($R^2=0.460$; Table 4). The AB and INT Q^2 results above zero ensure that the model has good predictive power (Hair et al., 2014). Figure 2 synthesizes the results showing the R^2 , path coefficients and p value for each path.

Only one respondent reported the absence of Cerrado native area in his property. Other landowners stated the presence of legal reserves, permanent protected areas or both as representatives of native remnants. Although most landowners claim to have the quantity of native areas required by legislation, 57% of them are interested in restoring areas in their properties (the latent variable INT above 0.0 corresponds to a mean above 5.0 in the four questions used to construct this variable and can be considered strong intention to restore). The frequency distribution of each latent variable was showed in supplementary material C.

Table 2: Evaluation of reflective measurement model. Outer loadings for each indicator, the average variance extracted (AVE), composite reliability and heterotrait-monotrait ratio (HTMT).

Latent	Indicators	Convergent Validity		Internal Consistency	Discriminant
		Loadings >0.7	AVE>0.5	Reliability Composite Reliability >0.7	Validity HTMT*
INT	INT1	0.955	0.913	0.977	yes
	INT2	0.955			
	INT3	0.956			
	INT4	0.956			
AB	AB1	0.925	0.778	0.933	yes
	AB2	0.882			
	AB3	0.809			
	AB4	0.906			
SN	SN1	0.805	0.576	0.803	yes
	SN2	0.741			
	SN3	0.729			
PBC	PBC1	0.862	0.657	0.851	yes
	PBC2	0.712			
	PBC3	0.848			
ESP	ESP1	0.716	0.511	0.838	yes
	ESP2	0.622			
	ESP3	0.747			
	ESP4	0.702			
	ESP5	0.776			

* Confidence interval does not include 1.

Table 3: Evaluation of structural model. For each path, the path coefficient (β), t-test value, p-value, confidence interval 95% (CI), the effect size of exogenous construct on the endogenous construct (f^2), relative predicted relevance of exogenous latent variables (q^2).

Path	Path Coefficient (β)	t- value	p-value	2,5% CI	97,5% CI	f^2	q^2
AB→INT	0.584	4.945	<0.001	0.317	0.784	0.347	0.247
SN→INT	0.134	1.332	0.183	-0.040	0.355	0.027	0.016
PBC→INT	0.126	1.203	0.229	-0.065	0.337	0.022	0.010
ESP→AB	0.599	8.763	<0.001	0.470	0.739	0.653	0.362
NSPR→AB	0.186	2.674	0.008	0.078	0.354	0.057	0.032
AGE→AB	-0.179	2.145	0.032	-0.348	-0.025	0.059	0.028
AGE→SN	-0.266	2.255	0.024	-0.505	-0.046	0.078	0.014
AGE→PBC	-0.162	1.500	0.133	-0.381	0.047	0.027	0.008
SIZE →AB	-0.230	1.704	0.088	-0.457	0.078	0.088	0.048
SIZE→SN	-0.120	0.890	0.374	-0.395	0.115	0.016	0.002
SIZE→PBC	-0.004	0.027	0.978	-0.284	0.231	0.000	-0.006
ESP→INT *	0.350	4.168	<0.001	0.184	0.514		
AGE→INT *	-0.161	2.433	0.015	-0.313	-0.054		
NSPR→INT *	0.109	2.323	0.020	0.035	0.217		
SIZE→INT *	-0.151	1.409	0.159	-0.339	0.091		

* indirect effects

Table 4: Results of coefficient of determination (R^2) and predictive relevance (Q^2) of endogenous latent variables

Latent	R^2	Q^2
INT	0.577	0.485
AB	0.460	0.315
SN	0.088	0.010
PBC	0.026	0.002

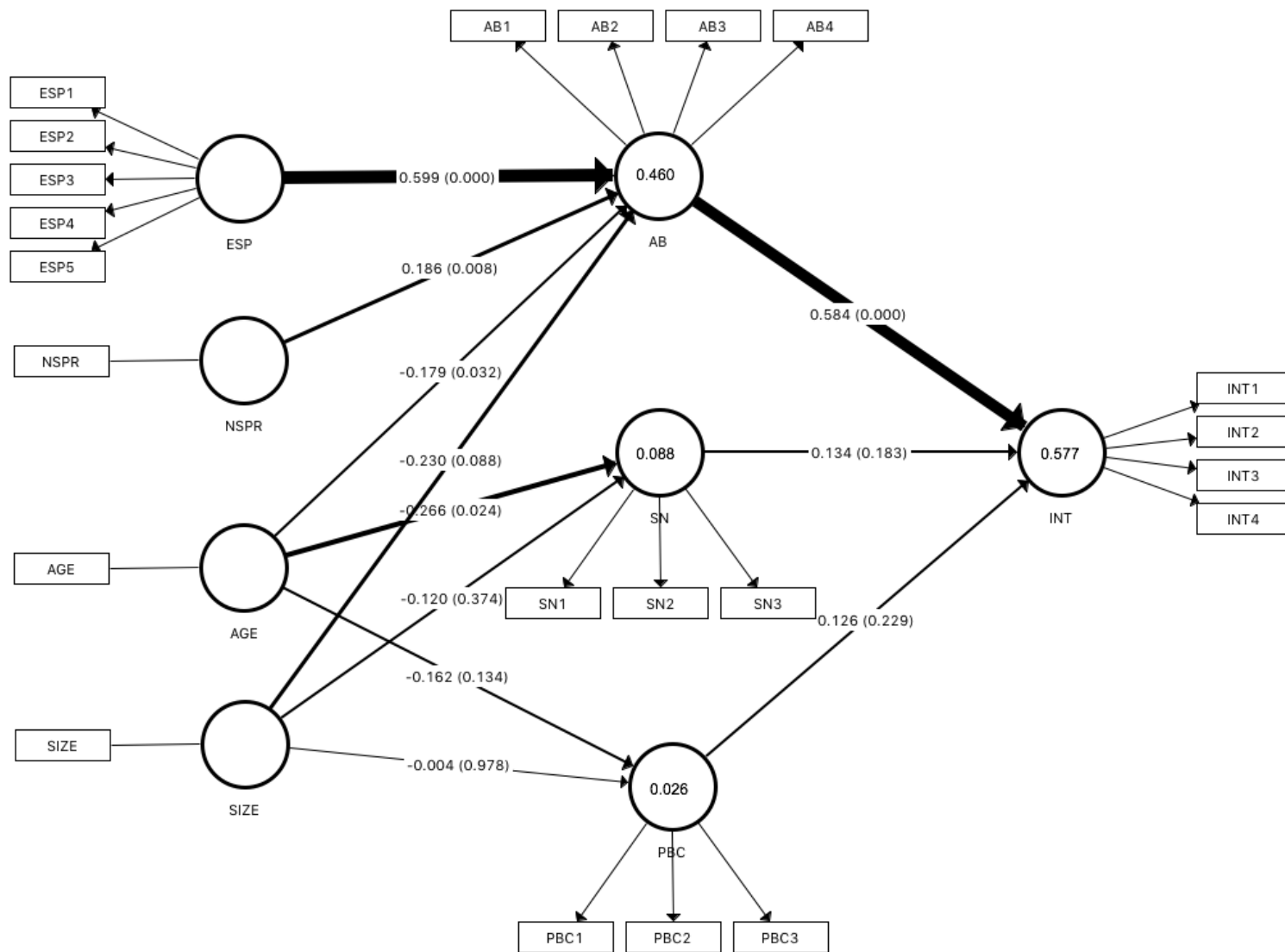


Figure 2: TPB model with background factors. R² are inside circles of endogenous latent variables intention (INT), attitude toward a behavior (AB), subjective norms (SN), perceived behavior control (PBC). The background factors ecosystem services perceptions (ESP), number of springs (NSPR), age (AGE), and property size (SIZE) are included in the model. Path coefficients and the p value (in brackets) of each path in structural model are in each arrow.

4. Discussion

The findings reveal that the landowners' intentions to restore areas on their properties is explained by the attitude toward a behavior (AB) construct under a Theory of Planned Behavior (TPB) approach. The higher the positive evaluation of restoration effects, the greater the intention to perform it. Ecosystem service perception (ESP) directly affects this evaluation and increases landowners' intentions to restore areas. Although most landowners claimed compliance with the amount of protected native area required by Brazilian law, this does not lessen their intentions to restore areas. Many landowners have expressed an interest in managing existing protected areas, including ecological improvements such as the increase of native vegetation. As originally hypothesized, subjective norms (SN) did not affect the intention under investigation. The same was true of perceived behavior control (PBC), contrary to our hypothesis. Thus, TPB is an adequate framework for understanding human behavior and highly applicable to the design of behavior change interventions like conservation practices (St John et al., 2010). Furthermore, TPB is capable of explaining what affects intention and behavior, and uncovering these mechanisms is essential to designing more realistic and effective conservation programs (Wauters et al., 2016).

TPB was a suitable socio-psychological approach to understanding the problem under investigation. Several meta-analyses support TPB's capacity to predict intentions and behaviors in different kinds of behavioral domains (Armitage and Conner, 2001; Steinmetz et al., 2016), with variance in explanations of around 39%. In our study, the predictive validity was 57%. The influence of each construct on intention varies according to the behavior investigated (Ajzen, 2005). Studies that evaluated landowners' intentions confirm this. For instance, Zeweld et al. (2017) conclude that the three determinants AB, SN and PBC affect the intentions of landowners to adopt sustainable agricultural practices in Ethiopia. The same result was found by Senger (2017) evaluating the intention of Brazilian farmers to diversify agricultural production. AB and PBC are the factors that influenced farmers to adopt soil conservation practices in Germany (Werner et al., 2017b) and to reuse agricultural biomass waste in China (Jiang et al., 2018). In our study, AB was the only construct to explain intention. This finding differs somewhat from studies of similar intentions that involve management of natural areas. Karppinen and Berghäl (2015) and Mastrangelo et al. (2014) showed SN to have the greatest explanatory power over intention, followed by AB, in farmers' intentions to promote silvicultural practices and to conserve forests, respectively. In an investigation to understand

the maintenance of a restoration program, Deng et al. (2016) found the intention was affected by the three TPB determinants. Despite similarities between the intentions under investigation, the social and environmental particularities of each study are sufficient to explain the differences. In our context we do not find SN to have any influence, perhaps because the perception of legal pressure exceeds the perception of social pressure to restore areas. Alternatively, landowners may not perceive any social pressure because they do not understand that the quality and size of their legal reserves and permanent preservation areas affect the ecosystem services of the area and thus are not worried about the situation of neighboring native areas. Contrary to our hypothesis, PBC did not affect the intention to restore areas, suggesting the absence of control variables underlying the behavior.

The perception of the benefits of behavior directly impacts attitude. For instance, Pino et al. (2017) also found AB to be a determinant in the adoption of water-saving measures, and the perception of the benefits in water provision played a central role in the favorable attitudes of Italian farmers. In our study we find a latent variable ESP measuring the perceived benefits of restoring areas positively impacting AB. Our results support the claim that the assessment of landowners' intentions to restore is dependent on their recognition of the ecosystem services provided by native areas. The number of springs also affects AB and, indirectly, intention. This result reinforces the role of ecosystem services and the perception of their benefits in influencing landowners to manage native areas on their properties (Fielding et al., 2005). In our interviews, landowners have shown great concern about water, and several of them have stated that springs and streams have dried up permanently in recent years. These background factors affect the behavioral beliefs and deepen understanding of how attitude toward behavior is formed.

In agricultural areas, ecosystem services increase production and generate economic gains (Milfont et al., 2013; Silva-Neto et al., 2013). Farmers perceived ecosystem services provided by natural areas (Caballero-Serrano et al., 2017; Teixeira et al., 2018; Wartenberg et al., 2018). Our results showed a direct relationship between the perception of ecosystem services provided by native areas and attitude towards restoration. This suggests that conservation activities in agricultural areas should prioritize educational outreach to landowners and their families in order to increase perception of those services, and thus engagement in conservation efforts (Bennett, 2016; Kross et al., 2018). It is important that farmers can understand ecological processes and the importance of native biodiversity, as well as the public and private PAs enhancing the maintenance of ecosystem services. Outreach

projects should also emphasize connectedness to nature, since the individual's understanding that we are part of nature also promotes more involvement in pro-environmental behaviors (Gosling and Williams, 2010).

According to our results, younger landowners are more willing to restore, a finding similar to that of Herath (2013) and Wang et al. (2018) investigating farmers' behaviors. In our interviews, it was common to hear older landowners saying that they were not interested in making changes in their properties. Otherwise, younger landowners (aged around 30-50 years) probably realize that the benefits of restoration will be perceived only in the medium-term (5-10 years), but they are willing to wait. They already perceive the impacts of environmental changes on production and realize the necessity of adopting agricultural and livestock conservation practices. Although younger people are more concerned about the environment, several studies report that older people are more engaged in pro-environmental behavior as shown by a recent review on these topics (Gifford and Nilsson, 2014). In the future, conservation interventions in the SNF region need to engage all landowners, with particular attention to turning younger people's intentions into pro-environmental behaviors.

This is, to our knowledge, a first attempt to apply a TPB model to the study of the relationship between restoration efforts and Brazilian landowners in the area of a PA. The SNF has a close relationship with the area through to educational activities, guidance for good environmental practices on the properties, and the community's effective participation in its advisory council. Therefore, it is possible to devise management strategies involving the participation of the local population. It is essential to design those strategies effectively since other protected areas in Brazil suffer from the impact of socio-environmental conflicts, historically constructed since their implementation (Anaya and Espírito-Santo, 2018; Machado et al., 2017). We consider that the TPB approach can play an important role in implementing human dimensions in the design of projects and conservation activities for different social and ecological contexts. Understanding how intentions and behaviors are formed equips conservationists with a set of stakeholder information that is essential to designing realistic projects, avoiding management efforts that make perfect sense to the scientist, but are not operable without the interest and comprehension of the local population. In conservation management strategies it is necessary to establish win-win solutions for both biodiversity and human well-being. Awareness of ecosystem services is one way to achieve this, but it is essential that people understand the ecological processes behind these services related to native biodiversity. This reasoning, however, needs to consider that PAs in Brazil exist in varying

social and ecological landscapes. For example, in the Cerrado biome there is Emas National Park, surrounded by intensive agriculture activity, and Chapada dos Veadeiros National Park, in a landscape of the traditional agriculture and animal husbandry of the *quilombolas* (people belonging to communities descended from slaves). Our results are obviously not directly generalizable to those systems but provide an important model to apply.

5. Conclusion

This study shows how the use of psychological theories can play a central role in the inclusion of human dimensions in conservation issues. The Theory of Planned Behavior approach demonstrates that landowners' intentions to restore can be explained by attitude toward a behavior. Positive evaluation of restoration activities is linked to the perception of benefits provided by native areas which promote rural activities and human well-being. The effect of ecosystem service perception as a background factor enables better understanding of this positive evaluation. Our results also demonstrate that younger landowners and those with more springs on their properties are more interested in restoring areas of native vegetation. These results create opportunities for the construction of regional management programs that consider the landowners' perspectives.

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Supplementary Material

We present in this supplementary material the evaluation of Structural Equation Modeling — measurement evaluation (A) and structural evaluation (B). We also present the frequency distribution of latent variables (C).

A. Measurement Evaluations

A1. Discriminant Validity Analysis

A1.1. Cross-loadings evaluation

	AB	AGE	ESP	INT	NSPR	PBC	SIZE	SN
AB1	0.925	-0.265	0.549	0.696	0.125	0.596	-0.090	0.650
AB2	0.882	-0.216	0.496	0.595	0.053	0.549	-0.126	0.550
AB3	0.809	-0.064	0.554	0.617	0.073	0.520	-0.159	0.434
AB4	0.906	-0.306	0.523	0.712	-0.014	0.622	-0.283	0.474
AGE	-0.246	1.000	-0.084	-0.362	-0.046	-0.162	0.034	-0.270
ESP1	0.501	0.026	0.716	0.513	-0.028	0.411	-0.052	0.480
ESP2	0.349	-0.118	0.622	0.298	0.014	0.405	0.033	0.462
ESP3	0.415	-0.058	0.747	0.394	-0.230	0.232	0.020	0.462
ESP4	0.247	0.071	0.702	0.127	-0.090	0.266	0.018	0.249
ESP5	0.527	-0.168	0.776	0.412	-0.012	0.371	-0.055	0.371
INT1	0.719	-0.328	0.518	0.955	0.087	0.499	-0.193	0.483
INT2	0.688	-0.353	0.487	0.955	0.081	0.453	-0.213	0.490
INT3	0.726	-0.291	0.508	0.956	0.033	0.591	-0.243	0.519
INT4	0.718	-0.411	0.498	0.956	0.062	0.577	-0.225	0.536
NSPR	0.066	-0.046	-0.091	0.068	1.000	0.152	0.322	-0.090
PBC1	0.585	-0.166	0.515	0.524	0.109	0.862	0.034	0.309
PBC2	0.407	-0.040	0.258	0.324	0.249	0.712	0.094	0.292
PBC3	0.562	-0.157	0.349	0.469	0.062	0.848	-0.120	0.318
SIZE	-0.189	0.034	-0.021	-0.229	0.322	-0.009	1.000	-0.129
SN1	0.354	-0.345	0.346	0.335	-0.053	0.174	-0.006	0.805
SN2	0.609	-0.072	0.597	0.452	-0.106	0.454	-0.130	0.741
SN3	0.399	-0.200	0.375	0.417	-0.046	0.227	-0.153	0.729

A1.2. Heterotrait-monotrait ratio (HTMT) evaluation

	AB	AGE	ESP	INT	NSPR	PBC	SIZE	SN
AB								
AGE	0.254							
ESP	0.685	0.141						
INT	0.795	0.368	0.565					
NSPR	0.079	0.046	0.119	0.070				
PBC	0.776	0.173	0.594	0.635	0.200			
SIZE	0.196	0.034	0.057	0.232	0.322	0.118		
SN	0.792	0.341	0.814	0.677	0.114	0.551	0.160	

A1.3. HTM confidence interval

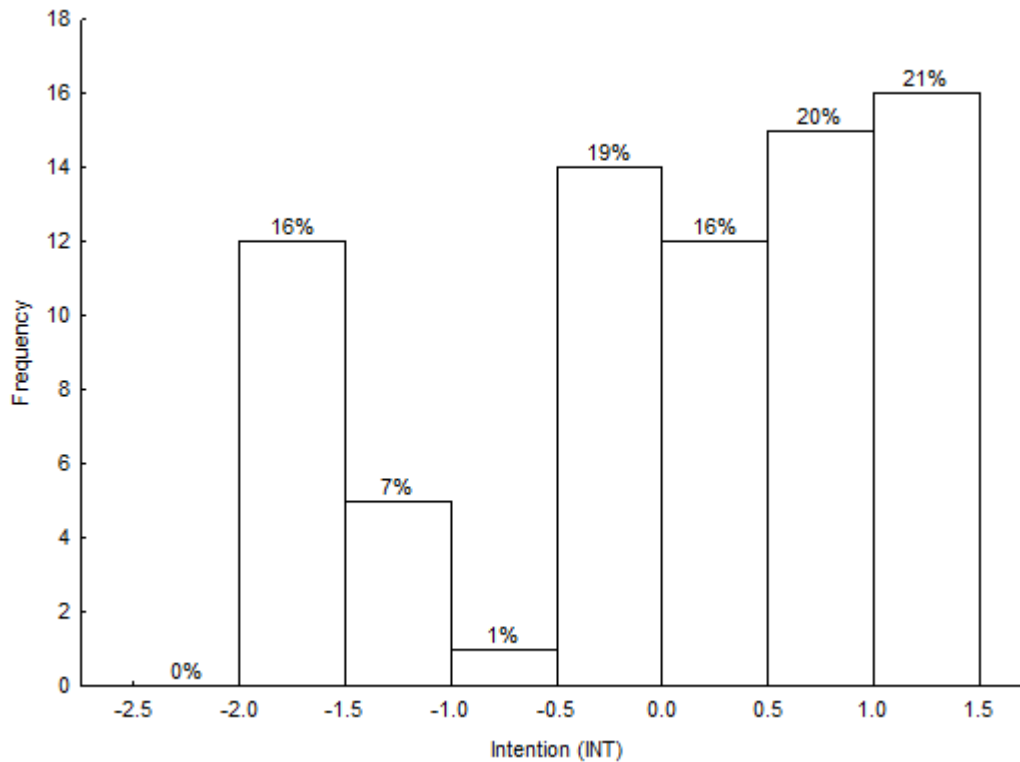
	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
AGE -> AB	0.254	0.266	0.107	0.440
ESP -> AB	0.685	0.686	0.490	0.861
ESP -> AGE	0.141	0.211	0.092	0.362
INT -> AB	0.795	0.793	0.632	0.915
INT -> AGE	0.368	0.367	0.162	0.554
INT -> ESP	0.565	0.572	0.393	0.738
NSPR -> AB	0.079	0.123	0.041	0.257
NSPR -> AGE	0.046	0.102	0.005	0.261
NSPR -> ESP	0.119	0.201	0.081	0.404
NSPR -> INT	0.070	0.120	0.020	0.298
PBC -> AB	0.776	0.778	0.646	0.900
PBC -> AGE	0.173	0.209	0.062	0.414
PBC -> ESP	0.594	0.623	0.447	0.790
PBC -> INT	0.635	0.637	0.405	0.839
PBC -> NSPR	0.200	0.222	0.086	0.399
SIZE -> AB	0.196	0.218	0.061	0.448
SIZE -> AGE	0.034	0.073	0.003	0.191
SIZE -> ESP	0.057	0.118	0.044	0.250
SIZE -> INT	0.232	0.230	0.039	0.421
SIZE -> NSPR	0.322	0.315	0.041	0.632
SIZE -> PBC	0.118	0.159	0.066	0.329
SN -> AB	0.792	0.795	0.602	0.953
SN -> AGE	0.341	0.376	0.164	0.607
SN -> ESP	0.814	0.830	0.641	1.027
SN -> INT	0.677	0.677	0.448	0.873
SN -> NSPR	0.114	0.172	0.042	0.396
SN -> PBC	0.551	0.573	0.335	0.821
SN -> SIZE	0.160	0.225	0.058	0.468

B. Structural Model Evaluation

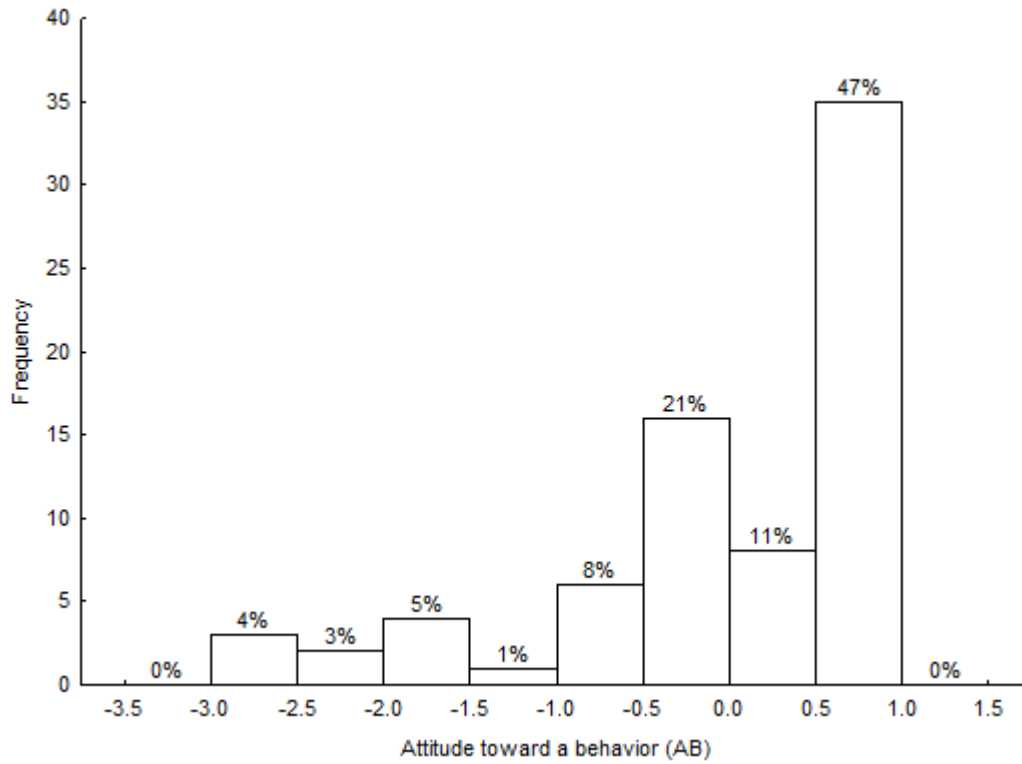
B1. VIF Results

	INT	AB	PBC	SN
AB	2.323			
AGE		1.013	1.001	1.001
ESP		1.016		
NSPR		1.130		
PBC	1.736			
SIZE		1.119	1.001	1.001
SN	1.559			

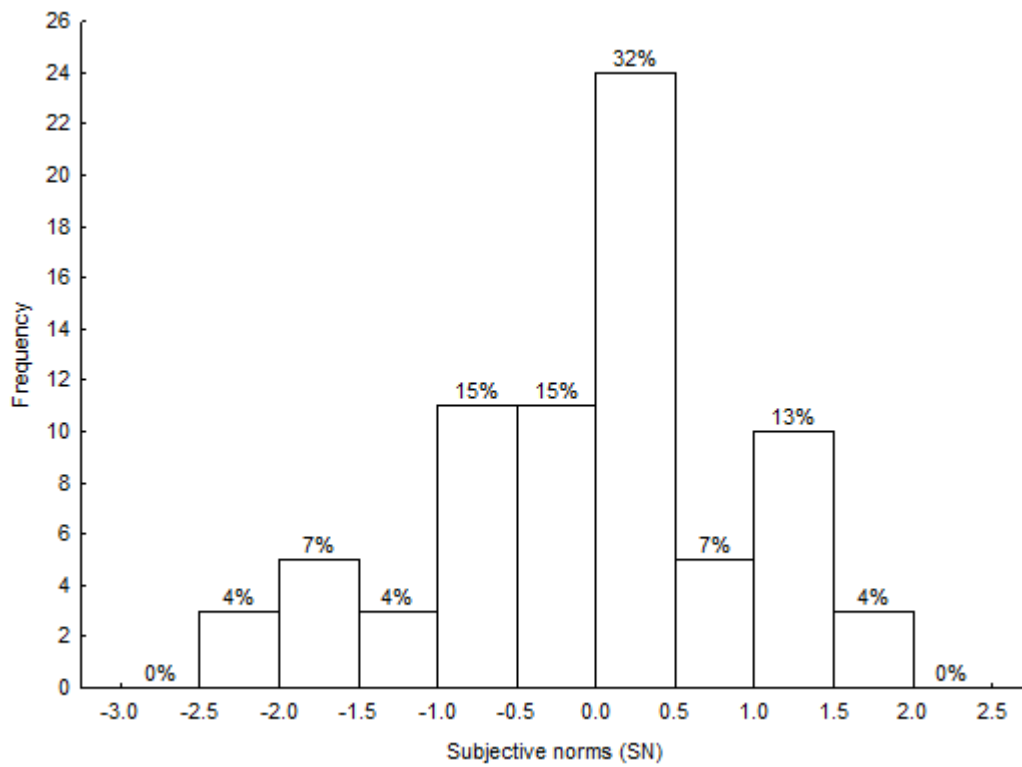
C. Frequency distributions of latent variables intention, attitude toward a behavior, subjective norms, perceived behavior control; ecosystem service perception.



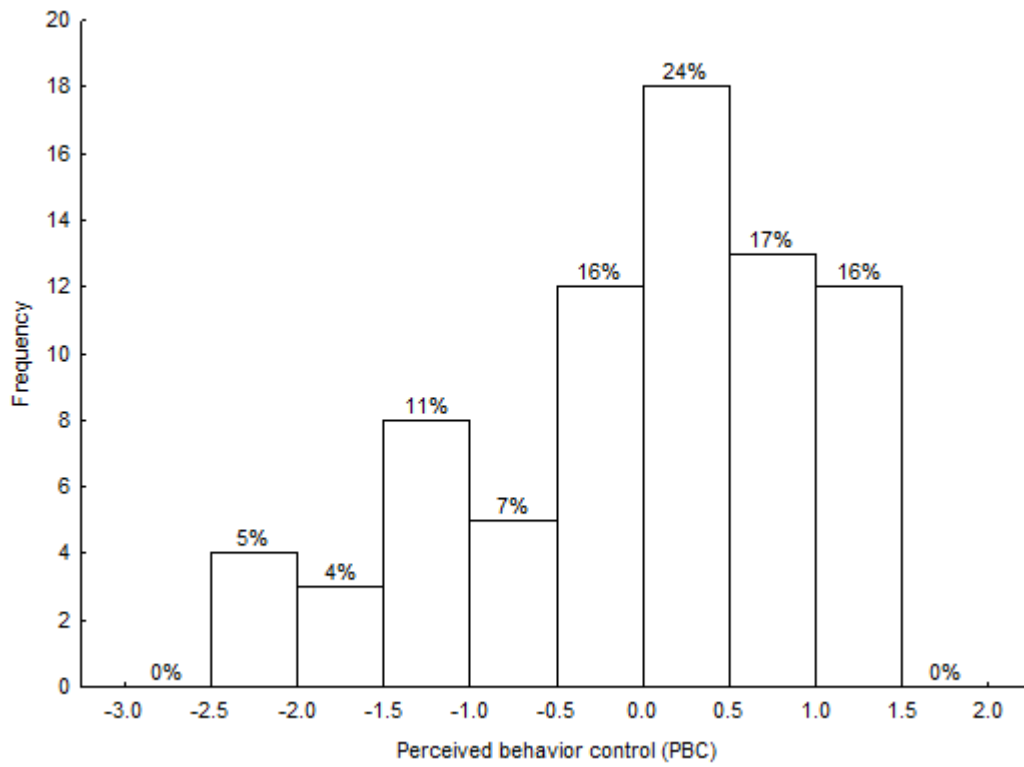
C1: Frequency distributions of latent variable intention.



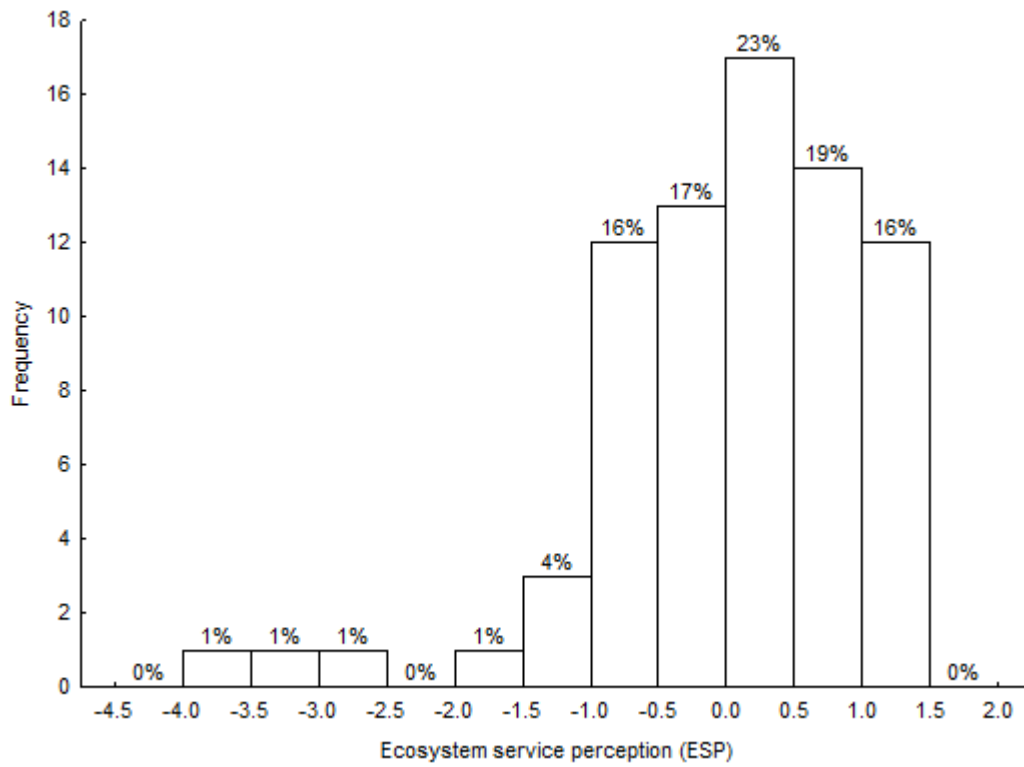
C2: Frequency distributions of latent variable attitude toward a behavior.



C3: Frequency distributions of latent variable subjective norms.



C4: Frequency distributions of latent variable perceived behavior control.



C5: Frequency distributions of latent variable ecosystem service perception.

CAPÍTULO III

NO BATS, NO GAIN: EDUCATIONAL INTERVENTION INCREASES FARMERS PERCEPTION OF ECOSYSTEM SERVICES

Flávia Pereira Lima; Rogério Pereira Bastos

Abstract

Brazil has 28.9% of its territory in network of public protected areas (PAs), with large remnants of native vegetation occurring on private lands. Landowners play central roles in any conservation debate: they are required to protect native vegetation on their lands and are neighbors of PAs. In this study, we tested the hypothesis that an educational activity focused on ecosystem services (ESs) and the ecological processes underpinning them could improve landowners' perception of public and private PAs. For this, we designed a classic experiment by applying a pretest and posttest to control and intervention groups. The intervention was a workshop for Brazilian landowners to educate them about a public PA and to demonstrate how ESs provided by native areas positively impact rural activities. We used a questionnaire and a series of images to conduct face-to-face interviews. Our results revealed that landowners who participated in the workshop identified more activities developed in the public PA, were more aware of pollination, and recognized more ESs during the interviews. Conservation initiatives should promote educational events for landowners. In particular, practical activities and demonstrations involving emblematic species help rural people to understand the links between native biodiversity, ESs and well-being.

Keywords

Brazilian savannah biome; Cerrado; farmer training; environmental perception; experimental design

1. Introduction

Public and private protected areas are recognized as effective strategies in biodiversity conservation, and in providing ecosystem services to society (Guerbois and Fritz, 2017; Pegas and Castley, 2016; Saout et al., 2013). Protected Areas (PAs) also have positive social impacts, contributing to the reduction of poverty levels in local communities (Andam et al., 2010; Braber et al., 2018), providing economic benefits (Heagney et al., 2015), and improving well-being (Bonet-García et al., 2015). Other studies have indicated that the social impacts are less clear. They find that PAs did not mitigate or exacerbate poverty (Hanauer and Canavire-Bacarreza, 2015), neither did they have positive socioeconomic impacts (Miranda et al., 2016), even considering financial compensation to nearby communities (Hall et al., 2014). It is known that the social impacts of PAs are context dependent (Pullin et al., 2013), and the perception of those impacts by local communities is influenced by their socioeconomic characteristics, history and culture (Jones et al., 2018, 2017).

The assessment of environmental perception is the first step towards incorporating this social dimension into conservation strategies (Quintas-Soriano et al., 2016). According to the definitions proposed by Bennet et al. (2017), Gregory et al. (2009), and Garling and Golledge (1989) we define perception as an individual and subjective mode of apprehending reality, of experiencing and interpreting the world. The information captured by the senses is interpreted through values, norms, beliefs, culture, attributes, experience and knowledge. Therefore, perception is a social construction based on history and context, and influences decision-processes by inculcating opinion and judgements. Environmental management strategies are better planned and implemented when the perception of the population involved is taken into account (Abram et al., 2014; Meijaard et al., 2013). Studies have demonstrated several factors affecting the perception of PAs such as age, gender, and ethnicity (Allendorf et al., 2017, 2014); level of education (Allendorf et al., 2014; Blayac et al., 2014; Pietrzyk-Kaszyńska et al., 2012; Vodouhê et al., 2010); involvement in educational activities (Allendorf et al., 2006; Sodhi et al., 2010); the positive evaluation of park management (Allendorf et al., 2012; Vodouhê et al., 2010); and the benefits arising from conservation (Allendorf and Yang, 2013; Ormsby and Kaplin, 2005; Sirivongs and Tsuchiya, 2012; Vodouhê et al., 2010).

Brazil has 28.9% of its territory (roughly 2.5 million km²) under official protection in PAs (UNEP-WCMC and IUCN, 2018). Brazilian legislation mandates that a portion of private lands maintain the original vegetation (Brasil, 2012). Because of this, considerable portion of native vegetation is preserved on private properties, highlighting the importance of these areas

as a component in the conservation scenario (Soares-Filho et al., 2014). The owners of these private lands play a central role in conservation debates: they are possessors of private PAs and often neighbors of public PAs. Understanding how landowners perceive these areas is a significant factor in designing conservation projects. Positive perception of PAs improves local people's attitudes (Allendorf, 2007; Sirivongs and Tsuchiya, 2012). In turn, attitudes influence farmers to participate in conservation activities and sustainable practices (Deng et al., 2017; Lalani et al., 2016; Menozzi et al., 2015; Zeweld et al., 2017).

Rural people are capable of identifying ESs associated with native areas (Abram et al., 2014; Muhamad et al., 2014). Increasing the knowledge of ESs provided by PAs is one way to improve the perception of the importance of these areas (Allendorf and Yang, 2013). It is necessary for local people to understand the correlation between biodiversity conservation and the provision of ESs, empowering people to link conservation to human well-being (Brandon et al., 2012). The perception of ESs also has a mitigating impact on the perception of problems associated with PAs (MacKenzie et al., 2017). Educational activities that promote more knowledge about ESs provided by native areas can contribute to comprehension of the benefits resulting from biodiversity conservation, positively impacting the perception of PAs (Jones et al., 2018).

Extension activities are widely used to promote landowners' behavior changes (Williams et al., 2012). Several studies have indicated an improvement in landowners' knowledge and adoption of agriculture best practices after training: reducing the use of nitrogen fertilizer (Jia et al., 2015, 2013); reducing pesticide use (Yorobe et al., 2011); increasing farmers' knowledge and practice of integrating pest management (Gautam et al., 2017; Hashemi et al., 2008; Mariyono et al., 2013); increasing the safe use of pesticides (Damalas and Koutroubas, 2017; Gautam et al., 2017; Jørs et al., 2014); and promoting the adoption of sustainable forest management practices (Rasamoelina et al., 2016). There are significant differences in methodological approach in these studies, including in the durations of workshops. There are studies in which farmers had only one hour of training (e.g. Jia et al., 2015, 2013), and studies that evaluated long programs with 14 theoretical and practical encounters (e.g. Jørs et al., 2014). Another study showed that an educational impact occurred only in training that includes field-guidance (Pan et al., 2017). Thus, there is evidence that training programs promote farmers' understanding of topics directly related to their work experience. However, can educational initiatives based on scientific ecological knowledge, with less obvious links to agricultural activities, also contribute to farmers' knowledge and

affect their environmental perception? Multiple dimensions of ES approach, integrating ecological, economic and social aspects, allow this framework to bridge the gap between agriculture and biodiversity conservation perspectives (Power, 2010). This approach has a pedagogical nature, making the benefits provided by the ecosystems more comprehensible (Fisher et al., 2009).

Therefore, our objective in this study was to test the hypothesis that an educational activity, focused on demonstrating the ESs associated with agriculture activities, affects the farmers' perception of public and private PAs. We predict that after participation in the workshop, landowners: i) will increase their perception of a public PA; ii) will perceive more ESs associated with native areas protected on their properties; iii) will better perceive the ESs related to agricultural activities; iv) will better perceive the ESs presented at the workshop; v) will perceive more ESs throughout the interview; vi) will have more comprehension of the ES concept.

2. Methods

2.1. Study Area

The Brazilian savanna (Cerrado) is the second-largest biome in Brazil, with an area of nearly 2 million km². It is a hotspot of biodiversity (Myers et al., 2000), highly threatened by anthropogenic action, mainly agribusiness expansion (Klink and Machado, 2005). The Cerrado has already lost 46% of its native vegetation and only 7.5% of its area is covered by PAs (Strassburg et al., 2017). Silvânia National Forest (SNF) is a component of the Cerrado public PA network. The SNF is a sustainable-use PA, covering 486.6 ha of the Cerrado, located 7 km from Silvânia, a municipality of Goiás State, Brazil (MMA, 2015). The SNF is an important remnant of the Cerrado, protecting a mosaic of savanna and forest phytophysionomies (MMA, 2015). Its history started in the late 1940s, when part of Marinho Farm was bought by Silvânia and renamed Horto Florestal (Forest Garden). In 1989, the name was changed to Experimental Forest Station, and research with native and exotic trees began. In 2001, after the promulgation of the Brazilian National Protected Areas System (SNUC), this area was raised to the level of National Forest, a category of sustainable-use PA (MMA, 2015). The SNF was first administrated by the Institute of Environment and Renewable Natural Resources (IBAMA). In 2007, the Chico Mendes Institute for Biodiversity Conservation (ICMBio) was created and assumed the management of federal public PAs in Brazil.

The SNF is surrounded by private properties, most of them developing agriculture-oriented activities, mainly corn and soybean cultivation and animal husbandry (Figure 1). Roughly 85.0% of the Silvânia municipality area is occupied by farms; 42.5% of this area (84,887.4 ha) is devoted to crops, and 34.0% (67,906.5 ha) to pasture (IBGE, 2018). There are 2,091 farms, and 88.7% of the farmers are male. On the majority of properties (62.1%), the landowner is between 30 and 59 years old, on 35.7% they are more than 60 years old, and on 2.2% they are less than 30 years old. In relation to education, 3.8% of the farmers do not have formal education, 30.9% have completed elementary school, 25.6% middle school, 22.3% high school, 17.0% college, and 0.3% a post-graduate degree (IBGE, 2018).

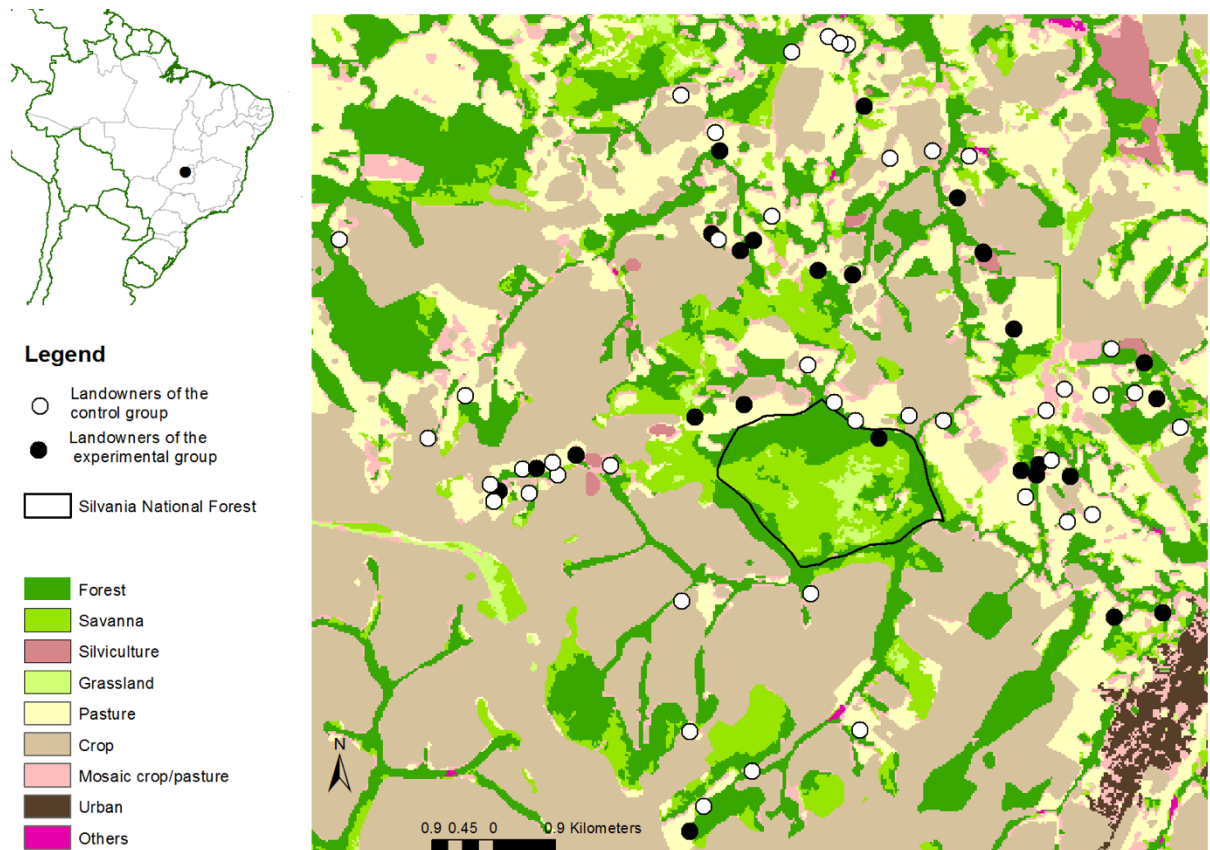


Figure 1: Properties of landowners interviewed — experimental group (n=29) and control group (n=44) — and land cover/land use around Silvânia National Forest. Source: Mapbiomas (www.mapbiomas.org).

2.2. Sample strategy and experiment design

This research was carried out in the 6 km zone surrounding the border of the SNF, following the southern PA buffer zone limit and avoiding the inclusion of urban areas. Using Google Earth images and information provided by SNF employees, we identified 104 potential properties that present some agricultural land use. This was a necessary condition because we also evaluated whether the workshop impacted the landowners' perception of ESs benefiting rural activities. Our initial sample had 75 landowners (72% of all possible respondents, Figure 1), because we were not able to find some landowners (some properties are closed or leased), and we had five refusals.

We designed a classical experiment by applying pretest/posttest to control/intervention groups (Campbell and Stanley, 1979). We implemented our research in three stages (Figure 2). The first stage was a pretest survey, in which we conducted a face-to-face interview with 75 landowners in the vicinity of the SNF from May to July 2017. The intervention stage consisted of the realization of a workshop in September 2017; 25 landowners previously interviewed participated in this educational activity. In the third stage we applied the posttest survey, using the same pretest questionnaire, in November 2017. We chose to do the posttest at least 30 days after the workshop to assess if any knowledge had been learned. All pretest and posttest interviews were performed by the same researcher (FPL), also responsible for the realization of the workshop. Despite several attempts, we did not find six farmers, and our final sample consisted of 69 landowners. Thus, our experimental group had 25 landowners, and the control group 44 (Figures 1, 2).

The randomization of experimental and control groups is a guarantee of equivalence between them (Shadish et al., 2002). However, in our study the experimental group was configured from those landowners that spontaneously participated in the workshop. Accordingly, we acknowledge the possible existence of bias due to sampling.

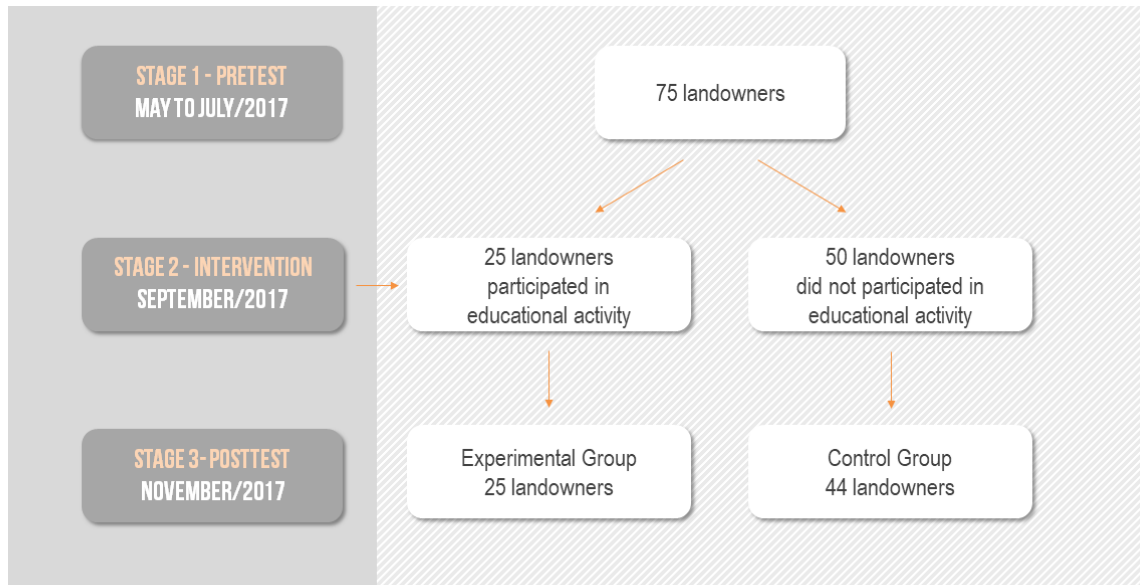


Figure 2: Stages of the experiment.

2.3 Landowner interviews

We visited each property to interview the landowner entitled to make decisions; in the case of couples, they decided who would be interviewed. Our study was conducted in accordance with the standards of the Human Ethics Committee of the State University of Goiás (approval number 66096317.5.0000.8113), and we explained that the conversation would be recorded for future analyses.

We drew up a questionnaire with open-ended questions to use in the survey face-to-face interviews (Supplementary Material A). The same questionnaire was used in the pretest and posttest interviews. We did a pilot at the beginning of the research with six landowners and verified that the questionnaire was comprehensible and achieved the research objectives. In this study, we used the following information:

- i. Personal information: name, age, education;
- ii. Property information: size, activities, products for sale, if there are protected areas on the farm;
- iii. Information and perceptions of the SNF: name of this public PA, activities developed in it, advantages/disadvantages of having property near to this public PA. From the answers to the last question, we could infer the ESs associated with the SNF.
- iv. Perception of ESs provided by private protected areas: advantages/disadvantages of having native areas on properties; benefits for the crops, cattle husbandry, and orchards. In relation to

agricultural activities, a set of images was used to illustrate the questions (Supplementary Material B). For example, to evaluate the perception of ESs impacting crops, two images were showed: a soybean field near to a native area/the same soybean field without native area. The interviewees were informed that they could think of other agricultural crops, like corn or beans, according to their agriculture experience. After this, they were asked if the production would be the same or different in the two images and the reasons for the differences. From the reasons presented by landowners, we could infer the ESs provided by native areas associated with agricultural activities. All images were digitally manipulated to allow comparison.

v. Ecosystem services connected with environmental maintenance: here, we also used paired images (Supplementary Material B) to allow farmers to demonstrate their perception of differences in spring and stream maintenance with the presence and absence of native vegetation.

vi. Comprehension of the ES concept: two question were asked— if the farmer had already heard about ecosystem services and if he/she could explain the meaning.

At the end of the posttest interviews, we also asked landowners that participated in the intervention what they remembered from the workshop, to better understand what kind of information was retained by them.

2.4. Implementation of intervention — the workshop

It is a challenge to promote educational events with landowners in Brazil, mainly when they need to leave their houses voluntarily. To enhance the success of our workshop, we personally visited all landowners three weeks before the event to invite them. In the week of the workshop, we phoned them to reinforce the invitation.

The workshop was entitled “Ecosystem Services on Rural Properties: Environmental and Economic Gains” and hosted at the SNF headquarters on September 30, 2017. About 100 people participated, among them 25 landowners who interviewed in our pretest, as well as their relatives, and a number of undergraduate students, and teachers from Silvânia. Everything was organized to provide participants an immersion day in the SNF with a discussion of ESs and the conservation of native biodiversity. The workshop started at 9 AM and ended at 4 PM. The following issues were presented: i. information about the SNF (history, activities developed, its role in biodiversity conservation); ii. the Cerrado biome and its role in water provision; iii. the protected areas on private properties; iv. ESs (concept and types); v. ESs benefiting rural properties — pollination, pest control, water purification, and climate regulation. The last item

focused on animal welfare, mainly in cattle raising. We based the entire workshop on information extracted from scientific papers and academic reports. They were cited during the workshop so that participants understood that the arguments presented were founded on scientific literature. We also discussed termites in their role in the nutrient cycle, because we had previous information that farmers had an interest in understanding more about these insects, considered by them to be agricultural pests. Examples of ESs provided by native biodiversity were used throughout the workshop, such as the bat *Glossophaga soricina*, the pollinator of the *pequizeiro*, a tree whose fleshy seed (*pequi*) is much appreciated in regional cooking. Participants could also see an exhibition of bees, termites, and anurans from the region. They also visited the seedling nursery and chose a seedling of a native tree to take home.

2.5 Data tabulation and organization

We listened to all interviews (pretest and posttest) to tabulate the data. The personal and property information, the name given to the SNF, and the perception of changes or lack of changes in the agricultural activities were easily extracted from the answers. Other questions, however, demanded a process of interpretation and categorization that was based on the presence of some keywords and key-phrases and the context of landowners' replies. For example, we identified six categories related to activities developed in the SNF (preservation, nursery of seedlings, education, research, release of animals, and supervision). We also interpreted landowners' answers to identify which ESs were perceived concerning the SNF and the native areas protected on farms. For this, we used as a reference the Millennium Ecosystem Assessment ESs classification (MEA 2005). In Supplementary Material C and D we provide examples of the statements/words spoken by landowners and the corresponding categorization into ESs.

In the two complementary questions used to assess the benefits provided by native areas on farms (questions 13 and 19, Supplementary Material A), we considered as a single occurrence when the same ES was identified in both cases. The perception of the impacts of native areas on rural production was made separately for the crop, cattle raising, and orchard pictures. We categorized the response as 1 if the landowner perceived an increase in production due to native areas, and as 0 if he/she didn't perceive a difference or did not know. In relation to environmental maintenance, we chose a descriptive approach, because of the high frequency of positive perception of native areas in maintaining springs and streams. We also compared

the landowners' conceptualization of ESs with MEA (2005), which emphasizes the benefits that people obtain from ecosystems.

To test our predictions, we organized the data as demonstrated in Table 1:

Table 1: Data organization for testing predictions.

Participation in the workshop increased	Data	Type of data
Knowledge of the SNF and perception of ESs	proper name given to the SNF	categorical (presence/absence)
	activities developed in the SNF	quantitative (number of activities)
	advantages in having a property near to the SNF	quantitative (number of advantages)
Perception of ESs related to private PAs	ESs interpreted from answers benefiting crop cultivation	quantitative (number of ESs) categorical (yes/no)
	ESs related to crop cultivation benefiting cattle raising	quantitative (number of ESs) categorical (yes/no)
	ESs related to cattle raising benefiting orchard	quantitative (number of ESs) categorical (yes/no)
	ESs related to orchard	quantitative (number of ESs)
	ESs related to springs	descriptive
	ESs related to streams	descriptive
Perception of ESs discussed in the workshop	pollination	categorical (presence/absence)*
	pest control	categorical (presence/absence)*
	climate regulation	categorical (presence/absence)*
	water purification	categorical (presence/absence)
Perception of ESs indicated during the interview	ESs interpreted from answers	quantitative (number of ESs)
Comprehension of ES concept	If he/she had already heard of ESs	categorical (presence/absence)

* They were initially added, but due to the low frequencies, we converted to presence/absence data.

We also analyzed the responses of landowners to their workshop memories and categorized them to present a descriptive perspective.

2.6 Data Analysis

To test our hypothesis that the workshop affected the farmers' perception of the SNF and their private PAs, we considered each landowner as a sample. In the cases where the response variable was quantitative, we used Repeated Measures Anova, comparing the results between the pretest and posttest for the experimental and control groups, controlling for each individual (Zar, 2010). To evaluate how the workshop affected perception, we analyzed the

interaction between “stage” (pretest and posttest) and “intervention” (experimental and control groups). If the interaction was significant, we could affirm that the workshop caused the change.

Regarding categorical response variables, we initially evaluated whether each respondent changed his/her answer, since our aim was to understand whether the workshop promoted increases in perception and knowledge. For example, if he/she perceived pollination on a particular question on the posttest but did not in the same question on the pretest, the difference was 1 and it was indicative of workshop effect. We considered that change did not occur if he/she answered in the same way in both stages, or the change was negative when there was positive response only on the pretest (in both cases we concluded that the workshop did not affect perception). This approach allowed us to use the chi-square test to evaluate if there were differences in perception between the experimental and control groups, pairing each individual from the sample. In the significant chi-square cases, we added the cases where there was no change to the cases where there was negative change in order to compare against positive change in a 2 x 2 contingency table (Zar, 2010).

2.7. Landowner and farm characteristics

In this research, 84.0% of the landowners were men, and 15.9% were women; 56.5% were, in 2017, between 30 and 59 years old; and 43.5% were 60 years old or more. With regard to education, 14.5% had no schooling or incomplete elementary school, 17.4% completed elementary school; 11.6% middle school, 29.0% high school, 17.4% college, and 10.1% postgraduate studies. In general, our sample of 69 landowners reflected the social characteristics of farmers in Silvânia in relation to gender and education. However, in our sample there are more older landowners and those with postgraduate degrees.

The 69 landowners in this research had farms that occupied 6,210.56 ha in Silvânia. 82.6% of the properties are considered small farms, measuring up to 120 ha ($\mu = 22.7 \text{ ha} \pm 6.0$); 10.1% are medium properties with sizes up to 450 ha ($\mu = 279.1 \text{ ha} \pm 50.4$); and 7.2% are large farms, measuring more than 450 ha ($\mu = 569.3 \text{ ha} \pm 110.9$). On these properties it was common to find orchards (88.4%), vegetable gardens (73.9%), corn (65.2%), cassava (59.4%), guerobas, palm trees native to the Cerrado, (36.3%), beans (21.7%) and eucalypti (17.4%). In relation to animal husbandry, chicken (79.7%) and cattle (78.3%) were frequent on these properties. Soybeans were cultivated on only 5.8% of the properties, but large areas were occupied by this commodity on the medium and large properties. In addition, 18.8% of farmers leased land for

soybean cultivation. On 73.9% of the farms, the landowners sold some agricultural products, with milk being the most common (33.3%).

3. Results

3.1. Perception of the SNF

The workshop did not promote any change in correct naming of the SNF (24.0% positive change in the experimental group and 13.6% in the control group; $\chi^2 = 1.472$; $df = 2$; $p = 0.479$). However, the workshop participants cited more activities developed in the SNF (interaction stage and intervention: $F = 5.64$; $df = 1$; $p = 0.021$; Figure 2). The workshop also did not affect the perception of the number of advantages of having the property near to the SNF (interaction stage and intervention: $F = 2.31$; $df = 1$; $p = 0.134$; Figure 2), but we observed that in pretest the experimental group already had a greater perception in this area (intervention: $F = 9.55$; $df = 1$; $p < 0.01$) and both groups perceived more advantages in the posttest (stage: $F = 10.69$; $df = 1$; $p < 0.01$). Among the workshop participants, the seedling nursery of was the activity most cited in the posttest (85.7%), and the sensation of supervision was the most frequently perceived advantage (45.8%). The frequency of responses of each question is available in Supplementary Material E.

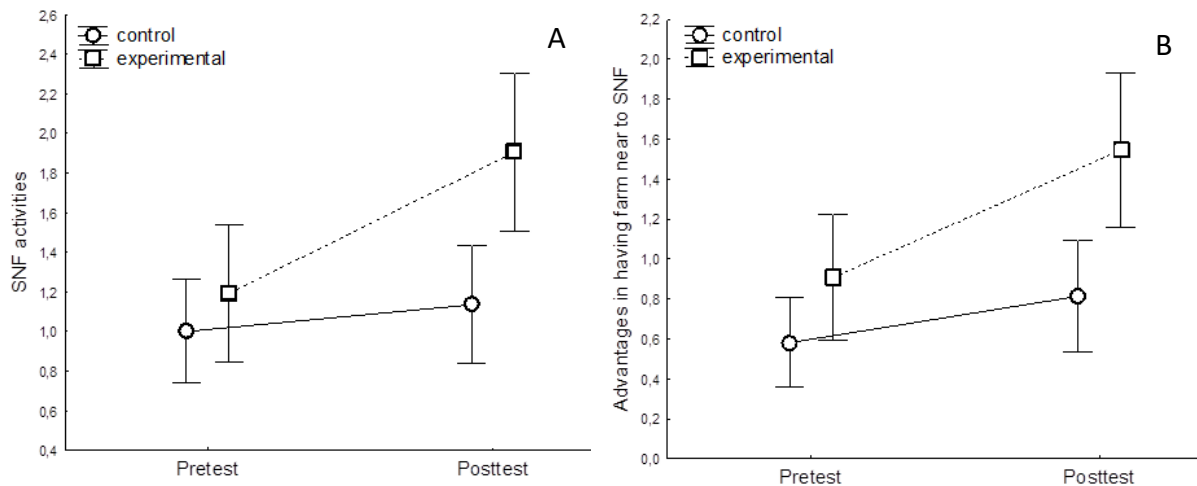


Figure 2: Results of Anova Repeated Measures in the pretest and posttest for experimental and control groups. A – number of activities developed in the SNF; B – number of advantages of having the farm near to the SNF.

3.2. Perception of ESs related to private PAs

The workshop did not affect the experimental group's perception of the number of ESs associated with private PAs (interaction stage and intervention: $F = 0.23$; $df = 1$; $p = 0.634$;

Figure 3A). Here we noted that the experimental group already had a higher perception in the pretest than the control group (intervention: $F = 4.68$; $df = 1$; $p < 0.03$) and both increased their perception in the posttest (stage: $F = 22.94$; $df = 1$; $p < 0.01$). The provision of water was the ES most associated with native areas (88.0% of the experimental group in the posttest), followed by climate regulation (64.0%), and aesthetic beauty (32.0%). In this particular question, we noted that the experimental and control groups both increased their perception of ESs related to native areas (Figure 3A). The frequency of ESs interpreted from farmers' answers are available in Supplementary Material E.

The educational intervention also did not change landowners' perception of ESs provided by private PAs in improving production of crops (20.0% of the experimental group showed positive change, compared with 16.3% in the control group; $\chi^2 = 1.288$; $df = 2$; $p = 0.525$), cattle (8.0% positive change in the experimental group, and 18.2% in the control group; $\chi^2 = 1.377$; $df = 2$; $p = 0.502$), or orchards (16.0% positive change in the experimental group, and 18.6% in the control group; $\chi^2 = 0.124$; $df = 2$; $p = 0.939$). The workshop did not affect the number of ESs associated with native areas improving crop production (interaction stage and intervention: $F = 3.41$; $df = 1$; $p = 0.069$; Figure 3B), or cattle beef/milk production (interaction stage and intervention: $F = 0.38$; $df = 1$; $p = 0.542$; Figure 3C). Here we noted an increase in perception in both groups in the posttest of ESs associated with crops (stage: $F = 7.02$; $df = 1$; $p = 0.01$) and with cattle (stage: $F = 15.48$; $df = 1$; $p < 0.01$). However, participants in the workshop associated more ESs with orchards (interaction stage and intervention: $F = 5.04$; $df = 1$; $p = 0.028$; Figure 3D).

In our study, the landowners had a high perception of the benefits of native areas to springs and streams. In the posttest, all of the farmers in the experimental group indicated that native areas helped to maintain the springs and streams, while this frequency was 90.9% for springs, and 97.7% for streams in the control group.

B

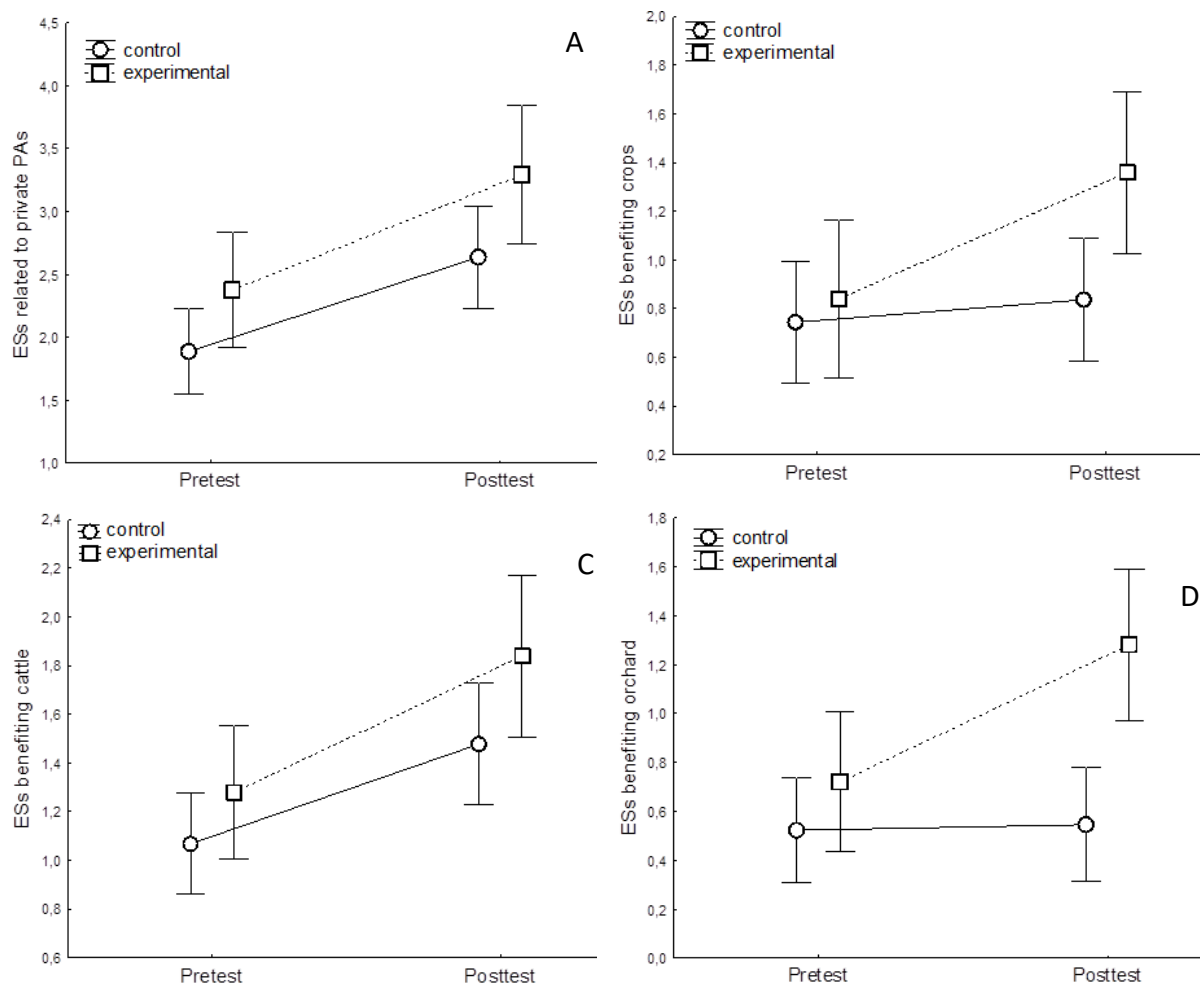


Figure 3: Results of Anova Repeated Measures in the pretest and posttest for experimental and control groups. A – number of ESs related to private PAs; B – number of ESs related to the increase in crop production; B – number of ESs related to the increase in crop production; C – number of ESs related to the increase in beef/milk production; D – number of ESs related to the increase in orchard production.

3.3. ESs discussed in the workshop, and those inferred from the interview

The workshop was effective in increasing landowners' perception of pollination, since 36.6% of the experimental group showed a positive change, as opposed to 9.1% in the control group ($\chi^2 = 7.549$; $df = 1$; $p = 0.006$). However, the change in the perception of pest control was the same among workshop participants and nonparticipants ($\chi^2 = 4.585$; $df = 2$; $p = 0.101$), and the same was true of climate regulation benefiting cattle welfare ($\chi^2 = 0.886$; $df = 2$; $p = 0.101$). Water purification was a very rare ES in the interviews. We did not identify it in any interview of the experimental group and it occurred in only 4.5% of the control group in the posttest (Supplementary Material E).

The workshop had an effect on landowners' broad perception of ESs. We could identify 2.9 more ESs in the posttest interviews with those in the experimental group than with those in the control group (interaction stage and intervention: $F = 8.36$; $df = 1$; $p < 0.01$; Figure 4).

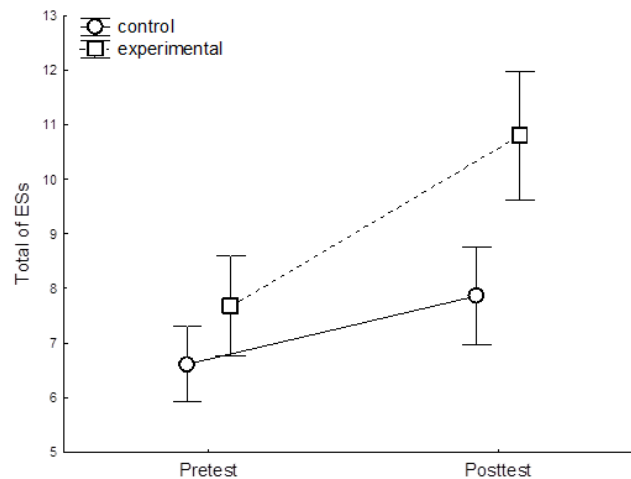


Figure 4: Result of Anova Repeated Measures in the pretest and posttest for experimental and control groups regarding the total of ESs identified during the interview.

3.4. Comprehension of the ES concept

The workshop provided an opportunity for farmers acquainted with the ES concept; 37.5% of the experimental group showed a positive change, affirming exclusively in the posttest that they had already heard the term, as opposed to 7.7% in the control group ($\chi^2 = 8.561$; $df = 1$; $p < 0.01$). However, despite the presentation of the concept, in addition to several explanations and examples presented in the workshop, no farmer showed an ES definition related to the idea of the benefits that people receive from the ecosystems.

3.5. Learning in the workshop

Some ESs and examples discussed in the workshop were remembered by farmers in the posttest interviews. The most remarkable example was the pollination of pequi by native species of bats, cited by 52% of the farmers. Two respondents affirmed that they stopped killing the bats to improve pequi production. Another said, “The pequi is full of pequi because the bats are working a lot.” Some of them explained the pollination process: “We eat pequi because the bat goes in the pequi’s flowers and goes to another and makes pequi. I grew up on the farm and had never paid attention to this.” Bees as pollinators were remembered by 44% of respondents, who cited examples related to tomatoes, passion fruit and soybeans, all of which were discussed in the workshop. Termites were another topic that generated interest and was

cited by 44% of farmers, as in this sentence: “Termites made a big impression on me, because I thought they were undesirable pests, but in reality, they have their usefulness.” The importance of the Cerrado biome in water infiltration was mentioned by 32% of farmers, who particularly remembered the deep roots of the trees: “The cerrado trees have deep roots. The rain goes down through the roots, which help to keep the water.” The role of vegetation in cattle welfare (12%), the loss of bees due to excessive use of pesticides (12%), a holotype frog of the SNF (12%), and the animals found in the SNF (12%) were also spontaneously remembered by some participants in the workshop.

4. Discussion

Our findings revealed that educational activity affected some of the indicators used to assess landowners’ perception of public and private PAs. The workshop participants identified more activities developed in the SNF, associated more ESs with orchards, were more aware of pollination, and enlarged their perception, recognizing more ESs. We consider that two aspects of the workshop were crucial in these outcomes: holding the event at the SNF headquarters, and using examples to explain the ecological processes based on local native biodiversity.

The workshop encouraged farmers and their families to visit the SNF and have a better comprehension of the work done in this PA. It is important to promote events to attract the local community to increase the positive interaction between local people and PAs (Allendorf et al., 2017). Environmental education, farmers’ workshops, tourism, and cultural activities are all possibilities for engaging local people to visit PAs and better understand their importance. In any cultural or educational activity it is interesting to insert some level of information about the role of the PA in protecting biodiversity and maintaining ESs essential to human well-being, because local communities have a more positive attitude in relation to PAs when they understand the benefits of conservation (Allendorf and Yang, 2013; Dewu and Røskaft, 2018; Sirivongs and Tsuchiya, 2012). For this, studies evaluating the ESs provided by PAs, as well as the evaluation of the impact of PAs on human well-being, as performed by Bonet-García et al. (2015), should be fostered. With this kind of information, PAs can look beyond their borders, promoting better dialogue with local communities, including their demands and expanding partnerships (Dudley et al., 2014).

Pollination is an ES with enormous pedagogical potential: it is easy to explain, it is observable, its result, the fruit, is tangible. In our research some farmers said, “Trees don’t like

to be alone,” expressing the idea that plants of the same species need to be close together for fruit production. However, farmers don’t necessarily comprehend the ecological processes underpinning pollination and how it benefits crop production (Munyuli, 2011). The link between biodiversity and pollination is particularly based on bees, often pollinators of plants in orchards and vegetable gardens (Giannini et al., 2015). It is necessary to invest in educational strategies for landowners to understand the pollination process and enlarge their knowledge of the different kinds of pollinators. Pollination can be a gateway for farmers (and rural people in general) to understand the ES concept and certain ecological processes. After the establishment of a conceptual basis, it is possible to expand to the other examples of ESs so important to maintenance of rural activities and human well-being. In our workshop, the farmers were amazed to discover that a bat was responsible for production of a fruit that is much appreciated in regional cuisine. In India, for example, rural people understand the benefits of fruit bats in seed dispersion and pollination and perceive direct and indirect benefits in cashew or areca seed collection (Deshpande and Kelkar, 2015). These examples reveal an interesting point: educational initiatives may invest in emblematic illustrations to spread the knowledge of ESs. Species with medicinal, ornamental, culinary, or economic appeal could be a way of awakening interest in the local people in better understanding the ecological processes underpinning ESs and how they affect the production in orchards, vegetable gardens, and plantations.

The ES concept is unfamiliar to farmers (Bernués et al., 2016; Logsdon et al., 2015), and our study reveals that a single educational activity did not affect the appropriation of the concept. But the workshop allowed farmers to have a broader perception of ESs associated with native areas. Bhattacharyya et al. (2017) also found an increase in perception of native bees after an educational workshop. Considering local ecological knowledge as a cumulative body consisting of both traditional experience and scientific learning (Tengö and Belfrage, 2016), an educational program of ESs with continuous and varied activities enhances the potential to integrate the scientific knowledge of ESs into farmers’ mindsets. In fact, any educational activity needs firstly to understand the local ecological knowledge associated with ESs: what farmers know, how they explain ecological processes, what species are connected with ESs. For this, it is fundamental to foster research into local ecological knowledge of ESs (Rawluk and Saunders, 2019). The challenge is to allow farmers to build ecological knowledge from their traditional knowledge, which is rich in practice and experience, and scientific knowledge that in turn enables the explanation of ecological processes from a theoretical perspective. Theory and practice can enable farmers to understand ESs in factual observations and infer

them, building causal links, in a variety of contexts. Wyckhuys (2010) found evidence of this: Honduran farmers that understood the ecological process of natural enemies were familiar with more pest management practices. Thus, it is necessary to approach the cultivation of local ecological knowledge as a process of conceptual reconstruction from interactions between spontaneous and scientific concepts (Vigotski, 1991). Farmers also learn better through practical activities (Pan et al., 2017), so active learning strategies are critical to success. Field visits, experiments with pollination, nutrient cycling, water filtration and pest control are examples of activities that make ecological processes more tangible.

Some of our analyses reveal that farmers in the experimental group already had a higher perception of ESs in some topics evaluated, compared to farmers in the control group. The lack of randomization in forming the two groups favored this bias, remembering that the experimental group consisted of those farmers that voluntarily participated in the workshop. This leads us to assume that farmers interested in educational activities are already more concerned with environmental issues on their properties. Another interesting point found is a possible seasonal effect on perception: in some topics assessed, the control group presented a higher perception in posttest, compared to their pretest. The pretest was realized during the beginning of the dry season, while the posttest took place after this period. The climatic seasonality is experienced by farmers each year, but it is possible that recent memories of the lack of rain impacted the perception of ESs, mainly those related to climate regulation. Seasonal conditions have been considered in studies of perception (Kross et al., 2018), mainly when the assessment of ESs included those associated with water regime (Greenland-Smith et al., 2016). Another possible explanation for the increase in the perception in both groups is instrument reactivity (Vaus, 2001), because farmers answered the same questions in the pretest and posttest. However, we consider that this did not occur because the posttest was applied at least four months after the first measurement. Besides this, during the posttest, only one farmer identified the similarity between the two interviews. The experimental design adopted in this study, with pretest and posttest applied to experimental and control groups, allowed us to identify these idiosyncrasies in our research and to confidently assert that the changes observed in perceptions were due to the workshop (Babbie, 2011).

Around the world, farmers perceive forests as sources of ESs (Ahammad et al., 2019; Allendorf et al., 2018; Allendorf and Yang, 2017; Caceres et al., 2015; Muhamad et al., 2014), and frequently have a more complex perception than external stakeholders, such as tourists (Teixeira et al., 2019). They take their perception and knowledge of ESs into account in

decision processes (Lamarque et al., 2014). Aside from this, knowledge and perception are important variables in determining local people's attitudes in relation to PAs (Bragagnolo et al., 2016). Thus, understanding the benefits provided by private or public PAs is a way to increase positive attitudes. Thinking in an agricultural context, it is a challenge to researchers and public PA managers to understand farmers' demands to develop actionable knowledge, a context-specific knowledge to support stakeholders in their decisions to promote an ecological intensification of agriculture (Geertsema et al., 2016). Improving farmers' knowledge and perception of ESs is a necessary step in building actionable knowledge, because they need to understand which ESs are needed for agricultural activities and how they can improve them on their properties.

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Supplementary Material

A - Questionnaire used in face-to-face interviews

PERSONAL INFORMATION
1. Name:
2. Age:
3. Education:
INFORMATION ABOUT THE RURAL PROPERTY
4. Name of the rural property:
6. Size of rural property:
7. What are the agricultural activities carried out on the property?
8. Which of your agricultural products do you sell?
9. Does the property have areas of native forest/cerrado? Are there legal reserves and/or permanent preservation area?
PUBLIC PROTECTED AREA
10. Have you heard about the federal protected area in this region? Do you know its name?
11. What is done in this protected area?
12. Has the protected area near to your farm brought any advantages or disadvantages?
ECOSYSTEM SERVICES AND NATIVE AREAS
<i>(Perception of advantages/disadvantages – question 1)</i>
13. Do protected native areas on the farm bring any advantages or disadvantages?
<i>(ESs and rural production)</i>
14. In these two pictures there are soybean plantations. Will the two plantations have the same or different production? Why?
<i>(ESs and rural activities)</i>
15. In these two pictures there are cattle in the pastures. In the two pictures will the cattle have the same or different production of milk/beef? Why?
<i>(ESs and rural activities)</i>
16. In these two pictures there are orchards. Will the two orchards have the same or different fruit production? Why?
<i>(Perception of advantages/disadvantages – question 2)</i>
17. What would change if native areas did not exist on the farm?
<i>(ESs and environment maintenance)</i>
18. In these two pictures there are streams and their banks. After a heavy rain, will the consequences in those areas be the same or different?
<i>(ESs and environment maintenance)</i>
19. In these two pictures there are streams near the houses. Are these springs the same or different? Why?
<i>(General perception of ESs)</i>
20. What would change if native areas did not exist on the farm?
<i>(ES concept)</i>
21. Have you heard about ecosystem/environmental services? Could you explain what they are?

B. Paired pictures used in the interviews

Paired pictures used to evaluate the perception of ESs provided by native areas impacting rural activities.



A1. Soybean plantation

Source of image used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/1/1d/Cultivo_de_soja.jpg



A2. Soybean plantation with nearby native vegetation

Source of images used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/1/1d/Cultivo_de_soja.jpg
https://cdn.pixabay.com/photo/2014/09/23/17/47/horizon-457991_960_720.jpg



B1. Cattle in the pasture

Source of images used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/9/94/Gado_Nelore_em_aten%C3%A7%C3%A3o_-_panoramio.jpg
<https://pxhere.com/pt/photo/591425>



B2. Cattle in the pasture near to native vegetation

Source of image used in edited picture:
https://upload.wikimedia.org/wikipedia/commons/9/94/Gado_Nelore_em_aten%C3%A7%C3%A3o_-_panoramio.jpg



C1. Orchard

Source of image: personal archive



C2. Orchard near to native vegetation

Source of images used in edited picture:
Personal archive
https://upload.wikimedia.org/wikipedia/commons/3/3f/Cerrado_Parque_Estadual_dos_Pirineus.jpg

Paired pictures used to evaluate the perception of ESs provide by native areas affecting environmental maintenance



D1. Spring on property with little native vegetation

Sources of images used in edited picture:
<https://images.pexels.com/photos/1638383/pexels-photo1638383.jpeg?cs=srgb&dl=aerofotografia-agricultura-ao-ar-livre-1638383.jpg&fm=jpg>
https://www.webharas.com.br/painel/core/fotos/foto_44026.jpg



D2. Spring in the property with lots of native vegetation

Source of image used in edited picture:
<https://images.pexels.com/photos/1638383/pexels-photo1638383.jpeg?cs=srgb&dl=aerofotografia-agricultura-ao-ar-livre-1638383.jpg&fm=jpg>



E1. Stream without riparian vegetation

Source of image used in edited picture:
[http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar\(3\).jpg](http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar(3).jpg)



E1. Stream with riparian vegetation

Sources of images used in edited picture:
[http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar\(3\).jpg](http://folharibeiraopires.com.br/userfiles/1628_Mata%20Ciliar(3).jpg)
https://upload.wikimedia.org/wikipedia/commons/c/c/C%C3%B3rrego_Piraju%C3%A7ara_1.JPG
<https://s3.amazonaws.com/igui-ecologia/wp-content/uploads/2017/04/mata-ciliar.jpg>
https://www.jornalspnorte.com.br/enviados/2015/07/3107_corrego-tremembe.jpg

C. Codification of SNF perception from landowners' answers during the interview.

What is done in the SNF?	Categories
biological reserve to protect the Cerrado; a preserved area to improve environmental quality; caring for the environment; preserve the forest and the animals	Preservation
making seedlings; it is a nursery of seedlings; it produces native plants of Cerrado	Nursery of seedlings
the schools take the children; they make people aware of preservation; they teach fire safety and prevention; they advise the neighbors	Education
research is done by universities; studies are done	Research
they release native animals; they release animals captured in other places	Release of animals
they check to see if the people are not deforesting; they fine; they inspect the farms; if someone is cutting a tree and they are called, they will see; inspection	Supervision
Advantages of having SNF near to farm	Categories of perceived benefits
preservation of animals because it is a refuge; protect the environment; it is a model for preservation; have nature close to me; preserve nature; preserve native animals; environmental reserve; they preserve; protect the Cerrado biome; it is a preserved area; the animals would be extinct in the region if it did not exist; endangered animals are there; there are more animals in the region	Preservation
water maintenance; it helps to maintain water	Provisioning and maintenance of water
to receive information; to participate in events promoted by Flona; to ask about environmental things; provide information; they are always in contact with neighbors; easy access to information to answer questions	Education
the people are more fearful of doing wrong things; if the reserve did not exist, there	Sense of supervision

would be no forest in the region; if the reserve did not exist, the people would deforested everything; with their presence, people do not cut trees; the people have respect and do not kill animals; the people preserve more because they are apprehensive; they also protect the surroundings of Flona; they help my farm avoid poachers and deforestation; the dump was not installed in our region because of the existence of the reserve; no invasions or predation	
there are more natural enemies	Pest regulation
it cools the region; it helps the climate	Climate regulation - temperature
it helps the rain in the region	Climate regulation - precipitation
we can buy cheaper seedlings; they donate seedlings	Plant seedlings
it helps to maintain soil humidity	Soil humidity
it purifies the air; it helps with the oxygenation of the air	Air quality regulation
Disadvantages of having SNF near to the farm	Categories of perceived harm
animals that live there eat the farm chickens; they released animals and they come to our farm and disturb us	Disturbance caused by native animals
excessive inspection; in this region they inspect a lot, while in other places things happen and they do not go	Inspection
we are in the buffer zone and this restricts our activities; if there is expansion in the future, our farms will be expropriated; we have difficulty expanding our productive activities	Buffer zone

D. Codification of ESs from landowners' answers during the interview.

Statements about perception of native areas perception presented by landowners during the interviews	Corresponding Ecosystem Service identified based on MEA approach
more beauty, more beautiful farm, the region is more beautiful, the forest is a charm, I like the scenery, the farm would be sadder if there was only cultivation, the family would not come to visit	Aesthetic value
cleaner air, purer air, improves air oxygenation	Air quality regulation
food for cattle, the cattle eat leaves from the forest, complements the cattle feed, natural feed for the cattle	Cattle feed
more rain, helps the rain, rains more in the region, less forest is causing lack of rain, attraction of rain, brings the rain, greater rainfall	Climate regulation: precipitation
shade, cooler, cattle look for shade, cattle like shade, cattle need shade, refreshing the land	Climate regulation: temperature
the farm and its forest have been in the family for years, the conserved forest is an inheritance, the forest will benefit the children and grandchildren	Cultural heritage
erosion, rain pulls down the ravine, rain washes the land, rain comes down hard strong and removes the soil, rain carries the soil, the roots of the trees fix the soil, it will damage the bank of the river, the ravine will be eaten away, helps to preserve the ravine, forest protects the soil, trees hold the ravine	Erosion regulation
helps in the production of honey	Honey
native animals cited beautifying the farm, native animals that appear on the farm and are admired, maintenance of native animals, native plants found, I like to see the native animals or plants in the forest on farm, forests bring animals, enjoy the native animals eating in the woods, I preserve native animals and plants	Inspiration (presence of biodiversity)
natural enemies, insects instead of going to the plantation go to the forest, helps to control pests, critters stay in the forest, pests stay in the forest, the forest absorbs the pests, protect from the arrival of the insects, barrier against insects, helps ward off fruit insects, less infestation of predatory insects, increases natural enemies	Pest regulation
pollination, bees come to pollinate, bees takes the pollen from one plant to another,	Pollination
more fertile soil, soil stays better, soil nutrients, soil provides nutrients to plants, soil compost	Soil fertility
moister soil, soil stays less dry, keeps water in the soil, forest keeps water	Soil humidity
sedimentation, clogs the stream, the stream becomes shallow, streams are filling with sand	Stream silting regulation
production of water, preserves water, there is more water, protects water, protects the source of the streams, without	Water provision

the forest the spring dries up, farm with more moisture, where there is a forest the water doesn't dry up, water penetrates the soil	
cleaner water, purer water	Water purification
barrier against the wind, less wind, protected from the wind	Wind break

E. Frequency of categories investigated

1. Frequency of names given by landowners to the Silvânia National Forest. Control (n=44) and experimental (n=25) groups, before and after the educational intervention.

Names	Control		Experimental	
	Before	After	Before	After
National Forest	34,1	34,1	44,0	60,0
Garden	63,6	63,6	60,0	48,0
IBAMA	36,3	29,6	36,0	36,0
ICMBio	2,3	4,5	0,0	16,0
EFLEX	0,0	6,8	0,0	4,4

2. Frequency of activities developed in Silvânia National Forest according to landowners interviewed. Control (n=44) and experimental (n=25) groups, before and after the educational intervention.

Activities	Control		Experimental	
	Before	After	Before	After
Education	9,1	2,9	16,0	4,8
Nursery of seedlings	27,3	48,6	52,0	85,7
Preservation	36,4	42,9	40,0	52,4
Release of animals	4,5	8,6	4,0	4,8
Research	11,4	11,4	4,0	33,3
Supervision	6,8	5,7	0,0	9,5

3. Frequency of advantages in having a property near to Silvânia National Forest, interpreted from landowners' answers. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Advantages	Control		Experimental	
	Before	After	Before	After
Air quality regulation	0,0	4,5	4,3	8,3
Biodiversity	14,0	9,1	17,4	12,5
Climate regulation: precipitation	0,0	0,0	4,3	8,3
Climate regulation: temperature	0,0	4,5	4,3	4,2
Education	9,3	15,9	8,7	20,8
Pest regulation	0,0	0,0	0,0	4,2
Plant seedlings	2,3	4,5	8,7	4,2
Preservation	18,6	22,7	21,7	33,3
Supervision	7,0	11,4	8,7	45,8
Water provision	2,3	6,8	4,3	8,3

4. Frequency of ESs interpreted from landowners' answers in relation to advantages in having protected areas on their properties. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem Services	Control		Experimental	
	Before	After	Before	After
Aesthetic value	20,5	34,1	20,8	32,0
Air quality regulation	13,6	15,9	20,8	24,0
Biodiversity	27,3	31,8	33,3	36,0
Climate regulation: precipitation	6,8	13,6	12,5	12,0
Climate regulation: temperature	18,2	40,9	41,7	64,0
Cultural heritage	4,8	0,0	0,0	8,3
Erosion regulation	11,4	11,4	12,5	8,0
Honey production	2,3	2,3	0,0	0,0
Increases production	0,0	2,3	0,0	4,0
Pest regulation	2,6	2,3	0,0	12,0
Pollination	0,0	0,0	0,0	8,0
Ecosystem services	0,0	0,0	0,0	4,0
Soil fertility	7,5	15,9	4,3	16,0
Water provision	72,7	70,5	75,0	84,0
Wind break	2,5	22,7	13,0	20,0

5. Frequency of ESs interpreted from landowners' answers perceived as benefits to crop cultivation. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem Service	Control		Experimental	
	Before	After	Before	After
Climate regulation: precipitation	9,3	9,1	4,0	0,0
Climate regulation: temperature	4,7	9,1	0,0	8,0
Erosion regulation	4,7	2,3	0,0	12,0
Pest regulation	27,9	22,7	36,0	40,0
Pollination	0,0	4,5	0,0	8,0
Soil fertility	0,0	0,0	0,0	8,0
Soil humidity	16,3	27,3	24,0	44,0
Wind break	11,6	4,5	20,0	16,0

6. Frequency of ES interpreted from landowners' answers perceived as benefits to cattle husbandry. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem service	Control		Experimental	
	Before	After	Before	After
Cattle feed	11,4	20,5	12,0	16,0
Climate regulation: temperature	75,0	77,3	88,0	92,0
Pest regulation	0,0	9,1	0,0	12,0
Pollination	0,0	0,0	0,0	12,0
Soil fertility	0,0	18,2	12,0	12,0
Soil humidity	2,3	15,9	12,0	24,0
Wind break	4,5	4,5	4,0	4,0

7. Frequency of ES interpreted from landowners' answers perceived as benefits to orchard. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem Service	Control		Experimental	
	Before	After	Before	After
Climate regulation: precipitation	0,0	0,0	20,0	4,0
Climate regulation: temperature	7,0	11,4	8,0	20,0
Erosion regulation	4,7	6,8	8,0	0,0
Pest regulation	11,6	4,5	12,0	12,0
Pollination	18,6	18,2	8,0	36,0
Soil fertility	0,0	0,0	0,0	8,0
Soil humidity	11,6	9,1	12,0	36,0
Wind break	0,0	2,3	0,0	12,0

8. Frequency of ES interpreted from landowners' answers perceived as benefits to streams. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem service	Control		Experimental	
	Before	After	Before	After
Erosion regulation	90,7	79,5	87,5	100,0
Stream silting regulation	20,9	22,7	33,3	41,7

9. Frequency of ES interpreted from landowners' answers perceived as benefits to springs. Control (n=44) an experimental (n=25) groups, before and after the educational intervention.

Ecosystem Service	Controle		Experimental	
	Before	After	Before	After
Water provision	97,7	93,2	100,0	100,0
Water purification	9,1	4,5	4,2	0,0

CAPÍTULO IV

ENTREVISTA É MAIS DO QUE FAZER PERGUNTAS: 10 DICAS SOBRE O QUE FAZER — E O QUE NÃO FAZER— NUMA PESQUISA DE *SURVEY*

Flávia Pereira Lima

O meu primeiro contato com a entrevista como método de pesquisa ocorreu em 2000 num estágio que realizei com a equipe de educação ambiental do Instituto de Pesquisas Ecológicas (IPÊ). Uma jovem e empolgada estudante de Biologia se viu diante de trabalhadores e trabalhadoras rurais em um assentamento rural em Teodoro Sampaio (SP), no entorno da unidade de conservação estadual Morro do Diabo. Os desafios dessa primeira experiência me fizeram perceber que eu levava jeito para entrevistar pessoas e confirmaram o meu interesse pelos aspectos sociais da biologia da conservação. No meu trabalho de conclusão de curso, em 2003, realizei entrevistas com a população de duas cidades de Minas Gerais vizinhas ao Parque Estadual do Rio Doce. O objetivo foi avaliar as percepções ambientais com relação às espécies exóticas de peixes (Lima et al., 2010). Usar as entrevistas como ferramenta de pesquisa tornou-se uma prática no meu trabalho e acumulei experiências do que fazer e também do que não fazer. No meu doutorado a entrevista também foi a forma de compreender a percepção de serviços ecossistêmicos de proprietários e proprietárias rurais do entorno da Floresta Nacional de Silvânia (GO), bem como a intenção em recompor áreas com vegetação nativa. Considero o questionário utilizado na tese o mais bem elaborado dentre os que já utilizei em minhas pesquisas, o que não impediu que eu caísse em armadilhas criadas por mim mesma.

Neste ensaio, compartilho a minha experiência em utilizar a entrevista como método de avaliação de percepção ambiental. Longe de esgotar um tema tão relevante, minha proposta aqui é oferecer algumas dicas de como realizar melhores entrevistas e utilizar o questionário de maneira mais efetiva.

Dica 1: Faça um cuidadoso delineamento da pesquisa

Ainda persiste a equivocada noção que para se fazer uma entrevista basta elaborar umas perguntas. Pois informo que está muito longe disso. A entrevista como método de pesquisa exige rigor em todas as etapas e é uma tarefa com desafios próprios.

Um problema comum enfrentado por quem utiliza a entrevista é não saber o que fazer com o conjunto enorme de dados coletados. Elabora-se um questionário repleto de perguntas, que demanda muito tempo, para, no final, não se utilizar grande parte dos dados. A base desse problema é a falta de um bom delineamento da pesquisa. Por isso, invista em definir o que se quer pesquisar, em elaborar o problema de pesquisa. Feito isso, a próxima pergunta deveria ser “qual a teoria ou teorias que suportam esse problema de pesquisa?” ou “Qual teoria vou testar?”. Ter conhecimento das teorias que suportam o seu trabalho é fundamental para todas as etapas, incluindo a elaboração do questionário. Qual a saída? Ler muito. É essencial fazer uma cuidadosa revisão de literatura para entender como o tema da sua pesquisa foi construído historicamente e como está sendo atualmente debatido pela comunidade científica. “Mas eu vou trabalhar com um tema superespecífico. Vou avaliar a percepção de comunidades tradicionais do interior de Goiás sobre plantas medicinais”. O seu tema pode parecer muito específico dado os sujeitos da pesquisa, mas com certeza há estudos parecidos já realizados, que vão ajudar a construir o seu *background* teórico. Por exemplo, qual a concepção de percepção está sendo utilizada nos estudos publicados? Qual delas você acredita ser mais adequada ao seu trabalho? Qual o conceito de comunidades tradicionais, conhecimento local? E por aí vai... Nós contamos com o Periódicos Capes com milhares de publicações disponíveis. É o *streaming* da Ciência, está tudo à mão! É fundamental aprender a fazer pesquisa no Web of Science, Scopus ou em outras plataformas para a busca de artigos. Invista em identificar as palavras-chaves mais adequadas para a busca; verifique quais são usadas nos artigos que você está lendo e faça testes. Interessante também é entrar nas revistas cujo escopo seja adequado à sua pesquisa e explorá-las. Isso ajuda a entender melhor a área de pesquisa, mesmo que a partir de uma única revista. Também me ajudou muito acessar os trabalhos citados por artigos que considerei muito relevantes. Confesso que em momentos tive a sensação de estar naquelas salas de vários espelhos que projetam sua imagem inúmeras vezes: parece que é infinito, um artigo vai puxando o outro. Por isso, é preciso também decidir o momento de parar a busca e começar a ler. Nada impede buscas no futuro, à medida que o trabalho necessitar disso.

A revisão da literatura vai permitir elaborar objetivos coerentes, construir hipóteses e, inclusive, ajudar a delinear adequadamente os instrumentos de coleta de dados. Foi lendo artigos que me deparei com a Teoria do Comportamento Planejado que utilizo na tese. O artigo nem testava em específico a teoria. Fui estudar e descobri que essa teoria nem era nova e já vinha sendo testada em várias áreas (uma rápida busca na Web of Science retornou mais de 5.000 artigos!). Tinha em minhas mãos uma teoria da psicologia social muito adequada às

minhas perguntas e isso me ajudou muito. Ao trabalhar com uma teoria bem estruturada, minhas perguntas ficaram bem estabelecidas e construir o questionário foi mais simples, pois eu sabia com clareza o que queria responder. Mas nem sempre é assim. Mesmo sem teorias bem estabelecidas é preciso ter clareza dos conceitos básicos que suportam a pesquisa para que o questionário seja elaborado da forma mais coerente possível.

Portanto, conheça a sua área de pesquisa, faça uma boa revisão de literatura e delinheie o problema de pesquisa. Se na pesquisa de *survey* há investigação de associação das variáveis, seja com interferência entre elas ou não, também é possível elaborar e testar hipóteses (Volpato, 2015). O estágio pré-empírico é essencial para se definir quais dados serão necessários e como coletá-los na fase denominada estágio empírico (Punch, 2003).

Dica 2: Conheça o público a ser entrevistado

Quem são as pessoas a serem entrevistadas na pesquisa? Serão professores, crianças, proprietários rurais, comunidades tradicionais, gestores etc.? Um questionário para uma criança, por exemplo, exige o uso de linguagem e abordagem adequadas. Podemos estender isso a qualquer público a ser pesquisado pois os contextos histórico, social, cultural e econômico vão influenciar como a pessoa entrevistada vai compreender o propósito da pesquisa e mesmo as questões. Portanto, ter conhecimento sobre quem são as pessoas pesquisadas permitirá a elaboração de perguntas mais adequadas e ajudará a modelar o comportamento de quem entrevista. Conhecer o público a ser pesquisado pode ser informativo, desde que não se informe nada sobre a pesquisa, de modo a não influenciar os dados. Mas isso não é uma condição essencial. Você pode acessar pessoas semelhantes àquelas da sua pesquisa em outras localidades e também se informar com outros pesquisadores que já tenham trabalhado com públicos semelhantes.

Dica 3: Invista na elaboração do questionário

É chegada a hora de elaborar o questionário. Os livros *International Handbook of Survey Methodology* (Leeuw et al., 2008), *Internet, Phone, Mail and Mixed-mode Surveys* (Dillman et al., 2014), *Survey Research: the basics* (Punch, 2003), *Método de pesquisa de survey* (Babbie, 2003), e *The Practice of Social Research* (Babbie, 2011), são ótimas fontes de estudo para a construção de *surveys* e trazem capítulos bem detalhados sobre a formulação de questionários.

Perceba que a palavra *survey* está no título da maioria destes livros. *Survey* é um tipo de pesquisa social na qual informação quantitativa é sistematicamente coletada de uma amostra

relativamente grande retirada de uma população (Leeuw et al., 2008). Na minha tese de doutorado, por exemplo, eu utilizei da pesquisa de *survey* para avaliar a percepção de produtores rurais sobre os serviços ecossistêmicos prestados pelas áreas nativas. Eu coletei informações quantitativas por meio de uma entrevista baseada em um questionário de uma amostra específica (proprietários e proprietárias rurais do entorno da Floresta Nacional de Silvânia).

Há duas formas de coletar dados numa pesquisa de *survey*: por meio de entrevistas ou por questionários autoadministrados (Babbie, 2011, 2003). A entrevista pode ser realizada por telefone ou presencialmente (*face-to-face interviews*). Dependendo dos objetivos da sua pesquisa (Veja a importância de defini-los bem!), você escolherá dentre as duas formas. A vantagem dos questionários autoadministrados é a possibilidade de se conseguir grandes amostras, pois ele pode até ser enviado por e-mail. Já as entrevistas proporcionam um aprofundamento sobre o tema pesquisado, mas demandam mais tempo e pessoas para realizá-las. Ambos os métodos podem ser utilizados na mesma pesquisa, a depender dos objetivos.

Surveys incluem o questionário como o instrumento sistematizado da coleta de dados. Nas entrevistas presenciais o questionário guia a interação entre quem entrevista e quem é entrevistado (Leeuw et al., 2008). Muitas das pesquisas de *survey* buscam avaliar conceitos complexos, como escolaridade, percepção, atitude, bem-estar, muitos dos quais não são diretamente mensurados (os chamados construtos ou variáveis latentes). O primeiro passo antes de mesmo de elaborar o questionário é operacionalizar cada conceito, que pode, inclusive, necessitar de um conjunto de questões (Dillman et al., 2014). Analise o objetivo do seu trabalho e as hipóteses, identificando os conceitos relacionados e identifique as variáveis associadas (Punch, 2003). Novamente, os artigos científicos serão importantes nessa fase de operacionalização. Por exemplo, como os trabalhos medem atitude da população local com relação às áreas protegidas? Ter os objetivos e os conceitos bem estabelecidos ajuda a avaliar o que realmente se quer medir, a não esquecer de uma pergunta que seja essencial e garantir que a pergunta esteja medindo aquilo que se espera (Dillman et al., 2014).

Na formulação do questionário pode-se escolher dentre questões fechadas, nas quais é dada ao entrevistado uma lista de respostas a ser selecionada, e questões abertas, na qual solicita-se a formulação das respostas (Babbie, 2011). As perguntas devem ser redigidas de forma simples e objetiva, potencializando o entendimento das pessoas entrevistadas. Evite palavras difíceis, ambíguas ou de sentido muito abrangente. Não elabore múltiplas perguntas numa só questão, ou perguntas com inúmeros pontos de vista. Não faça perguntas baseadas nas

suas suposições. Se for preciso usar algum termo técnico, explique-o na questão. Elabore questões que as pessoas sejam capazes de responder (ex. não pergunte às crianças informações que, provavelmente, seja de domínio dos familiares). Evite o uso de negativas na questão, pois isso dificulta a compreensão. E, finalmente, atente-se à ordem das questões; caso haja alguma questão que influencia outras, coloque-a no início do questionário (Babbie, 2011, 2003; Dillman et al., 2014; Leeuw et al., 2008). Esses são apenas alguns pontos que precisam ser levados em conta na elaboração do questionário. Há muito literatura que explica e exemplifica isso (os livros citados anteriormente trazem capítulos específicos sobre esse tópico).

Ainda é preciso ter atenção para não cair na armadilha de construir um questionário com demasiado número de questões, muitas das quais sequer serão utilizadas no estudo. A vontade é de perguntar cada vez mais, no entanto é preciso ponderar entre o objetivo da pesquisa, o tempo requisitado em cada entrevista e o tempo para tabular os dados. Sugiro o seguinte exercício: elaborada a primeira versão do questionário, avalie a pertinência de cada uma das perguntas. Para isso, retorne às hipóteses e à lista de variáveis operacionalizadas. Conecte cada uma de suas hipóteses e as variáveis necessárias para testá-las às perguntas do questionário. Assim, você terá um panorama se há perguntas adequadas e suficientes para testar as suas hipóteses. Cuidado com o “E se eu precisar também desse dado?”. Se você delineou bem o projeto, foque em responder às suas perguntas. Há situações em que o trabalho faz parte de uma pesquisa maior, nos quais os dados da entrevista serão utilizados por várias pessoas. Mesmo nesses casos é importante que os envolvidos elaborem questões que realmente serão utilizadas na pesquisa. É importante lembrar que estamos demandando tempo dos entrevistados e devemos usá-lo da forma mais eficiente possível.

Na tese eu fiz esse exercício e elaborei um questionário sucinto. Mesmo assim, ao longo da escrita dos artigos deixei de usar uma pergunta, pois avaliei que ela não atingiu os objetivos. Como a pesquisa científica é algo dinâmico, é muito provável que outras ideias surjam. Para algumas delas você terá dados para responder, outras não. Caso a segunda opção aconteça, não se aflija: deixe para um futuro trabalho. Fiz o exercício de operacionalizar as variáveis antes da elaboração do questionário, mas foi insuficiente. No momento da análise, senti a necessidade de reorganizar algumas variáveis. Por exemplo: deveria categorizar os serviços em tipos ou não? Somar os serviços ecossistêmicos inferidos das respostas dos proprietários rurais ao longo da entrevista seria uma boa medida de percepção? Ao longo da pesquisa você tomará diversas decisões e conversas com o(a) orientador(a), com seus pares e com a literatura científica ajudarão a resolver os dilemas. Na minha tese eu refleti muito sobre como coletar as variáveis

respostas, mas o mesmo não aconteceu para as variáveis explicativas. Em alguns momentos senti falta de melhores dados para compreender os resultados. Por isso, em seus estudos também dê atenção para essas variáveis. Por exemplo, o artigo de Bragagnolo et al. (2016) é uma boa referência sobre as variáveis independentes usadas em pesquisa que avaliam atitudes e percepções com relação a áreas protegidas.

Dica 4: Atente-se às questões éticas

Toda a pesquisa que envolva, direta ou indiretamente, seres humanos, precisa ser avaliada por um Comitê de Ética em Pesquisa (CEP). Isso inclui pesquisas de *survey* autoadministrados ou por entrevistas presenciais.

É necessário cadastrar o projeto na Plataforma Brasil (plataformabrasil.saude.gov.br). O cadastro exige diversas informações, dentre elas, resumo, introdução, hipóteses, objetivos e metodologia, riscos e benefícios aos participantes. Há manuais disponíveis na internet que ajudam muito a entender a plataforma. É necessário também anexar o Termo de Consentimento Livre e Esclarecido (TCLE) e o projeto detalhado. O TCLE é apresentado ao entrevistado antes da realização da pesquisa. Nele são apresentados os dados do pesquisador, a possibilidade de recusa, o objetivo da pesquisa, a garantia de sigilo e do uso dos dados exclusivamente na pesquisa. As universidades possuem CEP que ofertam orientações sobre todo o processo.

É importante ter em mente que o processo de avaliação pelo CEP pode demandar alguns meses até a aprovação, pois provavelmente haverá pedidos de ajustes de pendências. Portanto, é muito importante, já no cronograma do projeto de pesquisa, planejar um tempo adequado para esse procedimento (sugiro de no mínimo 3 meses).

Dica 5: Faça o teste piloto

Avaliar o questionário antes de realizar as entrevistas é uma etapa essencial. Você pode iniciar por um teste informal: leia o questionário em voz alta e verifique se ele tem fluência, se as palavras estão adequadas; entreviste a si mesmo, respondendo as perguntas e verifique se há algo muito difícil de ser respondido; entreviste colegas, familiares; tudo isso ajudará a ajustar as perguntas e a dinâmica da entrevista (Leeuw et al., 2008). No entanto, nada disso substitui o teste piloto com um público semelhante ao da sua pesquisa. Nesse teste a pessoa que vai entrevistar verificará se as perguntas estão compreensíveis, se atingem o objetivo proposto, se a ordem das questões está adequada, se as perguntas causam algum desconforto — o que deve ser cuidadosamente avaliado (Leeuw et al., 2008). Com o teste piloto é possível deixar o

questionário ainda melhor, além de treinar a entrevista: qual a melhor forma de abordar, de se portar, o que fazer para melhorar o entendimento de uma questão.

Caso haja mais de uma pessoa entrevistando, é importante um treinamento para que haja uma padronização nos comportamentos durante a entrevista. Cada pessoa tem um estilo próprio, mas é interessante discutir, por exemplo, que tipos de feedback pode se dar durante a entrevista, os cuidados para não influenciar as respostas, posturas corporais etc. O teste piloto também é um momento importante para esse tipo de ajuste.

Dica 6: A entrevista também exige um trabalho criterioso

Em se tratando de pesquisas de *survey*, as entrevistas presenciais são aquelas em que há interação de duas pessoas: quem entrevista utilizando um questionário para fazer as perguntas (o entrevistador ou a entrevistadora), e quem responde às perguntas (o entrevistado ou a entrevistada) (Leeuw et al., 2008). O trabalho de campo, como denominarei a fase de entrevistas, requer planejamento e uma vigilância constante por parte de quem entrevista para garantir rigor à coleta de dados. Esse rigor, como discutiremos mais a seguir, tem a ver com cuidados para se realizar todas as perguntas e não interferir nas respostas da pessoa entrevistada, e não com distanciamento comportamental. Pelo contrário, é necessário que o entrevistador ou a entrevistadora se apresente como uma pessoa acessível, genuinamente interessada na interação que se estabelece. Já que a pessoa está oferecendo o precioso tempo e informações pessoais, merece que a experiência seja a mais agradável possível (Babbie, 2003).

A primeira etapa do trabalho de campo é encontrar quem entrevistar. A localização das pessoas a serem entrevistadas, a abrangência da pesquisa e o delineamento amostral são fatores determinantes para o delineamento do trabalho de campo. No doutorado, tive apoio do ICMBio por meio dos funcionários da Flona de Silvânia. Como eles conheciam a região, isso facilitou encontrar as propriedades rurais. Isso não me eximiu de alguns desafios: abrir dezenas de porteiros, cada uma de um tipo, ou pular algumas delas; voltar à propriedade diversas vezes para encontrar o proprietário ou a proprietária; me deparar com propriedades fechadas e tentar descobrir informações sobre a quem pertenciam. O trabalho de campo exige esforço e, por mais planejamento que haja, imprevistos acontecem.

O primeiro contato com a pessoa entrevistada exige uma apresentação formal: quem é você, o que está fazendo ali, a qual instituição vincula-se. Caso haja aceitação em participar, é preciso apresentar o TCLE. A pessoa terá o tempo necessário para avaliá-lo. O termo é um documento e, à princípio, gera um desconforto nas pessoas diante da formalidade. Mas logo

entendem que trata de um documento que garante o sigilo e a possibilidade de retirada da participação a qualquer momento. Na minha pesquisa algumas pessoas pediram para analisar o termo com outros familiares e que retornássemos outro dia. Também houve casos que, depois da explicação do motivo da pesquisa, a pessoa se recusou a participar. Isso é uma ocorrência comum em pesquisas de *survey*. Garanta que o objetivo da pesquisa seja realmente entendido e, se a recusa permanecer, não insista, a pessoa está exercendo o direito de não participar.

Nas entrevistas presenciais, quem entrevista tem a possibilidade de motivar o participante a se envolver na pesquisa, utilizando também linguagem não verbal, dar mais explicações quando preciso, responder às dúvidas (Dillman et al., 2014). Mas a presença do entrevistador ou da entrevistadora também pode influenciar as respostas, ao gerar inibição nas questões controversas, receio de exposição, medo de julgamento (Leeuw et al., 2008). Além disso, na entrevista presencial a pessoa entrevistada tende a dar respostas que deixem boa impressão, um fenômeno denominado conveniência social (*social desirability*) (Dillman et al., 2014). O uso de algumas técnicas auxilia a evitar esses vieses e potencializa que a entrevista alcance seus objetivos (Babbie, 2003; Leeuw et al., 2008):

- A pessoa entrevistada precisa ter informações sobre a pesquisa para que possa compreender qual o envolvimento naquela participação. O TCLE cumpre essa tarefa, pois descreve os objetivos da pesquisa e as razões da participação.
- Familiaridade com o questionário: treinar a leitura do questionário dá fluidez e diminui o tempo da entrevista. As perguntas devem ser lidas naturalmente, como numa conversa formal, mas é preciso se ater ao texto regido, mesmo se quem entrevista tenha decorado as questões.
- Instruções gerais também são importantes para o bom desenvolvimento da entrevista. Elas podem estar descritas no próprio questionário, como forma de serem pautadas na conversa. Apesar de não ter feito isso (mas farei no futuro), antes de iniciar entrevista eu esclarecia aos proprietários e às proprietárias que poderiam levar o tempo necessário para responder cada pergunta, que poderiam solicitar explicações, que não havia avaliação de conhecimento e eu sempre reafirmava o sigilo dos dados.
- Também é importante oferecer instruções específicas a cada nova parte ou tarefa solicitada. Por exemplo, eu utilizei pares de imagens para a pessoa entrevistada comparar se havia diferença na produtividade dada a presença da área nativa. Antes de apresentar a questão, eu mostrava as duas imagens, especificava que a única diferença era a presença da vegetação nativa em uma delas e daí fazia a pergunta. Também notei logo nas primeiras entrevistas a necessidade de melhorar a instrução sobre o uso da escala *Likert*, não usual para os proprietários

e proprietárias rurais. Para isso, eu inseri uma pergunta para treinar o uso da escala: a pessoa respondia, usando uma escala de sete pontos variando de definitivamente não a definitivamente sim, à afirmação “Eu gosto de jiló”. Essa estratégia ajudava a descontrair a conversa e foi essencial para que as pessoas compreendessem o uso da escala.

- A pessoa que entrevista também precisa oferecer feedbacks durante a conversa “Ok”, “Obrigada”, “Compreendi”, e mesmo “Poderia repetir?”, “Poderia dar mais exemplos?”, “O que quis dizer com esse termo?”, os quais auxiliam na produção de respostas mais informativas

Durante a etapa de campo percebi que algumas pessoas, principalmente aquelas de menor escolaridade, sentiam-se envergonhadas por essa situação e não entendiam o porquê de uma pessoa “de fora” estar interessadas na opinião delas. Por isso a importância de um contato com empatia e respeito, esclarecendo os objetivos da pesquisa. Nesses casos eu explicava novamente que a minha presença se dava justamente pela importância de escutá-las para entender a experiência de anos na vida rural. Uma verdadeira fala do meu interesse e o não julgamento permitiam que se abrissem para a conversa. A entrevista presencial também permite escutar demandas e experiências que vão além das perguntas do questionário. De fato, na minha pesquisa eu também consegui criar um certo vínculo com os proprietários e as proprietárias, o que foi importante para que alguns participassem do curso posteriormente oferecido na Flona de Silvânia e que também fez parte do doutorado.

A naturalidade na conversa é um fator importante para a entrevista, mas não se pode comprometer o rigor na coleta de dados em função dela. Nesse ponto eu cometi alguns equívocos. Como eu acabei por decorar o questionário, em algumas entrevistas fui menos cuidadosa em seguir a sequência das perguntas e até mesmo esqueci de fazer algumas. Isso não deve ocorrer. O questionário escrito de forma criteriosa precisa ser seguido. Para evitar isso, eu deveria sempre voltar meus olhos à pergunta, marcando com uma caneta aquelas já realizadas (Com certeza farei isso de agora em diante!). Por outro lado, muitas vezes a pessoa entrevistada divaga, conta histórias sobre a vida e sobre a propriedade. Cabe uma escuta ativa nesses momentos, mas quem entrevista não pode perder o ponto onde parou no questionário. Caso as histórias estejam muito longas, com educação é possível retornar à entrevista com uma fala do tipo “Muito interessante essa história, gostei de ouvir. Voltando para a nossa entrevista...”. Apesar do mesmo questionário, a duração da entrevista varia muito, pois há pessoas mais falantes e outras mais concisas. Por exemplo, na primeira etapa de campo da minha pesquisa as entrevistas variaram entre 14 e 47 minutos.

As entrevistas da pesquisa de doutorado foram gravadas e eu escutei todas para realizar a tabulação. Neste processo percebi outros equívocos por mim cometidos: algumas vezes eu interrompi a fala da pessoa entrevistada. De fato, eu estava na busca de mais informações, mas ao interromper eu atrapalhava o fluxo de pensamento da pessoa, o que até poderia comprometer a resposta. Para evitar isso eu poderia anotar na lateral do questionário possíveis perguntas de interesse para realizá-las depois. Também percebi que muitas vezes um entrevistado ou entrevistada fazia uma pergunta e eu enveredava em uma explicação, com isso desviávamos do fluxo da entrevista. À primeira vista, isso pode não ser problema. No entanto, quem entrevista deve ter muito cuidado em suas falas para não influenciar nas respostas dos entrevistados. Acredito que é importante responder às perguntas que surjam na conversa, mas é possível anotá-las e explicar que, ao final da entrevista, vocês retornarão àquele tópico. Em síntese, tem que se focar nas perguntas do questionário e garantir que todas sejam realizadas. Logo findada a entrevista, nada impede de continuar a conversa, respondendo dúvidas e conversando sobre outros temas.

A pessoa que entrevista deve ter a atenção muito focada para ser capaz de notar detalhes nas respostas, nuances nas falas para aprofundar nas falas dos respondentes. Por exemplo, uma percepção relacionada às áreas nativas de Cerrado foi “melhora o clima”, mas isso em termos de temperatura ou precipitação? Vale, portanto, acrescentar uma pergunta “O que você quer dizer com isso?”. Outro exemplo “A mata serve como barreira natural” que pode ser mais bem explorada com “Me explique essa ideia de barreira natural, por favor”, visto que no caso da pesquisa eram respostas vinculadas à percepção de serviços ecossistêmicos. Quem entrevista não deve corrigir a fala do entrevistado. Algumas pessoas, por exemplo, falaram da “polirização” e logo percebi que poderia se tratar de polinização. O anseio é dizer “Seria polinização?”, mas isso pode constranger o entrevistado. Então, se houver dúvida, melhor solicitar uma nova explicação. Outro desafio é medir até que ponto se pode insistir na busca pela resposta. Quem responde pode dizer num primeiro momento, que não sabe (isso é muito comum em pesquisa com crianças e adolescentes), mas com gentileza quem entrevista pode fazer a pergunta novamente. Por exemplo, eu questionava se sabiam o que se fazia na Flona, algumas primeiras respostas foram negativas. Eu insistia um pouco com perguntas do tipo “Já escutou alguém falar o que é feito lá?” ou “Já visitou lá e viu algo?” e algumas lembranças afloravam. Nesse caso não é um processo de indução de respostas, mas uma ajuda no resgate de memórias e percepções. Se dificuldades desse tipo forem detectadas no piloto, essas estratégias podem aparecer como instrução no próprio questionário.

Quem entrevista também precisa ter cuidados operacionais: levar consigo questionários, canetas e pilhas sobressalentes, quando for usar equipamentos. Por desatenção, eu esqueci o gravador na casa de um entrevistado o que gerou perda de tempo. Em outro dia a pilha acabou durante outra entrevista e eu demorei um pouco a perceber. Por isso, antes de sair a campo, verifique todo o material e inclua água e algum alimento.

Dica 7: Invista na tabulação dos dados e evite retrabalho

A tabulação de uma entrevista exige um criterioso trabalho. Tabular questões fechadas é mais fácil do que as questões abertas, cujas respostas são muito mais amplas. Daí, novamente, a importância de se ter estabelecido o que se quer com cada questão, pois são necessários critérios para se categorizar as respostas, lembrando que *surveys* são estudos quantitativos. Há outras formas de entrevistas e análises, como análises de discurso, que exigem outros métodos de tabulação dos dados, como a descrição das falas.

Nas pesquisas de *survey* que já realizei, a tabulação seguiu alguns princípios. Os dados são tabulados em planilha (há diversos programas editores de planilhas disponíveis), cuja primeira linha é destinada aos títulos de cada variável que estão nas colunas. Por sua vez, cada linha da planilha é uma amostra, ou seja, toda a entrevista de uma pessoa deverá ser tabulada em apenas uma linha. Com essa estrutura, é possível colocar informações relevantes da pesquisa (nome do entrevistado, local, data, coordenadas geográficas etc) e as variáveis dependentes e independentes. Na pesquisa do doutorado eu optei por gravar o áudio das entrevistas, o que ajuda muito na fluidez da conversa. No entanto, isso exigiu muito trabalho no momento da tabulação, não foram raras as vezes que tive que escutar a mesma resposta diversas vezes. As respostas abertas exigem uma cuidadosa análise para categorizá-las em cada variável. Da pergunta “Quais as vantagens/desvantagens de se ter áreas protegidas na sua propriedade?” eu inferi os serviços ecossistêmicos percebidos pelo entrevistado. Para isso, eu inicialmente precisei verificar todos os possíveis serviços ecossistêmicos, o que fiz baseando-me na classificação do MEA (2005). Como se tratou de um processo de inferência, eu tinha que ser coerente nas minhas decisões para mantê-las na tabulação de todas as entrevistas. Fiz algumas anotações relacionadas a algumas categorizações que me geravam certas dúvidas. No entanto, na avaliação do artigo o revisor mencionou não ter compreendido o processo de interpretação dos serviços ecossistêmicos a partir das repostas dos proprietários. Para mim estava muito óbvio, mas de fato não estava. Precisei escutar novamente os áudios para construir uma tabela de conversão de palavras e sentenças presentes nas entrevistas e em qual serviço ecossistêmico

foi categorizada. Isso gerou um grande trabalho e um ensinamento: o processo de tabulação precisa de ainda mais critério para que não haja retrabalho. E quando não havia aparecido uma categoria ainda? Isso não é incomum de acontecer e, desde que se confirmado tratar de uma nova categoria, basta inserir uma nova coluna com a nova variável (que não estará presente nas amostras anteriormente tabuladas). Eu, frequentemente, tabulo os dados relativos à frequência que ocorrem nas respostas. Se interpretei a presença do serviço ecossistêmico polinização na questão 3 do proprietário 20, essa célula recebeu o número 1. Se eu não identifiquei esse serviço na mesma questão do proprietário 21, a célula recebeu 0.

É importante não postergar o processo de tabulação, pois é preciso investir um considerável tempo para se garantir qualidade dos dados. Outro hábito que possuo é inserir, no mesmo documento, uma planilha com a explicação do nome dado a cada variável e a explicação dos códigos (por exemplo, categorias de idade ou de escolaridade). No futuro, caso precise utilizar os dados, você pode recordar o que cada variável quer dizer, porque a gente acaba esquecendo como nomeamos as variáveis. (Sim, já passei por isso!)

Um questionário bem estruturado, com o propósito de cada questão estabelecido, influenciará no trabalho de tabulação. No meu trabalho de graduações, por exemplo, o questionário ficou inadequadamente longo, tanto que as colunas do Excel acabaram. Isso foi lá em 2003, não sei se acontece ainda, mas o limite foi de 256 colunas! Era um enorme trabalho para tabular cada questionário e tenho certeza que não utilizei todos aqueles dados na época e nem depois.

Dica 8: As análises estatísticas são só mais uma etapa: não apavore

Dados corretamente tabulados, é hora da análise estatística. Sim, quem trabalha com pesquisas sociais também precisa entender de estatística. Por isso, aproveite muito as disciplinas e compreenda os diferentes métodos. Com essa ferramenta você conseguirá testar adequadamente as suas hipóteses e terá mais confiança em suas conclusões. Eu não sou uma grande conhecedora dos métodos estatísticos, mas domino aqueles essenciais na minha pesquisa (resolvo muito coisa com qui-quadrado, teste-t, ANOVA, regressão). No doutorado fiz análises mais sofisticadas (General Linear Models, Structural Equation Modeling) para as quais tive que estudar bastante e também contei com parcerias. Por isso, mesmo que a princípio você não domine os testes estatísticos, invista tempo em estudá-los. Isso lhe dará segurança e autonomia em futuras pesquisas.

Dica 9: É importante comunicar os resultados aos entrevistados

Uma reclamação comum dos entrevistados é que nunca sabem dos resultados das pesquisas pois não há retorno. Como essa é a etapa final do trabalho, é por muitas vezes negligenciada, ou por falta de tempo do pesquisador que se envolve em outras atividades, ou por restrição de recursos financeiros. Mas é essencial que haja um retorno dos resultados às pessoas entrevistadas. A ideia não é apresentar uma palestra acadêmica: é demonstrar os principais resultados da pesquisa de forma compreensível. É uma forma de reconhecer a importância de cada pessoa que participou da pesquisa, possibilitando que entendam qual o uso dado às informações.

Dica 10: Seja feliz com sua pesquisa

Parece difícil ser feliz com algo que demanda horas de estudo, momentos longe da família e dos amigos. Por isso mesmo a atividade de pesquisa não pode se transformar num calvário: seja na graduação, mestrado ou doutorado, você e seu TCC, dissertação ou tese estarão juntinhos muitas horas por dia. O trabalho acadêmico exige foco, criatividade, estudo, autonomia, desenvolvimento intelectual. Também somos constantemente avaliados, o que é da natureza da Ciência. Por mais difícil que a pesquisa acadêmica possa parecer em alguns momentos, gosto de pensar no privilégio que é trabalhar com a construção do conhecimento e na possibilidade de entender fenômenos. Para quem trabalha com *survey*, ainda há um adicional: conhecer muitas pessoas interessantes.

Cada um vai construir a sua relação com o trabalho acadêmico. Eu criei algumas estratégias que me ajudaram a tornar esse processo, por vezes muito cansativo, em algo gratificante. Longe de ser uma receita de autoajuda, só quero demonstrar que alguns recursos foram fundamentais para eu me manter centrada e feliz, mesmo passando por momentos de angústia e cansaço. Para começar, eu escolhi pesquisar um tema que eu gosto, que me desperta a curiosidade e, que para mim, é muito relevante. O doutorado se tornou, portanto, tempo de estudo e investigação e eu gosto muito disso. Então, já que você vai passar muito tempo debruçado sobre artigos, que seja algo que desperte a sua curiosidade! Um aspecto superimportante e por vezes negligenciado: a saúde mental e física. A gente tem o hábito de se descuidar quando os prazos apertam, pois é justamente nesses momentos que não podemos deixar de olhar para o nosso bem-estar. Faça exercícios, saia com os amigos, tenha tempo com a família, visite parques, respire natureza, jogue videogame, não deixe de lado os seus hobbies. Se você tem feito a sua parte no trabalho, não há razão para se culpar nos momentos de lazer.

O que me ajuda muito no meu processo de foco e autocompaixão é o *mindfulness*. Foi por meio desse treinamento diário de meditação que não deixei a ansiedade tomar conta de mim, o que frequentemente acontecia. Também aprendi a ter mais compaixão com os meus próprios erros e a encará-los como exercício de aprendizagem, além de celebrar as pequenas conquistas, reconhecendo o meu esforço pessoal e crescimento profissional. Eu também li outras coisas além de artigos científicos e escutei muitos *podcasts* que me ajudam a refrescar a mente. Se possível, participe de um laboratório ou grupo de pesquisa, isso dará ânimo e ajudará você a ter discussões muito ricas. E por fim, esteja perto de quem lhe faz bem e peça ajuda sempre que precisar: o trabalho acadêmico deve ser colaborativo, seja na construção das ideias, no trabalho de campo, nas horas do café e também nas celebrações.

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CONSIDERAÇÕES FINAIS

É crescente conversão das áreas de vegetação nativa em áreas produtivas em todo mundo (VAN ASSELEN; VERBURG, 2013). No Brasil, país cuja economia é fortemente baseada na agropecuária, as pressões políticas e econômicas para flexibilização das leis ambientais não são recentes. A última iniciativa que ganhou projeção nacional é o Projeto de Lei 2.362/2019 cujo objetivo é alterar a Lei de Proteção da Vegetação Nativa (Lei 12.651, de 2012) com a revogação do capítulo que trata das Reservas Legais. Justifica-se que essas áreas protegidas impedem a expansão do agronegócio brasileiro. As unidades de conservação públicas também sofrem massiva pressão por parte da expansão da agricultura e obras de infraestrutura (DE MARQUES; PERES, 2015) e atividades de mineração (VILLÉN-PÉREZ et al., 2018), dentre outras. No bioma Cerrado o cultivo da soja é o maior agente de conversão de áreas nativas em áreas agrícolas (RAUSCH et al., 2019), impondo ainda mais pressão ao que resta de vegetação nativa, dado que 46% da cobertura vegetal natural já fora convertida nesse bioma (STRASSBURG et al., 2017).

A pesquisa apresentada nesta tese, realizada no bioma Cerrado, direciona o foco para os produtores rurais, agentes ativos nas mudanças de uso de solo. Paradoxalmente, também são agentes da conservação da biodiversidade, visto que considerável área nativa do bioma é protegida nas áreas de proteção permanente e reservas legais das propriedades privadas (SOARES-FILHO et al., 2014). Além disso, muitas vezes os produtores rurais são os vizinhos das unidades de conservação públicas. O complexo cenário que se forma entre produção de alimentos e conservação da biodiversidade coloca os proprietários rurais como agentes centrais da discussão. Portanto, compreender as percepções desses proprietários rurais quanto às áreas nativas, sejam públicas ou privadas, fornece informações estratégicas para o delineamento de ações conservacionistas, diretamente associadas à conservação da biodiversidade ou direcionadas à construção de uma agricultura baseada em práticas mais sustentáveis. Os serviços ecossistêmicos considerados em suas dimensões social, ecológica e econômica, fornece um arcabouço conceitual e instrumental que pode instrumentalizar as discussões de conservação nas paisagens agrícolas (SMITH; SULLIVAN, 2014).

Acreditamos que a pesquisa apresentada nesta tese colabora para se compreender para a relação dos proprietários rurais com as áreas nativas do Cerrado. De forma geral, podemos sistematizar os principais resultados em cinco pontos:

- i. Os produtores rurais identificam os benefícios gerados pelas áreas protegidas na propriedade, principalmente aqueles relacionados aos serviços ecossistêmicos de regulação;
- ii. Produtores com maior escolaridade foram capazes de perceber mais os serviços ecossistêmicos menos observáveis, como a polinização e o controle biológico.
- iii. A intenção em recuperar áreas na propriedade é afetada pela avaliação positiva desse comportamento, vinculada também aos serviços ecossistêmicos percebidos.
- iv. Atividade educativa, mesmo pontual, pode contribuir para a ampliação da percepção dos serviços ecossistêmicos.
- v. Não há uma percepção generalizada da unidade de conservação federal como provedora de serviços ecossistêmicos.

Apesar de não terem o conceito formal de serviços ecossistêmicos estabelecido, os produtores rurais participantes da pesquisa entendem que as áreas nativas beneficiam a propriedade. O conhecimento local, baseado na experiência da vida do campo e passado pelas gerações, permite ao proprietário sentir sensorialmente as mudanças causadas pela presença da mata, por exemplo, no “refrescamento da propriedade”. A preocupação com mudanças no regime das chuvas e diminuição da quantidade de água disponível é sentida pelos produtores e muito deles, principalmente os que possuem pequenas propriedades, acusam a conversão das áreas de Cerrado em plantações de soja (fenômeno crescente na região estudada) pelas mudanças percebidas.

Se os produtores têm uma percepção dos benefícios, verificamos que essa pode ser mais ampliada pela escolaridade formal. Produtores com mais anos de educação formal conseguem perceber serviços menos óbvios, mais dependentes de conhecimento teórico para serem percebidos. A escolaridade é uma variável complexa e mudanças do nível educacional de uma população ocorrem ao longo prazo, por meio de efetivação de políticas públicas. Mas esse resultado nos informa que a aprendizagem pode mudar a forma de se perceber o ambiente. Portanto, podemos lançar mão da educação informal para ampliação da percepção dos serviços ecossistêmicos. Proprietários rurais são um público que usualmente recebe assessoria técnica, sejam por meio da Emater, da Embrapa e de empresas privadas. Pesquisas mundiais demonstram mudanças de comportamentos de proprietários que participam de treinamentos, como redução de uso de fertilizantes e pesticidas (YOROBÉ; REJESUS; HAMMIG, 2011; JIA et al., 2015). Estratégias de conservação, portanto, podem ampliar suas ações e inserir treinamento sobre os serviços ecossistêmicos, um conceito particularmente interessante para o contexto agrícola. Entender que uma área de Cerrado conservada aumenta a infiltração e

purificação da água ou a presença de abelhas polinizadoras do tomate, são argumentos que geram interesse nos produtores. A manutenção das áreas nativas pode passar a ser vista mais do que para embelezamento ou qualidade do clima local, mas como um ativo na propriedade.

O produtor rural que conserva o Cerrado também sente necessidade de receber algo por estar ajudando a toda a sociedade. Na pesquisa, foi comum a reclamação de que o produtor rural é penalizado ao manter uma área na propriedade que ajuda a sociedade, mas não recebe nada de volta por isso. Daí a importância de se generalizar o conhecimento sobre os serviços ecossistêmicos para a compreensão dos benefícios gerados pelas áreas nativas. Também é preciso a implementação de políticas públicas para valorização dos atores sociais provedores de serviços ecossistêmicos. Projetos para pagamentos de serviços ambientais já estão se difundindo no país, principalmente vinculados à produção de água e armazenamento e estoque de carbono (GUEDES; SEEHUSEN, 2011). No Brasil, o acesso a informação é um fator determinante na decisão dos proprietários em participar de projetos para pagamentos de serviços (ZANELLA; SCHLEYER; SPEELMAN, 2014).

É incessante o trabalho dos funcionários da Floresta Nacional de Silvânia (Flona) para manutenção da qualidade ambiental dessa unidade e a busca frequente da participação da comunidade local. No entanto, ainda é comum na região a noção que a Flona exerce fiscalização, resquício da época em que essa unidade era gerenciada pelo Ibama. A maior parte dos proprietários rurais identifica a Flona como uma área importante para a conservação da natureza em sentido amplo. No entanto, há pouco conhecimento sobre o importante papel da Flona para a manutenção dos serviços ecossistêmicos da região que, inclusive, impactam a produtividade. Portanto, é preciso que a Flona invista mais na divulgação do seu papel na conservação da biodiversidade e na manutenção dos serviços ecossistêmicos. Nos últimos anos, várias iniciativas estão sendo realizadas para que a população utilize mais a Flona, por exemplo, para o ecoturismo. Nossa sugestão é que em todas as ações sejam associadas iniciativas educacionais que demonstrem a importância da Flona na manutenção da biodiversidade e, por conseguinte, dos serviços ecossistêmicos que beneficiam toda a população da região.

Aspectos históricos, políticos, econômicos e científicos se confluem e tornam Silvânia um interessante caso para estudo e implementação de práticas agrícolas sustentáveis e manutenção dos serviços ecossistêmicos. No ano de 1987 foi iniciado o Projeto Silvânia, com a participação de diversas instituições, incluindo a Embrapa Cerrados, *Centre de Coopération Internationale en Recherche Agronomique pour le Développement*, Emater GO e associações de pequenos agricultores já existentes na região. O objetivo do projeto foi o desenvolvimento

rural a partir do desenvolvimento de uma metodologia local para inserção de inovações tecnológicas no contexto rural de Silvânia. Um dos resultados alcançados foi o desenvolvimento das associações que permitiu aos participantes ganhos econômicos e sociais (ZOBY; XAVIER; GASTAL, 2003). Até hoje, Silvânia conta com um grande número de associações e cooperativas. Há uma unidade de conservação federal que mantém um bom relacionamento com a comunidade e com o poder público. O Conselho Municipal de Defesa do Meio Ambiente é atuante. Houve a instituição, em 2018, da Política Municipal de Serviços Ambientais e o Programa de Pagamento por Serviços Ambientais. Silvânia também é o sítio do Projeto Conectividade Funcional e Antropização da Paisagem: Estudo de caso na Flona Silvânia e microbacia do Rio Vermelho, uma Pesquisas Ecológicas de Longa Duração. O desafio, portanto, é a interlocução desses diversos atores sociais para o delineamento de ações que promovam uma agricultura mais consonante com a conservação da biodiversidade.

No Plano de Manejo da Floresta Nacional de Silvânia está registrada a intenção da implantação de corredores ecológicos de biodiversidade (MMA, 2015). A nossa pesquisa revelou que muitos proprietários rurais têm intenção em realizar recuperação de áreas na propriedade e que essa intenção é afetada pela percepção dos serviços ambientais. Logo, qualquer iniciativa futura para o delineamento desses corredores deve, primeiramente, investir em ações educacionais que ampliem o conhecimento sobre os serviços ecossistêmicos e como a recuperação de áreas pode aumentar a provisão dos mesmos para as propriedades e para toda a paisagem.

Alguns aspectos metodológicos da pesquisa foram importantes para se alcançar os resultados apresentados. O questionário sucinto e simples não gerou dificuldades ou constrangimentos para os participantes. Além disso, o uso de imagens pareadas facilitou muito a entrevista, pois concretizou as perguntas realizadas. O delineamento experimental adotado também garantiu que de fato entendêssemos os impactos da atividade educacional na percepção dos proprietários. Acreditamos que os ganhos advindos do delineamento experimental suplantam as dificuldades em implementá-lo.

Esta pesquisa foi realizada em um contexto particular, mas acreditamos que revela aspectos que podem ser generalizados a outros contextos brasileiros. Primeiramente, é preciso se compreender como os produtores rurais percebem as áreas nativas da propriedade em termos de serviços ecossistêmicos. É necessário investir em estratégias educativas para disseminação dos serviços ecossistêmicos, principalmente daqueles não observáveis, e como eles afetam a propriedade, inclusive em ganhos na produtividade. Iniciativas conservacionistas, como a

recuperação de áreas para efetivação de corredores ecológicos, podem ser potencializadas quando a população envolvida entende melhor os serviços ecossistêmicos associados. É preciso também se ampliar o conhecimento das populações sobre o papel central das unidades da conservação da biodiversidade nativa que, por sua vez, garante a manutenção e provisão dos serviços ecossistêmicos para toda a sociedade.

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