Conservation assumptions and development in Brazilian Cerrado

Rodrigo de Jesus Silva[1*] and Maria Elisa de Paula Eduardo Garavello[2]

[1]Programa de Pós-graduação em Ecologia Aplicada, Universidade de São Paulo, São Paulo, Brazil. [2]Departamento de Economia, Administração e Sociologia da Universidade de São Paulo, Escola Superior de Agricultura "Luiz de Queriroz", Av. Pádua Dias, 11, 13418-900, Piracicaba, São Paulo, Brazil.*Author for correspondence. E-mail: rodrigojsilva@usp.br

ABSTRACT. This study reviews the debate concerning socioeconomic impacts of established protected areas on local populations. On one side, there are those who defend the idea that protected areas may assist in poverty reduction by generating alternative sources of income, and on the other hand, those who argue just the opposite, due to the eminent expropriation of the land. Thus, the relationship between protected areas and poverty is evaluated through development indexes (Human Development Index and Gini Coefficient) and by contrary assumptions. Through a disaggregated analysis method of "strict protected" and "sustainable use", the proposal was to evaluate, in the context of Brazilian Cerrado, if the presence of protected areas has influence on the local social conditions, and which protection methods have the greatest effect. In this evaluation, it was verified that despite the heterogeneity of income distribution, the municipalities with integrally protected areas of indirect-use have higher values of human development than those of direct-use.

Keywords: poverty, resource use, protected areas.

Pressupostos de conservação e desenvolvimento no Cerrado Brasileiro

RESUMO. Este trabalho retoma o debate a respeito dos impactos socioeconômicos da criação de unidades de conservação (UCs) sobre as populações locais. De um lado há aqueles que defendem que as UCs podem auxiliar na redução da pobreza através da geração de fontes alternativas de renda e, de outro, aqueles que falam justamente o oposto, devido à política de expropriação de terras. Assim, através de pressupostos contrários, avalia-se através de indicadores de desenvolvimento (Índices de Desenvolvimento Humano e de Gini) a relação entre unidades de conservação e pobreza. Por meio de um método de análise desagregada pelos grupos de unidades de conservação de proteção integral e uso sustentável o objetivo é avaliar se no contexto do cerrado brasileiro a presença de unidades de conservação influencia as condições sociais locais e, em caso positivo, quais formas de conservação afetam mais. Nesta interface, apesar da heterogeneidade da distribuição de renda, observou-se que os municípios com unidades de conservação de proteção integral apresentam melhores valores de desenvolvimento humano do que aquelas de uso direto.

Palavras-chave: pobreza, uso dos recursos, áreas de proteção.

Introduction

Since the mid-nineteenth century, with the creation of the world's first national park - Yellowstone - protected areas have been one of the most frequently used strategies to contain the advance of environmental degradation (ADAMS et al., 2004; BRUNER et al., 2001; RODRIGUES et al., 2004).

Some authors, embodying the preservation perspective, argue that the creation of protected areas may assist in poverty reduction by generating higher local income (ANDAM et al., 2010; BINI; DINIZ-FILHO, 2004). However, many others enforce the idea that such a conservation strategy reduces local social conditions by restricting access to natural subsistence resources, thereby creating serious consequences with conflicts to local populations (BROCKINGTON, 2004; DIEGUES,

2000; GHIMIRE; PIMBERT, 1997; PRETTY; SMITH, 2004; ROE; ELLIOTT, 2004).

Facing this conundrum, the Brazilian National Conservation Unit System (SNUC), classifies protected areas into two groups: "sustainable use" and "strict protected areas". Such areas may be divided, respectively, due to the manner in which the natural resources are used. Under the direct-use assumption, human presence is permitted, whereas in indirect-use, the same is prohibited (SNUC, 2002). Thus, in accordance to these assumptions, this evaluation intends to investigate the socioeconomic context of protected areas, providing understanding of the relationship between biodiversity conservation and poverty.

According to Brockington (2004), it is not the mere existence of poverty - inferred from indicators of human development that help elucidate social

conditions and income distribution heterogeneity - that generates conservation problems, but its distribution in the society. Thus, the lower the inequality of a society the greater is the chance for economic growth to reduce human misery (DA VEIGA, 2001).

Moreover, this study is justified by the fact that Brazilian Cerrado is considered one of the world conservation hotspots, in other words, one of the main conflict zones in the world regarding environmental conservation (MYERS et al., 2000). Thus, this study evaluated: (i) if the presence of protected areas affects the variation in the local social conditions for 1,058 municipalities in Brazilian Cerrado, and, (ii) which protection methods or resource-use assumptions had the greatest effect.

Material and methods

The socioeconomic conditions of 1,058 municipalities in Brazilian Cerrado were inferred using the Human Development Index (HDI) and Gini Coefficient (GC), collected from a database (last publication in 2000) in the Human Development Atlas of the United Nations Development Program (PNUD BRASIL, 2000) While the HDI measures socioeconomic conditions from three basic dimensions of human development - health, education, and standard of living - the GC measures the wealth distribution among individuals, where zero (0) represents perfect equality and one (1), total inequality (PNUD BRASIL, 2006; UNDP, 2006).

The data of protected areas were obtained from institutional databases of Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and National Indian Foundation (FUNAI). Subsequently, these data were stored according to a grid with 181 cells of 1° latitude by 1° longitude each, that cover the entire Brazilian Cerrado biome (see SILVA et al., 2006). Although this scale tends to overlap some municipalities and protected areas in each cell, it is useful to relate the distributions of social status with effective conservation of biodiversity (see BINI;

DINIZ-FILHO, 2004). Thus, by estimating the mean and standard deviation of the statistical analysis employed, the overlaps in each cell were automatically bypassed.

Therefore, municipalities with established protected areas were classified as one (1) and those without them, as zero (0). Second, municipalities with protected areas (1) were classified, according to the "strict protected" and "sustainable use" resource assumptions as protected areas groups: indirect-use (IU) and direct-use (DU), respectively. Third, seeking to isolate the possible socioeconomic effect of each group and conservation assumption, the human development index (HDI) of municipalities with IU and DU units were compared to those absent (0).

The statistical analysis of both treatments was carried out with the SAS 9.2 software, using the non-parametric Wilcoxon-Mann-Whitney test, corresponding to the unpaired t-test, in order to compare two independent samples (SOKAL; ROHLF, 1995). It is important to mention that the significance level used was five percent ($\alpha = 5\%$).

Results and discussion

First, the municipalities with presence of protected areas (1) had human development indexes (HDI) significantly lower than those without these areas (0) (Table 1).

Therefore, by evaluating only the raw data of protected areas, one could unadvisedly conclude that all municipalities with protected areas presence (1) have worse social conditions in terms of health, education, and standard of living. Nonetheless, by disaggregating the data according to the protected areas groups, it was noted that the DU were responsible for low HDI levels from the previous treatment, since the HDI of municipalities with DU units is significantly lower than those with IU units. Moreover, by isolating the effects, the average HDI of municipalities with DU was considerably lower than those without protected areas (0), which did not occur for those with IU units (Table 1).

Table 1. Descriptive analysis of the Gini Coefficient (GC) and the Human Development Index (HDI) with values for average (M), standard deviation (SD), statistic of Mann-Whitney test (U), Z of the normal approximation, degrees of freedom (DF), probability (p), and sample size (n) of treatments with (1) and without (0) protected areas, protected areas of indirect use (IU) and direct use (DU).

	M	SD	M	SD						
Variables	1		0		U	Z	DF	p	n 1	n 0
GC	0.5630	0.0574	0.5709	0.0613	156491.5	-1.63	1148	0.0507	286	863
HDI	0.7228	0.0671	0.7317	0.0657	156272.5	-1.65	1148	0.0491	286	863
	IU		DU		U	Z	DF	p	n IU	n DU
GC	0.5674	0.0575	0.5556	0.0568	14165.0	-1.76	285	0.0392	179	107
HDI	0.7286	0.0652	0.7131	0.0694	14149.5	-1.77	285	0.0376	179	107
	IU		0		U	Z	DF	p	n IU	n 0
GC	0.5674	0.0575	0.5709	0.0613	91697.5	-0.45	1041	0.3260	179	863
HDI	0.7286	0.0652	0.7317	0.0657	91683.5	-0.43	1041	0.3335	179	863
	DU		0		U	Z	DF	p	n DU	n 0
GC	0.5556	0.0568	0.5709	0.0613	45641.0	-2.31	969	0.0104	107	863
HDI	0.7131	0.0694	0.7317	0.0657	45436.0	-2.36	969	0.0090	107	863

Nevertheless, as the human presence assumption in DU units showed low HDI values, which reflects a more pronounced poverty state and consecutively lower maintenance of the local socioeconomic conditions in those areas, the expropriation assumption in the IU units showed a low wealth distribution (GC). Though there is no difference between treatments with (1) or without (0) protected areas, the municipalities with IU units revealed a significantly higher average GC, that is, closer to total inequality, than those with DU units (Table 1). Also, as the factors in the third treatment were isolated, it was verified that the average GC of the municipalities with DU units was significantly lower, close to perfect equality, than those with no units (0), it can be noted that this did not occur when comparing municipalities with IU to those without any units (Table 1).

These results suggest that although municipalities with indirect-use (IU) units have better local social conditions - HDI values - than direct-use units, they do not have a higher income distribution generated by several economic activities, perhaps including environmental services. Consequently, this pattern of more concentrated income distribution in municipalities with IU is possibly reflected by their HDI values, since this index is composed of education, health, and standard of living - all measured by income.

As the GC helps elucidate social heterogeneity issues regarding wealth concentration, the HDI supplies a more effective indicator of human development than just measurements of per capita income (UNDP, 2010). In this scenario, poverty must be viewed as privation of individual liberties, in other words, a lack of basic needs and not simply as low income, which is measured by the HDI (SEN, 2000). With a similar approach, Rodrigues et al. (2009) used the same HDI database (year 2000) from the UNDP to evaluate the relationship between deforestation in the Amazon and development levels in the region.

According to Joppa et al. (2008), Andam et al. (2010), Joppa and Pfaff (2010), and Sims (2010), protected units are frequently established in remote areas with high poverty rates. However, according to results using conservation assumption methodology, it can be observed a pattern of established protected areas with DU in regions with higher poverty rates than IU. In this sense, another finding that does not follow the same rule is that, in general, "strict protected areas" of Brazilian Cerrado biome (IU) were created in areas with better social conditions -

less poor - when compared with municipalities without protected areas (0) (Table 1).

Based on interpretations by Sen (2000) about privation of individual liberties and Da Veiga (2001) about social inequality, the results found here through the HDI and CG values suggest that protected areas with DU can be important for poverty reduction if the income distribution increases. Bini and Diniz-Filho (2004), using the same database and a similar methodology, detected a significant difference in variable per capita income between municipalities that harbor protected areas and those that do not, with the presence of protected areas leading to increases in income. Sims (2010) has already demonstrated that protected areas increase the average consumption and reduce the poverty rates, despite imposing binding constraints on agricultural land availability.

Once Bini and Diniz-Filho (2004) had shown that conservation does not compromise social development in Brazilian Cerrado, thus similar would prevail for strict protected areas (IU). According to the database used in this methodology, it is estimated that up to year 2000, there were 205 protected areas in Brazilian Cerrado, of which 121 were "strict protected", amounting to 5,484,680 ha, and 104 were "sustainable use", amounting to 9,950,719 ha. However, converting all the conservation unit groups into the "strict protected" assumption would not be an effective solution for the improvement of local social conditions. In the same way, Scherl et al. (2006) describes that according to the context, protected areas can generate both opportunities as limitations to poverty reduction. On the other hand, another interpretation to these results is that smaller protected areas, in the case of "strict protected" (IU), may have been established in richer municipalities and with better standards of living (BINI; DINIZ-FILHO, 2004). In this sense, the opposite may also be true, since larger protected areas with DU may have been established in poor municipalities with worse standards of living.

Although these data cannot distinguish between these two explanations, they suggest that "strict protected" areas (IU) can be an important component for poverty reduction if income distribution is increased. Bini and Diniz-Filho (2004) shows that the municipalities of cerrado established before 1991 do not exhibit any variation in income with the presence of protected areas, but the difference observed for those created between 1991 and 2000 suggests that protected areas can

improve economic activities relatively in a short period.

However, in the national scenario of great socio-economic heterogeneity is difficult to predict the time needed to make it happen. This depends from case to case, mainly when the expropriated population migrates to other regions and the social impacts of conservation are not directly reflected in the place of origin. So, to better understand the relationship between poverty and conservation in a given space of time are recommended more specific researches and at a smaller scale than used here. Accordingly, case studies in Costa Rica and Thailand reinforce that protected areas besides contributing to environmental conservation, also aids in poverty alleviation (ANDAM et al., 2010).

On the other hand, one cannot disregard all the possible impacts of "strict protected areas" to the local populations, derived from land expropriation, prohibition of subsistence resource use, and consecutively, loss of primary income sources (BALMFORD; WHITTEN, 2003; SCHMIDT-SOLTAU, 2003). Regarding the "sustainable use" of protected areas, a possibility could be to invest in integrated management - publicly and privately - with more social participation, stimulating the local autonomy and improvement of basic social conditions, such as health, education, and income, to have a more equitable and equalized development (SEN, 1998).

Alternatively, for such investments to be efficient, it is necessary to carry out more "case studies" about knowledge, attitude, and local perceptions of stakeholders, such as, practicing alternatives to management and handling of their protected areas (DIEGUES, 1998; XU et al., 2006). In a broader context, Adams et al. (2003) highlighted that the management of common pool resources depends on the perceptions of the protagonists, and that the understanding of management problems by the stakeholders is essential to effective dialogue.

Conclusion

These results provide valuable information about the relationship between poverty reduction and conservation in Brazilian Cerrado that can help the management of protected areas.

In order to mitigate socioeconomic impacts of strict protected areas, it is crucial to develop local economic devices for better income distribution, while those sustainably used need improvement in the three dimensions of human development researched to combine conservation with social demand.

Thus, it is necessary to implement more sociocultural assessments than those current, complemented by applied work on smaller scales in order to establish a causal linkage among conservation and broader aspects of human development.

Acknowledgements

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