

Contents lists available at [ScienceDirect](http://www.elsevier.com/locate/biombioe)

Biomass and Bioenergy

journal homepage: <http://www.elsevier.com/locate/biombioe>

Research paper

Resident perceptions of the impacts of large-scale sugarcane production on ecosystem services in two regions of Brazil

Camila Ortolan Fernandes de Oliveira Cervone^{*}, Arnaldo Walter, Marjorie Mendes Guarengi, Camila Favero

ARTICLE INFO

Article history:

Received 25 April 2016
 Received in revised form
 25 August 2017
 Accepted 26 August 2017
 Available online xxx

Keywords:

Ecosystem services
 Biofuels
 Sugarcane
 Environmental management
 Local community perceptions

ABSTRACT

Sugarcane ethanol is an alternative to fossil fuels that can mitigate greenhouse gas emissions and offer socioeconomic benefits, but at the same time have a series of negative impacts. Brazil is the second largest producer of fuel ethanol globally, with this production predicted to almost double over the next 15 years. However sugarcane ethanol production in the country has been shown to interact with a range of ecosystem services. It is only when such interactions are understood that we can fully determine the potential trade-offs, synergies and sustainability outcomes of biofuel production in the country. This paper explores the local perceptions about the impacts of sugarcane production on ecosystem services in two municipalities in the state of Sao Paulo with significant sugarcane production: Capivari and Rancharia. Impact perceptions have been elicited through interviews with local residents, with the results showing that perceptions vary between the two study sites and are affected considerably by the different local experiences with sugarcane production. For example, although sugarcane farming has been traditionally performed in Capivari, it has been Rancharia that has experienced more recently a rapid sugarcane expansion that has caused considerable changes in land use and farming patterns. Interview results also suggest that the negative effects of sugarcane farming can be reduced through the adoption of good agricultural practices and the enforcement of existing laws, as many respondents cited considerable improvements in ecosystem health from such actions. Assessing the perception of local communities such as the one reported in this paper can be crucial in designing policies and planning land uses that enhance the sustainability of biofuel production.

© 2017 Published by Elsevier Ltd.

1. Introduction

Anthropogenic activities have contributed to the destabilization of ecosystems [1]. Agricultural systems constitute part of this problem. The increasing pressure to boost productivity and produce bioenergy at large scales pose a great threat to the environment because of land use change, potential biodiversity loss, and excessive fertilizer use [2,3]. For example, agriculture is expected to cause approximately 70% of the projected loss in terrestrial biodiversity [2]. Nevertheless, when managed well, agricultural systems can also contribute positively to the environment [4,5].

However, land management practices that primarily focus on maximizing one service from agricultural systems (e.g. biomass production for food, energy and other industrial uses) are likely to

cause the degradation or loss of other services such as aesthetic and historical values [6]. Conversely, focusing on the optimizing the delivery of multiple benefits from agricultural systems can lead to the provision of multiple ecosystem services [7]. An ecosystem services perspective to agricultural systems can help understand their negative impacts in a systematic manner, and contribute to the development of management practices that can increase their capacity to provide multiple benefits [5]. Here, ecosystem services (ES) are understood as the benefits people obtain from ecosystems directly and indirectly, such as provisioning (e.g., food, fuel), regulating (e.g., water flow regulation, water purification), supporting (e.g., nutrient cycling) and cultural services (e.g., recreation, cultural heritage) [8].

In Brazil, sugarcane cultivation is a major agricultural activity for the production of sugar, ethanol and other industrial products. Currently the area designated for farming sugarcane is estimated at 87,000 km². All fuel ethanol production in Brazil is based on sugarcane, with approximately 50% of the sugarcane being used to produce ethanol. The large-scale production of fuel ethanol started

^{*} Corresponding author.

E-mail address: camila.ortolan@fem.unicamp.br (C. Ortolan Fernandes de Oliveira Cervone).

in the mid-1970s, and in 2015, $30.3 \times 10^6 \text{ m}^3$ were produced ($11.3 \times 10^6 \text{ m}^3$ of anhydrous ethanol and $19 \times 10^6 \text{ m}^3$ of hydrated ethanol). Anhydrous ethanol is blended with gasoline whereas hydrated ethanol is used as neat fuel. Ethanol production could reach $54 \times 10^6 \text{ m}^3$ in 2030, which is estimated to require a total sugarcane production of approximately 1100×10^6 tonnes and the expansion of sugarcane production to approximately 55,000 km² [9]. Recent sugarcane expansion has occurred in southeastern Brazil (particularly in the state of São Paulo) and in the centre-west. Between 2000 and 2010, approximately 70% of the area converted for sugarcane production was cultivated pasture land used for cattle ranching, whereas the direct conversion of native vegetation into sugarcane has historically accounted for less than 1% of the sugarcane expansion in Brazil [10,11].

The large-scale production of sugarcane for ethanol has been controversial. Several published papers have either assessed its overall sustainability [12–15] or addressed potential specific impacts including effects on water resources [13,15,16], biodiversity [17–19], soil [11,20,21], air quality [22–24] and socio-economic impacts [14,25,26]. However the effects of sugarcane production on ES have remained largely unexplored in the current literature.

Establishing clearly the linkages between ES and human well-being can play an important role in highlighting to local communities the importance of protecting and restoring natural ecosystems [8,27]. At the same time, local communities that directly depend on natural resources (and the ES they provide) usually have ecological knowledge of these resources [28]. Mapping local community perspectives can allow capturing such place-based ecological knowledge, which is usually different from knowledge presented in the academic literature [29,30]. A growing number of participatory tools have been developed to capture this local ecological knowledge and identify how and when it should be incorporated into environmental decision-making [30,31]. However, we could find no studies that have examined the perspective of local communities about the ES impacts of sugarcane production in Brazil, and how these views can affect land management decisions.

The aim of this paper is to capture the perceptions of residents in local communities in Brazil about the impacts of sugarcane farming on ES. Two Brazilian regions in the state of São Paulo that experienced large-scale sugarcane production were studied: Piracicaba and Presidente Prudente. The former is a region where sugarcane has been traditionally produced, while in the latter has experienced sugarcane expansion only relatively recently. Both regions are located in a transitional zone between the Atlantic Forest and

Cerrado biomes, which have the highest recorded levels of terrestrial biodiversity and species endemism in Brazil. One of the key hypotheses of this research is that local community perceptions vary both regionally and within groups of residents (e.g., farmers and non-farmers). Section 2 outlines the methodology and Section 3 reports the main perceptions across different areas, resident groups and ES. In Section 4, we argue that understanding these diverging perceptions (and integrating them in current policies and practices) can improve the delivery and sustainability of biofuels in Brazil.

2. Methodology

2.1. Study sites

2.1.1. Piracicaba/Capivari

The Piracicaba region has been a traditional sugarcane production area with several functioning mills. However, its prominence has been recently reduced due to the lack of available land for sugarcane following the expansion of industrial activities, real estate speculation and local topography, which hinders harvesting mechanization. According to estimates based on satellite images [19], the area occupied by sugarcane in Piracicaba region was 1216 km² in the 2003–2004 harvest season (4.1% of the total area cultivated with sugarcane in the state of São Paulo), growing to 145.2×10^3 ha 1452 km² in the 2013–2014 harvest season (2.5% of the total sugarcane area in the state of São Paulo). Sugarcane farming land has remained relatively stable in recent years, possibly experiencing a slight decline for the above-mentioned reasons.

Capivari was selected as the study municipality in the region (Table 1, Fig. 1). It is the second largest producing municipality in Piracicaba region (after the municipality of Piracicaba), with 210 km² of sugarcane cultivated in 2013–2014 (approximately 15% of the sugarcane area in Piracicaba region). The evolution profile of sugarcane production in Capivari is typical of the historical production in the overall region: minor growth during 2003–2005, with the area under sugarcane remaining nearly the same since 2005. Approximately 65% of the total agricultural area is under sugarcane (data for 2013) and almost 60% of the total sugarcane area in 2012 (the latest available data) was harvested using machines without previous burning [19]. Fig. S2 in Supplementary Electronic material is a picture of typical landscapes nearby the studied area in Capivari.

Interviews were conducted in a neighborhood at the south of

Table 1
Study sites characteristics.

Parameter	Site 1		Site 2	
	Capivari (Municipality)	Neighborhood (Study area)	Rancharia (Municipality)	Agissê (Study area)
Latitude – South	23° 01' 07"		22° 13' 45"	22° 31' 56"
Longitude – West	47° 29' 26"		50° 53' 35"	50° 54' 38"
Total area (km ²)	322.9		1587.5	
Urban area (km ²)			10.4	0.18
Studied area (km ²) ^a		59.3		93.0
Sugarcane area in 2003 (km ²)	192.4		89.7	
Sugarcane area in 2013 (km ²)	210.5		403.6	
Share of sugarcane area in 2013 (%)	65.2		25.4	
Sugarcane area in 2015 (km ²) ^a		40.8		39.0
Share of sugarcane area in 2015 (%) ^a		68.9		41.9
Estimated total population (2015)	53,152		29,778	
Total population (Census 2010)	48,576		28,804	824
Rural population (Census 2010)	2672		2976	519

^a Estimate by the authors based on areas and land use in Agissê and in Capivari's agglomeration.

Source: [33].

Download English Version:

<https://daneshyari.com/en/article/7062881>

Download Persian Version:

<https://daneshyari.com/article/7062881>

[Daneshyari.com](https://daneshyari.com)