Biodiversity information in sugarcane industry CEA

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Abstract

Deficiencies related to CEA were found in the EIA process of sugarcane industry projects in São Paulo State (Brazil). Among the causes of poor practice, this paper analyzes biodiversity information availability and adequacy regarding the cumulative effects related to the change in the species diversity in forest fragments. Review of 27 ToR and EIS using content analysis found that this effect is overlooked and insufficiently considered. For supporting the assessment of cumulative effects on biodiversity, we point out the need to (i) ToR focus on specific questions and key information to assess change in species diversity; (ii) provide guidelines with general procedure, tools and techniques to drive CEA; (iii) adoption of initiatives – by the environmental agency - to manage biodiversity data and information generated in the EIA process, in order to facilitate their use in the future EIA; and (iv) reinstatement of landscape ecology studies in EIS.

Keywords: cumulative effects; biodiversity; sugarcane industry; licensing process.

1 Introduction

Cumulative effects assessment (CEA) is an internationally recommended good practice of environmental impact assessment (EIA) that identifies and analyzes the cumulative environmental changes of a combination of past, present and reasonably foreseeable future activities (Harriman & Noble 2008; Canter 2015), with focus on the effects on valued components (VCs) - environmental and social attributes considered important in a region. The CEA enables a better understanding and monitoring of the environmental consequences of development projects, especially those related to biodiversity (IFC 2013). Biodiversity is a key factor for the CEA in regions where there is a marked loss and continuing threats to biodiversity and ecosystem services (CBD 2006).

In Brazil, there are regulatory requirements to consider cumulative and synergistic properties during the preparation of an environmental impact statement (EIS). Specifically for sugarcane industry projects, the EIA regulations in São Paulo call for the "adequate assessment" of cumulative impacts (São Paulo 2008), due to the spatial concentration of monocultures and industrial plants in the state (Walter et al. 2014). However, previous research suggests that EIA of these projects insufficiently address their potential cumulative effects (Gallardo & Bond 2011). Neri et al. 2016 pointed out that practical difficulties to conduct CEA in Brazil include the lack of technical and methodological guidelines and availability of reliable information about other projects.

Internationally, it is acknowledged that availability of guidance is critical to improve practitioners' understanding of cumulative effects and how they should be addressed at project-level (IFC 2013; Olagunju & Gunn 2015). Further, difficulties to access information and/or its insufficiency limits the CEA application, due to the non-establishment of a relevant database for the baseline of VCs and understanding of other projects and activities in study area (Canter & Atkinson 2011; Noble et al. 2011).

Considering the need of baseline information to be available and transferred over time to properly support project-based CEA (Noble et al. 2016), this paper analyzes biodiversity information availability and adequacy to assess potentially significant cumulative effects on biodiversity in the EIA of sugarcane industry projects in São Paulo.

2 Methodology

The research was conducted in three steps (Figure 1). The study period was limited to 2009 to 2014 because the explicit requirement to "… adequately assess the associated environmental impacts, including cumulative impacts…", during the licensing process of sugarcane industry which was gazetted in 2008 (Resolution 88/2008).

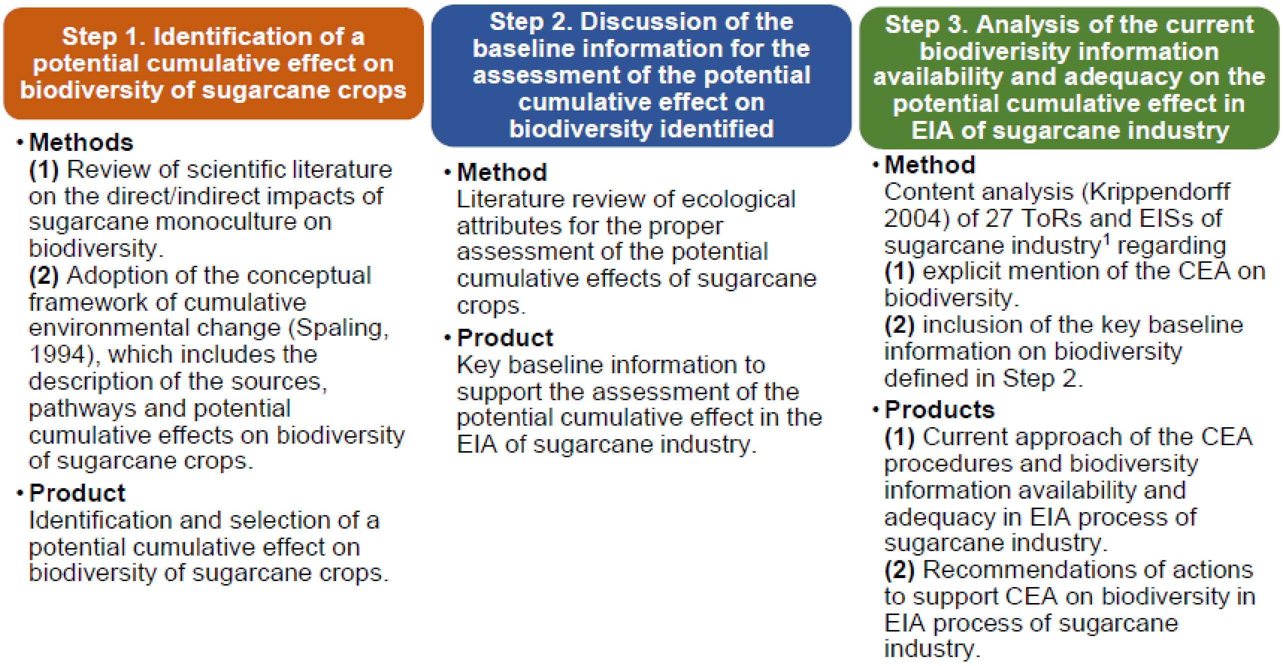

Figure 1. Main steps for the discussion of biodiversity information availability and adequacy to support CEA of sugarcane industry projects. Source: Elaborated by the authors.

3 Results

3.1 Potentially significant cumulative effect on biodiversity of sugarcane crops

Along the application of the conceptual framework (Step 1), we considered as *source* the implementation of sugarcane crops and corresponding land use change. The expansion of sugarcane in São Paulo state has not been occurring at the expense of deforestation, but as a result of replacing former pastures and agricultural lands (Filoso et al. 2015), in areas where the remaining forest is highly fragmented (Macedo 2005). To describe the *pathways*, we considered the several accumulated impacts that result in a more significant impact (Rajvanshi 2016), induced by a single sugarcane industry project. In this way, it was considered as direct impact 'change in the permeability of the landscape matrix'[1]. The ability of the landscape matrix is to support species (Franklin et al. 2002), and also it has critical role in controlling the connectivity in the landscape through allowing the movement of organisms in patches of native vegetation (Franklin & Lindenmayer 2009). In this scenario, we pointed out as accumulated impacts the alteration of habitat species and resources availability, changes in movement of individuals between populations, and changes in the abundance of species in sugarcane areas. These several impacts contribute to the larger effect of sugarcane crops (*cumulative effect)* 'change in the species diversity'[2] in native forest fragments over time.

3.2 Key baseline information to assess change in species diversity in forest fragments

As result of the literature review regarding the ecological attributes related to the cumulate effect discussed, we summarize some key baseline information that could be addressed in EIA of sugarcane projects in the light of CEA principles.

Landscape change is a dynamic process, whose description involves the understanding of compositional gradients, diversity of land uses, number of fragments, and structure connectivity of the landscape elements. Species occurrence is influenced by the sizes, shapes and composition of fragments, as well as the land use adjacent to the fragment (Bennet & Saunders 2010). Also, it is relevant to consider both temporal and spatial functional connectivity. Spatial functional connectivity is related to the connectivity of landscape structure,

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[1] Landscape matrix is defined as a unit of landscape that controls its dynamics. In general, the matrix covers most of a landscape (Hobbs 2002).

[2] Species diversity is a measure of diversity that incorporates both number of species and their relative abundance (Gotelli & Chao 2013).

making possible the movement of fauna in space. Temporal functional connectivity is linked to persistence of organisms in time, in a same place (Auffret et al. 2015).

Considering the potential of change in species diversity in forest fragments, it is relevant to recognize (i) the isolation of a population by the distance between habitats; and (ii) the human land use on the ability of organisms to move through the landscape, take in the past influence in landscape structure, by land use history (Bennet & Saunders 2010). In doing so, landscape structure should be inventoried and monitored through: (i) aerial photography and satellite imagery; (ii) use of Geographic Information System (GIS); (iii) time series analysis of remote sensing data and indices of landscape pattern (Noss 1990).

Walz (2011) also notes the relevant relationship among landscape structure and species diversity, considering (i) the benefit of using habitat modelling of individual species or species groups; (ii) indicators of landscape diversity in monitoring agricultural landscapes, and (iii) GIS for evaluation of spatial information as land use information, habitat type, and others, which depend on availability of data, in order to better understand the effects of different landscape patterns on composition and diversity of species.

In summary, the key baseline information that should be addressed in EIA is: (1) past and current land cover characterization and mapping; (2) analysis of landscape structure (number of remaining fragments, shape, size, composition, types; permeability of landscape matrix); (3) temporal analysis (data from past activities and habitat conditions). Collection and analysis of such information should be supported by tools such as GIS, satellite images, indices, indicators, and modelling.

3.3 Analysis of biodiversity information in sugarcane EIA

In the analysis of the 27 ToR, no explicit requirement for assessing the cumulative effects on biodiversity was found. Only the need to consider the cumulative effects of water consumption in the region of the projects, taking into account other projects, is made explicit. However, 14 ToR call for considering the impacts on fauna communities due to the land use change, in which can be discussed the potential cumulative effects.

Reviewing the EIS, brief mention to cumulative effects on biodiversity was found in 9 studies (Figure 2), with no structured approach to assess them. Regarding the change on species diversity in forest fragments, 1 EIS pointed out the indication of cumulative effects due to the reduction of local richness of reptiles and amphibian.

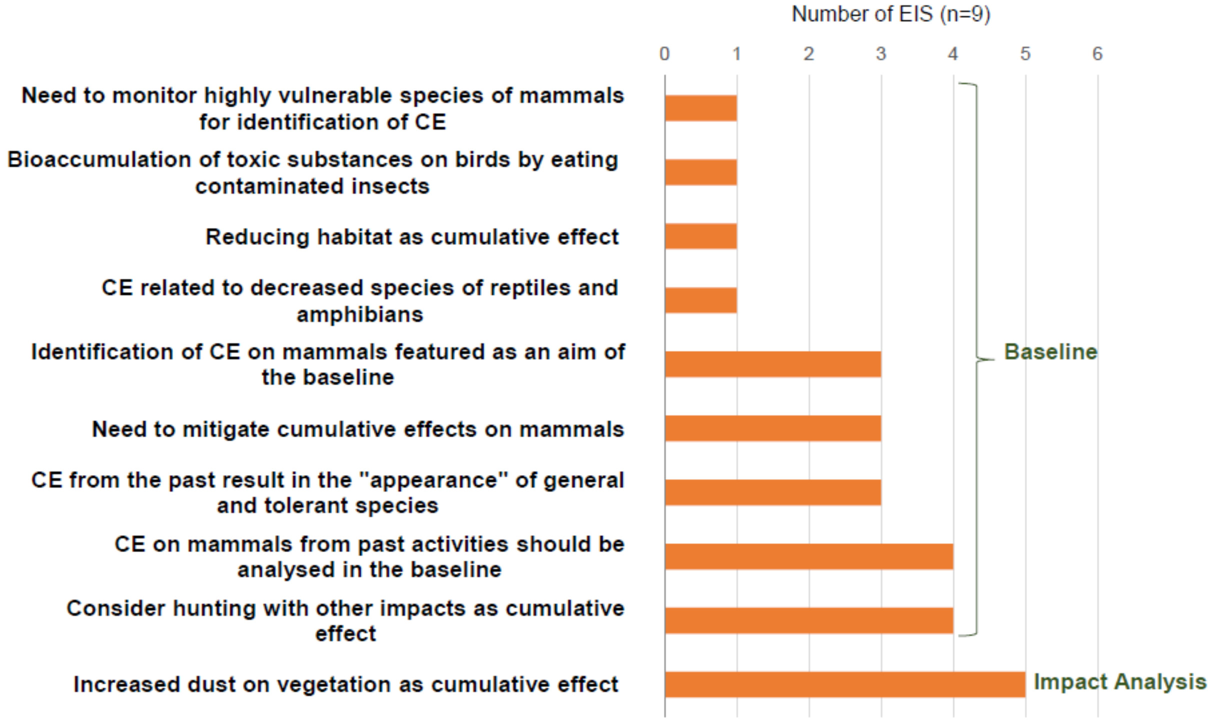

Figure 2. Synthesis of explicit mention to cumulative effects in EIS of sugarcane industry. Source: elaborated by the authors.

The analysis of key baseline information that could support the assessment of change in species diversity in forest fragments in EIS, resulted in the findings:

- 9 EIS consider the decrease or change in the permeability of the landscape matrix permeability due to the land use change. They recommend maintaining the scattered trees for allowing gene flow in fragments. In 1 EIS, the potential of increasing rodents abundancy is described, while 4 EIS mention the potential of reducing abundance and richness bird species.
- All EIS present flora and fauna species list; describe the current composition of forest fragments by richness and abundance species, and habitat conditions compared with secondary data. Regarding landscape analysis, we found the identification in maps or satellite image and quantification of the remaining fragments, description of past vegetation, brief description of historical dynamics of land use and past influences in the study area, use of GIS for mapping current land use and sugarcane areas, and 7 EIS refer to maps of areas of biological importance and connectivity.
- There is no use of indices of landscape pattern or indicators of landscape diversity. In 7 EIS, there is the application of an index of sensibility to human alterations to classify fauna species with high, medium and low sensibility.
- Time series analysis is not used for the baseline and impact analysis. There is no specific temporal boundary to identify and analyze the influences of past and/or future actions on VC selected. There is a description of past changes in the studies areas due to the land use, considering in some studies the potential contribution to cumulative effects, without ponder future actions.

4 Discussion

As stated above, sugarcane industry can cause highly significant cumulative effects on biodiversity that should be integrated in the EIA process for promoting biodiversity conservation, as the change in species diversity in forest fragments.

Some studies approach the species richness and abundance of species in sugarcane areas that could assist this understanding. Dotta and Verdade (2011) determined composition and frequency of occurrence of medium to large-sized mammals on an agricultural landscape in south-eastern Brazil and concluded that cane fields shelter a greater abundance of species as compared with pastures. Further, Dotta and Verdade (2009) consider the potential increasing in abundance of felines in forest fragments due to the increase of small rodents found in cane fields.

In this scenario, we also reinforce the crucial role in adopting a landscape or broader regional scale for support the CEA on biodiversity of sugarcane industry in the licensing process, that could be held by integrating Landscape Ecology in EIS to manage agricultural crops as sugarcane (Von Glehn, 2008). The application of tools or techniques such as landscape indicators, indices of biological integrity and habitat evaluation systems could also be used to improve CEA, supported by GIS to integrate spatial and temporal data.

Likewise, based on a recommendation of Noble et al. (2016), ToR should direct the types of cumulative effects questions and key information to assess the change in richness and abundance of specific species in forest fragments, to be considered in the EIS.

Finally, to allow a detailed identification of past, existing or planned activities that can contribute to significant impact is valuable for assessing cumulative effects (IFC 2013), better access to about other projects, possibly through the creation of a public database (Neri et al. 2016), is needed. Availability of baseline information of VC conditions from other studies to the usage by proponents is equally important to properly conduct CEA, likewise “a legal requirement on project proponents to share EA data/information” (Noble et al. 2016).

5 Conclusion

The notable spatial concentration of sugarcane industry projects in São Paulo State summon up the need to integrate a broader spatial and temporal scales in EIS, for an appropriate analysis of the combination of multiple influences in VCs, especially those related to biodiversity. The main practical difficulties of the CEA on biodiversity of sugarcane industry include: the vague definition in ToR and provision of directions to conduct CEA; lack of guidelines with specific terminology, procedures and tools to CEA; availability and standardization of past and current biodiversity data that could be addressed in the assessment and integrated adoption of landscape analysis. For supporting CEA on biodiversity in EIA, we point out the need to (i) ToR focus on specific question regarding cumulative effects on biodiversity, as the definition of key information to assess the change in species diversity; (ii) provide a guideline with general procedure and potential tools and techniques to drive the CEA; (iii) the environmental agency adopt initiatives to manage biodiversity data and information generated in the EIA process, in order to facilitate their use in future EIA; and (iv) reinstatement of landscape ecology studies in the environmental licensing process of São Paulo sugarcane industry as a requirement.

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