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ESCOLA DE ENGENHARIA DE SÃO CARLOS

Programa de Pós-graduação em Ciências da Engenharia Ambiental

ALEJANDRA DANIELA MENDIZÁBAL CORTÉS

Atlas de avaliação de sustentabilidade: Inovação em sistemas de
apoio à tomada de decisão para o setor da cana de açúcar no
estado de São Paulo

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Sustainability assessment atlas: Innovation on decision-making
support systems for sugarcane sector in the São Paulo state

São Carlos

Estado de São Paulo

2017

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Sustainability assessment atlas: Innovation on decision-making
support systems for sugarcane sector in São Paulo state

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"In a few decades, the relationship between the environment, resources and conflict may seem almost as obvious as the connection we see today between human rights, democracy, and peace."

Wangari Maathai,
Nobel Peace Prize, 2004

ABSTRACT

MENDIZÁBAL CORTÉS, A.D. (2017). Sustainability assessment atlas for São Paulo municipalities with sugarcane production: support-systems innovation for decision-making. Dissertation (Ph.D.) - São Carlos Engineering School, University of São Paulo. São Carlos - SP, Brazil.

The sugarcane cultivation in Brazil is one of the leading economic pillars, as it is an ethanol precursor, a renewable fuel produced in industrial markets as a substitute for fossil fuels. Brazil produces about 27.44% and 43% of the world production of ethanol and sugar, respectively. São Paulo state has the environmental and logistic conditions for a sugarcane industry, both characteristics turn it the main Brazilian's sugarcane production pole, with 63.74% of sugar and 48.23% of ethanol production (RFA, 2017). In São Paulo, the Agro-Environmental Zoning establishes the areas to cultivate sugarcane. However, tools to check the sugarcane industry influences on municipalities' socioeconomic aspects are superficial.

Considering sugarcane industry importance to São Paulo state and Brazil, the Nucleus of Research and Extension on Sustainability and Sanitation initiated different investigations and efforts to study, analyze, and predict the sugarcane industry's impacts and sustainability. Within this research's general line, the focused was on environmental impacts with emphasis on their accumulation and synergy, climate change scenarios, sustainability concept management among its stakeholders, industry's governance, mill unit's sustainability evaluation, and so forth. In this context, it appears as a necessary and conclusive step the sustainability assessment tool's development, allowing sugarcane industry evaluation, while respecting the individual circumstances. Therefore, this project objective is to develop a sustainability assessment model to sugarcane sector decision-making implemented in an atlas format.

The sustainability assessment model includes eighteen indicators about environmental, social, economic, and municipal policies issues. Those indicators describe seven of the eight Gibson's principles. It was the principles grouped according to their indicators' nature in three domains (environmental, socioeconomic, and municipal policies) that finally compose the sustainability index. Some indicators are considered elimination factors to avoid the trade-off between principles and domains, because more than limiting the calculus' next level, they cut the unsustainable situations by classifying them as such. In the end, the atlas present twelve maps that describe the distribution of principles, domains, and sustainability index across São Paulo state. The results show that the sugarcane ethanol sector still faces new environmental and social impacts, while the Agro-environmental Zoning presents a limited contribution to sustainability. According to the model, environmental issues (Domain A) there are new areas where sugarcane must be forbidden or, at least, increase its requirement for water quality improvement. Nevertheless, half of the state of São Paulo has the environmental condition for sugarcane

cultivars. For socioeconomic issues (Domain B), most municipalities presented a moderate performance. In the Domain C few municipalities reached the very high-performance, while the high-performance stood out for being the main one. In both, the Domain B and the Domain C, moderate and high are the significant municipalities' performances.

The atlas format results in a useful instrument, because it is easy to understand, can deliver a full state context and regions contrast, as well it brings a specific outcome for each municipality, and in case of environmental issues it also presents more precise details according to natural limits. Finally, the sensitivity analysis showed that the social indicators explain the results in 19.2%, while the municipal policy indicators influence 15.7% and the economic indicators 5.7%. The environmental indicators correspond to 59.4%, with indicator A3 (water quality) accounting for 19.7%.

Keywords: Sustainability assessment, sugarcane expansion, models, elimination factors, planning tools.

RESUMO

MENDIZÁBAL CORTÉS, A.D. (2017). Atlas de avaliação de sustentabilidade: Inovação em sistemas de apoio à tomada de decisão no setor da cana de açúcar no estado de São Paulo. Tese (doutorado) - Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, SP, Brasil.

O cultivo da cana-de-açúcar no Brasil é um dos principais pilares da economia do país, pois é um precursor de etanol, combustível renovável produzido em quantidades industriais como substituto de combustíveis fósseis. O Brasil produz cerca de 27.44% e 43% da produção mundial de etanol e açúcar, respectivamente. O Estado de São Paulo tem as condições ambientais e logísticas para a indústria da cana-de-açúcar, e ambas as características o tornaram o principal polo de produção no Brasil com 63.74% de açúcar e 48.23% de produções de etanol (RFA, 2017). Em São Paulo, o Zoneamento Agro-Ambiental (AENZ) estabelece as áreas onde a cana-de-açúcar pode ser plantada, considerando critérios ambientais. No entanto, ferramentas para avaliar as influências sobre os aspectos socioeconômicos dos municípios onde as culturas e indústrias de cana-de-açúcar estão inseridas são ainda superficiais.

Considerando a importância da indústria da cana-de-açúcar para o Estado de São Paulo e Brasil, o Núcleo de Pesquisa e Extensão de Sustentabilidade e Saneamento iniciou diferentes investigações e esforços para estudar, analisar e prever os impactos e a sustentabilidade da indústria da cana-de-açúcar. Dentro desta linha geral de pesquisa, o foco foi sobre os impactos ambientais com ênfase em sua acumulação e sinergia, cenários de mudança climática, gerenciamento de conceito de sustentabilidade entre os *stakeholders*, governança do setor, avaliação de sustentabilidade de usinas, etc. Neste contexto, parece ser um passo necessário e conclusivo o desenvolvimento de uma ferramenta de avaliação de sustentabilidade, que permita a avaliação da indústria da cana-de-açúcar, respeitando as circunstâncias particulares de cada região. Portanto, o objetivo deste projeto é desenvolver um modelo de avaliação de sustentabilidade para a tomada de decisão do setor de cana-de-açúcar operacionalizado em um atlas.

O modelo de avaliação de sustentabilidade inclui dezoito indicadores sobre questões de políticas municipais, ambientais, sociais e econômicas. Esses indicadores descrevem sete dos oito princípios de Gibson. Foram os princípios agrupados de acordo com a natureza de seus indicadores em três domínios (políticas ambientais, socioeconômicas e municipais) que finalmente compõem um índice de sustentabilidade. Alguns indicadores são considerados fatores de eliminação para evitar o *trade-off* entre princípios e domínios, porque mais do que limitar o próximo nível do cálculo, eles eliminam as situações insustentáveis, classificando-as como tal. No final, o atlas apresenta doze mapas que descrevem a distribuição de princípios, domínios e

índice de sustentabilidade em todo o estado de São Paulo. Os resultados mostram que o setor de etanol de cana ainda enfrenta novos impactos ambientais e sociais, enquanto o Zoneamento Agroambiental apresenta uma contribuição limitada para a sustentabilidade. De acordo com o modelo, em relação às características ambientais (Domínio A), existem novas áreas onde a cana-de-açúcar deve ser proibida ou, pelo menos, se deve aumentar as exigências para a melhoria da qualidade da água. No entanto, metade do estado de São Paulo tem a condição ambiental para as cultivares de cana-de-açúcar. Em questões socioeconômicas (Domínio B), a maioria dos municípios apresentou desempenho moderado. No domínio C, poucos municípios atingiram o muito alto desempenho, enquanto o alto desempenho se destacou por ser o principal. Em ambos, o Domínio B e o Domínio C, moderado e alto são os desempenhos significativos dos municípios. O formato do atlas resulta em um instrumento útil, porque é fácil de entender, pode oferecer um contexto de estado completo e o contraste de regiões, além disso traz um resultado específico para cada município e, em caso de problemas ambientais, também apresenta detalhes mais precisos de acordo com os limites naturais. Finalmente, a análise de sensibilidade mostrou que os indicadores sociais explicam os resultados em 19.2%, enquanto os indicadores da política municipal influenciam 15.7% e os indicadores econômicos 6.7%. Os indicadores ambientais correspondem a 59.4%, com o indicador A3 (qualidade da água) representando 19.7%

Palavras-chave: Avaliação de sustentabilidade, expansão da cana-de-açúcar, modelos, fatores de eliminação, ferramentas de planejamento

RESUMEN

MENDIZÁBAL CORTÉS, A.D. (2017). Atlas de evaluación de sostenibilidad: Innovación en sistemas de apoyo a la toma de decisión en el sector de la caña de azúcar en el Estado de São Paulo. Tesis (doctorado)-Escuela de Ingeniería de São Carlos, Universidad de São Paulo, São Carlos, SP, Brasil.

El cultivo de la caña de azúcar en Brasil es uno de los principales pilares de la economía del país, pues es un precursor de etanol, combustible renovable producido en cantidades industriales como sustituto de combustibles fósiles. Brasil produce cerca del 27.4% y el 43% de la producción mundial de etanol y azúcar, respectivamente. El Estado de São Paulo tiene las condiciones ambientales y logísticas para la industria de la caña de azúcar, y ambas características lo tornaron el principal polo de producción en Brasil con el 63.74% de azúcar y el 48.23% de producciones de etanol (RFA, 2017). En São Paulo, la Zonificación Agroambiental (AENZ) establece las áreas donde la caña de azúcar puede ser plantada, considerando para ello criterios ambientales. Sin embargo, herramientas para evaluar las influencias sobre los aspectos socioeconómicos de los municipios donde las culturas e industrias de caña de azúcar están insertadas son todavía superficiales.

Considerando la importancia de la industria de la caña de azúcar para el estado de São Paulo y Brasil, el Núcleo de Investigación y Extensión sobre Sostenibilidad y Saneamiento inició diferentes investigaciones y esfuerzos para estudiar, analizar y predecir los impactos y la sostenibilidad de la industria de la caña de azúcar. Dentro de esta línea general de investigación, se centró en los impactos ambientales con énfasis en su acumulación y sinergia, escenarios de cambio climático, gestión del concepto de sostenibilidad entre sus grupos de interés, gobierno de la industria, evaluación de la sostenibilidad de la unidad de beneficio, etc. En este contexto, aparece como un paso necesario y concluyente el desarrollo de la herramienta de evaluación de sostenibilidad, permitiendo la evaluación de la industria de la caña de azúcar como un todo, mientras se respeta las circunstancias individuales. Por lo tanto, el objetivo de este proyecto es desarrollar un modelo de evaluación de sostenibilidad para la toma de decisiones del sector de la caña de azúcar implementado en un formato de atlas.

El modelo de evaluación de sostenibilidad incluye dieciocho indicadores sobre temas ambientales, sociales, económicas y de políticas municipales. Esos indicadores describen siete de los ocho principios de Gibson. Fueron los principios agrupados según la naturaleza de sus indicadores en tres dominios (políticas ambientales, socioeconómicas y municipales) los que finalmente componen el índice de sostenibilidad. Algunos indicadores se consideran factores de eliminación para evitar los *trade-offs* entre los principios y los dominios, porque más que limitar el próximo nivel del cálculo, cortan las situaciones insostenibles clasificándolas como tales. Al

final, el atlas presenta doce mapas que describen la distribución de los principios, los dominios y el índice de sostenibilidad en el estado de São Paulo. Los resultados muestran que el sector del etanol de caña de azúcar aún enfrenta nuevos impactos ambientales y sociales, mientras que la Zonificación Agroambiental presenta una contribución limitada a la sostenibilidad. De acuerdo con el modelo, considerando los indicadores ambientales (Dominio A) existen nuevas áreas donde la caña de azúcar debe estar prohibida o, al menos, en las que se debe aumentar su requerimiento sobre la mejora de la calidad del agua. A pesar de ello, la mitad del estado de São Paulo tiene la condición ambiental para los cultivos de caña de azúcar. Para cuestiones socioeconómicas (dominio B), la mayoría de los municipios presentaron un desempeño moderado. En el Dominio C, pocos municipios alcanzaron un rendimiento muy alto, mientras que el de alto rendimiento se destacó por ser el principal. En ambos, el Dominio B y el Dominio C, moderado y alto son los rendimientos de mayor incidencia.

El formato atlas resulta en un instrumento útil, porque es fácil de entender, puede ofrecer un contexto de estado completo y el contraste de regiones, además de traer un resultado específico para cada municipio, y en caso de problemas ambientales también presenta detalles más precisos de acuerdo con los límites naturales. Finalmente, el análisis de sensibilidad mostró que los indicadores sociales explican los resultados en un 19.2%, mientras que los indicadores de política municipal influyen en un 15.7% y los indicadores económicos un 6.7%. Los indicadores ambientales corresponden al 59.4%, siendo que el indicador A3 (calidad del agua) representa el 19.7%.

Palabras clave: Evaluación de sostenibilidad, expansión de la caña-de-azúcar, modelos, factores de eliminación, herramientas de planeación.

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PRESENTATION

PRESENTATION

Five chapters divide this dissertation. Each one corresponds to a paper in submission process to a scientific journal, at the time it was delivered the final document for evaluation. As shown in figure 1, the five chapters/ papers follow a chronological order.

Figure 1. Dissertation chronological order.

The dissertation includes other two sections: The first one brings initial considerations to explain the dissertation's research subject, structure, goals, and objectives; and the second one is the final considerations about the research, its limitations, and the future follow-up aspects.

It is important to mention that the format and language used in this document are by São Carlos School of Engineering' recommendations and standards.

INITIAL CONSIDERATIONS

DISSERTATION'S GENERAL RESEARCH SUBJECT CONSIDERATIONS

Far from the vision that doctoral research must sustain itself, this work belongs to a long path developed by different postgraduate students, in a timeline that also reflects a step-way on thinking sometimes further from previous steps and sometimes closer.

All began with the sugarcane study on sugarcane producer municipalities' environmental system by Silva Neto (2010) and government- sugarcane entrepreneur's relationship characterization by Cetrulo (2010). In 2013, Regra analyzed scenarios tool to climate-change planning in sugarcane producer municipalities, noticing its potentialities as a dialog process between stakeholders, while Dibo (2014) evaluated the cumulative impacts inclusion in environmental impact studies and Gomes (2014) focused on sustainability concept through the sugarcane sector sociotechnical net. In the first two studies, it was possible to conclude a vertical relationship between government- sugarcane industry, with a government focusing on its command and control function and the sugarcane sector centered on the environmental improvements' economic advantages. Dibo (2014) concluded that a tool for analyzing the whole system is necessary as long there is cumulative impacts inclusion. Regra (2013) suggested to deep in scenarios tool to overlook the lack of stakeholders' interaction. For Gomes (2014), the absence of dialogue is essential, and it reflects itself in the use of the triple-bottom-line, a simple theoretical framework based on constant tradeoffs between dimensions, while given sugarcane sector complexity it should consider an integrated frame for planning with a focus on all aspects of sustainability.

For Duarte (2013), the Gibson's principles use as a framework to assess sugarcane mills responded to those demands. Then, a sustainability assessment tool with a focus on sugarcane sector and integrative framework was missing. Therefore, this tool elaboration showed up as a natural close for all these efforts. Nevertheless, its conception, direction, and method are entirely new, focusing on a vision that adds and not replace old works.

Sugarcane sustainability selection as a research topic was due to the constant growth of culture within the state of São Paulo and its economic importance for São Paulo state and Brazil. As a developing industry, sugarcane crops did not go unnoticed, as did their environmental, social and economic impacts. Its importance also lies in its potential for the large-scale renewable fuel

generation. However, to be sustainable, it is not enough to be a fuel that decreases dependence on fossil fuels, but its production must occur under sustainability conditions.

The sugarcane industry development under sustainability parameters has several advantages: first, the sustainable development of such significant economic activity would allow preventing large-scale environmental and socioeconomic adverse impacts, mitigate climate change scenarios, and it will be an example to other agricultural cultures and industrial activities. Likewise, it would allow gaining new international markets, as it would be possible to surpass European countries' currently imposed barriers.

It is given the sustainability not only by the production-environment relationship, but also by the links established with society, institutions, and local economy. In this sense, dissociating an economic activity from territory simplifies its analysis, although this simplification tends to homogenize regions, which is inadequate in environmental and social perspectives.

Then, it should not be the economic activity evaluated alone, but assessed in a social, economic, and environmental context and for such, it should include the entire set. On this line, the analysis of one economic activity is incomplete considering that many actions happen at the same time in each territory. Nevertheless, it is a limit required and, because if it predicts and includes all economic activities, the analysis would become too complicated and, therefore, it would avoid the very purpose of a decision-model elaboration.

The problem developed in this dissertation is: considering current efforts, it is necessary to establish an assessment tool that includes local aspects, whether environmental or social, that allow a panoramic view of sugarcane producer municipalities and local solutions to direct efforts and decisions to sustainability.

Then, it is the following question naturally developed:

Is it possible to create a sustainability assessment tool to improve decision-making support systems for sugarcane sector in the São Paulo state that consider regional context and local decisions?

Thus, this study goal consists in the elaboration of a sustainability assessment model for sugarcane sector and its implementation in an atlas, as a tool that can work to improve decision-making and considers geographic differences, either environmental or political.

For this purpose, it was the following specific objectives established:

1. To understand the current impacts of sugarcane industry and review the sustainability assessment efforts;
2. To Analyze the existing instruments that allow progress of sustainability in sugarcane sector;
3. To establish a sustainability assessment framework, its criteria, and principles;
4. To develop the atlas by using the indicators and maps algebra.

The sustainability assessment requires a frame that orders standards around different dimensions. Therefore, to search for an adequate structure is not easy. Following earlier works (Duarte, 2013; Gomes, 2014), it was the Gibson's sustainability principles chosen due to two factors:

1. By not focusing on dimensions, but instead, their interactions, the Gibson's Principles allow to consider and mix different types of indicators;
2. The eight principles cover the most accepted sustainability definition on its key aspects, such as resource use, intra-generational equity, intergenerational equity, social participation.

Additionally, the Gibson's Principles were appropriate to the intended sustainability assessment in both, the scale and the function for this; it was the principle five not considered because generates greater uncertainties, all at the production unit level.

For the other principles, the selected indicators had to meet specific requirements: (a) be available to the public, (b) originate from reliable sources, (c) and continually updated (as possible).

The indicators fusion in an atlas was possible through the establishment of algebraic relationships and the re-scaling of each indicator to unidimensional units. This resizing allowed both, to establish mathematical relationships and to present the results on a map. Finally, the one-at-the-time (OAT) sensitivity analysis application verified each indicator influence over Gibson's principles, domains, and final index.

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CHAPTER I.

THE SUGARCANE INDUSTRY: IMPACTS AND SUSTAINABILITY IN SÃO PAULO STATE, BRAZIL.

THE SUGARCANE INDUSTRY: IMPACTS AND SUSTAINABILITY IN SÃO PAULO STATE, BRAZIL

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ABSTRACT

Brazilian sugarcane production started in the colonial period, but until the 1970s, the government decided to promote ethanol fuel from sugarcane (PROALCOOL program) that São Paulo became the main production center. São Paulo State has environmental and logistic conditions to sugarcane industry, and both characteristics have turned it in the main production polo in Brazil. In this paper, we present a literature review regarding São Paulo's sugarcane industry impacts and efforts to measure and certify its sustainability. The main conclusion is that sugarcane ethanol industry still must tackle new environmental and social impacts.

Keywords: sugarcane, certification, sustainability, assessment.

1. INTRODUCTION

Brazil has more than 40 years of technological innovation experience in sugarcane production (de Moraes, Rodrigues, & Kaplan, 2017). Sugarcane cultivation for sugar production began in Brazilian Colonial period at the Northeast (NE) region, at that time, production yield was less than 10% of all national agricultural crop production. Until 1970's NE region dominated sugarcane processing, thus, this sector development was slow.

Due to the world oil crisis in 1973, the Brazilian government started the National Alcohol Program (PROÁLCOOL) to encourage the alcohol production for automotive fuel (a mixture up to 20% of ethanol in gasoline), in São Paulo state. As Monteiro *et al.* (2008) indicate, at that moment the price of oil reached record levels, while the price of sugar was declining.

However, at the end of the 1980's, the alcohol supply crisis, the reduction in stimulus to its production and the fall in oil prices affected the PROÁLCOOL program credibility (Monteiro, et al., 2008; Duffey and Stange, 2011). This situation ended with the state sector deregulation, and sugarcane industry started its self-organization aiming to achieve more efficient management, attempting to reduce costs and increase productivity (Barros & Moraes, 2002; De Oliveira, 2012; Van den Wall Bake et al., 2009).

At the end 1990's, a new phase of crops expansion began in other states as Paraná, and Minas Gerais, the major producers because their favorable environmental conditions, furthermore extending to Cerrado biome, mainly to Goiás and Matogrosso do Sul (Simões de Castro *et al.*, 2010) (Figure 2). In São Paulo, the changes in crop area were not expressive, considering that already 20% of the area produced sugarcane. Instead, the beat in São Paulo was, and is still today, related to the productivity and the reduction in water and other resources consumption.

Figure 1. Planted area history with sugarcane in Brazil and the main producer states. Elaborated by the authors with data from UNICA (2016).

Between 2003 and 2004, Brazil increased its exports by 259%. Since 2005, Brazil has been the second largest bioethanol producer accounting for 33.2% of global production; the USA is the first largest bioethanol producer. In 2010, Brazil produced 27,520 million liters, almost half of the United States production (Duffey and Stange, 2011), and in the 2016/2017 harvest, Brazil produced 685 million tons of sugarcane, 27.7% of all world ethanol production and 20.3% of worldwide sugar production (DEPEC, 2017). In 2016/2017, São Paulo participated with 55.2% of national sugarcane production. In other words, São Paulo accounted for 27.67% of all sugar in the world and 13.36% of all ethanol (DEPEC, 2017).

Brazil stimulates the generation of second-generation biofuels. These efforts focus on the production of cellulosic bioethanol research and development, and on the reuse of sugarcane bagasse. Among the ongoing projects, the company Petroleo Brasileiro S.A. (PETROBRAS) stands out, with the use of enzymatic hydrolysis processes (Eisentraut, 2010). In this scenario, two technologies arise for

sugarcane bagasse use as an energy source, one is electricity generation to supply the industry and surroundings, and the other is ethanol production (Mutanga et al., 2016). Several innovative technologies regard second-generation biofuels are deployed at São Paulo state research centers and focus on producing second-generation ethanol to increase the amount of biofuel produced without increasing acreage. (Carpio; & de Souza, 2017). Smeets et al. (2008) conclude in its study that competition with food production is a major concern to the ethanol industry.

Figure 2. Sugarcane production expansion in Brazil. Source: IBGE (PAM) in Sauer & Leite, 2012.

Since PROALCOOL program, it is the São Paulo state preferred to developing sugarcane crop, due to its favorable environmental conditions, like soil and climate characteristics and logistics. According to Camara and Caldarelli (2016), the production gains come from price incentives and

territorial expansion on natural and cultivated pastures and on temporary and permanent cropping areas.

Sugarcane crops started in the center zone of São Paulo, and from it expanded to areas formerly occupied with livestock activities in the state's western region, in the former decade, substituting livestock that has lower profitability than sugarcane production (Monteiro et al., 2008). A study deployed by Egeskog et al. (2016) regard São Paulo farmers' opinion regard shifting from livestock production to sugarcane production presents that most farmers interviewed "considered sugarcane as a land diversification option with relatively low economic risk. "At the national level, the regulation regard sugarcane industry environmental impacts include a set of 50 "laws, resolutions, ordinances, decrees and most relevant technical standards in agricultural and industrial sectors" (Macedo & Nogueira, 2004).

Currently, sugarcane industry provides fuel and sugar to an internal and external large-scale market in Brazil. According to Dantas et al. (2013, p. 363), "sugarcane may provide a part of the solution to the global challenge of expanding energy supplies sustainably." By concentrating most of sugarcane crops, São Paulo state is a pioneer in legislation and has a broad database, much of which is available on the internet at government sites like the National Institute on Spacial Research (INPE), the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), the São Paulo state's Secretary of Environment (SMA), and the Environmental Company of the State of São Paulo (CETESB).

So far, there is "strong evidence that all bio-ethanol production is mild to strongly beneficial from the perspectives of climate protection and fossil fuel conservation" (Blottnitz and Curran, 2007, p. 161). However, to reach external markets, Brazil must demonstrate that considers sustainability in all its dimensions.

São Paulo State has environmental and logistic conditions to sugarcane industry, and these characteristics have turned it in the leading production polo in Brazil. In this paper, we present a literature review regarding the São Paulo's sugarcane industry impacts and efforts to measure its sustainability.

2. SUGARCANE INDUSTRY IMPACTS

Brazilian public and private initiatives have focused on international certification. Martinelli and Filoso (2008) point out that sugarcane industry must consider its sustainability, and to be socially just

and environmentally friendly to be competitive in the international market. Therefore, sugarcane must focus on five aspects: (1) Proper planning and environmental risk assessment for expansion; (2) Improvement of land use practice, (3) Protection of streams and riparian ecosystems; (4) banning sugarcane burning, and (5) establish fair working conditions for sugarcane cutters. Smeets et al. (2008) discuss in their work similar areas of concern for Brazilian bioethanol industry to achieve sustainability.

Sugarcane industry has improved all areas of concern and aspects mentioned above, but new considerations regarding environmental sustainability enhancement and broad social impacts consideration have risen (Silalertruksa; Pongpat; & Gheewala, 2017), as shown next. Still, sugarcane industry impacts can be positive and negative in almost all aspects of sustainability, according to Macedo and Nogueira (2004). Here it is presented a compendium regarding ethanol industry impacts and certifications found in the literature.

2.1. Environmental impacts

2.1.1. Air pollution

Leal *et al.* (2011) and Capaz *et al.* (2013), and more recently Morales *et al.* (2015), detach the increasing crude harvest, and its benefits to the greenhouse gas (GHG) emissions' reduction.

Luo *et al.* (2009) performed a Life Cycle Assessment, and they concluded that ethanol biofuel diminishes the abiotic depletion, GHG emissions, ozone layer depletion and photochemical oxidation. However, Galdos *et al.* (2013, p. 581) advice “about the importance of include black carbon emissions when” calculating the indicators of global warming and human health. According to their results, the present technology in Brazil is encouraging important environmental benefits, and they agree that the end of burning will decrease GHG emissions, but also the emission of black carbon in the agricultural phase of ethanol production”.

According to CATI (2017) data, São Paulo state has reached 90% of the mechanized harvest, so air pollution soon will be considered only if its calculus includes transportation phase.

2.1.2. Land Use Change

Zaubier & Van Vooren (2008) mention that cumulative impacts of major importance come from the agricultural phase and refer to land use change. They indicate that "in the last thirty years the production of sugarcane has been concentrated in the center-south region" and, according to Tetti and

Macedo (2005), the expansion has taken place in areas already converted to agriculture or livestock grazing.

Currently, the sugarcane crop has been advancing to the *Cerrado* biome, in Mato Grosso do Sul, Goiás, and Minas Gerais, with a possible increment in the pressure on biodiversity since it is recognized that the agricultural frontier expansion occurs by the sugarcane crop effects (Coutinho et al., 2010). Regarding this matter; De Sá et al. (2013) concluded that the effect's dynamic has a delay of ten to fifteen years. They also indicate that while the effect is small, if compared to traditional deforestation, it is significant. Lapole et al. (2010) complement that for 2020 Brazil will have a carbon debt of 250 years due to indirect land use change.

Macedo & Nogueira (2014) indicate that continued expansion of sugarcane occurs due to genetically improved varieties (selection of crosses) availability, allowing the expansion to less adequate areas while increasing productivity in the already converted land. Nevertheless, they also mention that the productivity per acreage increment prevents a proportionally continued expansion, reducing this indirect negative impact (Egeskog et al., 2016).

2.1.3. Soil erosion and degradation

In general, intensive agriculture has been the cause of soil erosion, acquiring greater importance in regions with extensive periods of droughts and heavy rainfall seasons, steep slopes and unstable soils (Duffey and Stange, 2011).

Macedo and Nogueira (2004) point out the erosion reduction by the quick growth of sugarcane, the rotation crops practice, and the five cuts cycle that allows the soil protection most of the time. On the other hand, they mention burning harvest leads to soil compaction, erosion and soil loss process.

The extensive agricultural production model adopted by sugarcane industry brings several adversities to soil's chemical and physical structure, decreasing its nutrients availability levels, incentivating compaction due to heavy machinery in the soil preparation phase, and loss of biotic ecosystems due to soil exposure are some of the sugarcane production environmental negative impacts (Brandani et al., 2016).

2.1.4. Chemicals contamination

Luo, Van Der Voet, & Huppes (2009) performed a Life Cycle Assessment, concluding that ethanol biofuel increases toxicity, ecotoxicity, acidification, and eutrophication. The genetic improvement

helps in phytosanitary control against pests and diseases by reducing to similar or lower levels of herbicides, pesticides, and fertilizers than other large-volume crops (Vilaça & Pinto, 2012), like citrus, corn, coffee, and soybean (Tetti and Macedo, 2005).

For Cerri et al. (2011), the agricultural management that promotes carbon capture and carbon accumulation in the soil is an essential potential mitigation option. From the burning to the crude harvest, there is a carbon accumulation in the soil surface, which changes according to the soil's characteristics.

Leal et al. (2013) explain that sugarcane straw used to cover the soil between cultivation periods avoids erosion and soil degradation. Furthermore, the straw blanket increases microorganisms that could be plagues, or instead, it could present an important role in the insect pests' biological control or the soil's organic substances decomposition. The percentage of bagasse to fulfill the soil cover is still undetermined, and to the surplus, there are some solutions as burning it to get electricity.

Dias et al. (2013) indicate that sugarcane trash bagasse can be lignocellulosic material to generate electricity or second-generation ethanol. They concluded that to change the production from electricity to ethanol, it is necessary flexible biorefineries. To them, this would create economic advantages, while environmentally will diminish CO₂ emissions (annulling the transportation emissions from fields to mills). However, they also remark the necessity to consider the chemicals, e.g., as high-risk solvents, used in second-generation ethanol generate more impacts to the environment than electricity production.

According to Christofolletti et al. (2013), frequent discharges of vinasse, over a long period, produce chemical and physical-chemical properties changes of soils, rivers, and lakes, affecting agricultural soils and biota in general, due to its low pH, electric conductivity, and chemical elements.

The vinasse, commonly used on soil without treatment as fertilizer, could be processed by anaerobic digestion in biorefineries due to its energy potential. Moraes et al. (2014) indicate that it could produce the energy demanded by a population of 130,000 inhabitants or to stimulate the second-generation production. The authors also conclude that fertirrigation with bio-digested vinasse could reduce environmental impacts due to the decrease of global warming potential impacts and pollutant loads, which was comparable to the population of some cities for a single sugarcane processing plant. Furthermore, the author considers the economic gains from carbon credit commercialized could contribute to the motivation of applying this technology. From the global economic perspective,

sugarcane could have high profit with vinasse bio-digestion and with the use of biogas than traditional fertirrigation. It could lead to profits, considering energy, environmental and economic perspectives.

2.1.5. Water quality and availability

Throughout sugarcane cultivation and industrial processing, several potential impacts on water quality are of major concern, considering the agrochemicals used and the vinasse chemical characteristics as a non-treated residue (Guarengi; & Walter, 2016). Goldemberg et al. (2008) pointed out the surface water bodies' pollution, and the contamination's risk increment using fertilizers and agricultural pesticides. Sugarcane can generate water heating, acidification, increase of turbidity, oxygen imbalance and increased bacteria levels (Gunkel et al., 2007). Also, Filoso et al. (2003) reported loading across rivers in São Paulo state (Ipojuca river, in Piracicaba), while Martinelli and Filoso (2008) correlated burning harvest with acidification and the detection of polycyclic aromatic hydrocarbon in lake's sediment in São Paulo. Furthermore, there is an association of ethanol production with agrochemicals into sediments and fishes in Piracicaba's river (Martinelli and Filoso, 2008).

The quantity of water required in sugarcane cultivation depends on climatic conditions. Therefore, when irrigation is necessary, the water footprint increases (Scapore et al., 2016). Fertirrigation diminishes the pressure on water (and land) availability and according to Martinelli and Filoso (2008), and Scapore et al. (2016), vinasse can be used for irrigation and, if properly managed, may be an excellent source of nutrients and organic matter for sugarcane crops, increasing production yield.

According to Vilaça and Pinto (2012), the current use of vinasse in the process of fertirrigation and the reuse of water has drastically reduced this potential impact. At present this problem is restricted to areas with little rain, and where water is required mainly to employ vinasse in the process of fertirrigation of sugarcane (a process that increases productivity and reduces costs) (Vilaça & Pinto, 2012).

2.1.6. Ecosystems

All the impacts on soil and water, will potential effects on sensitive ecosystems (Duffey and Stange, 2011), and communities. As well, the field expansion diminishes the natural habitat directly and indirectly.

2.2. Socioeconomic Impacts

2.2.1. *Equity income and life quality*

Zuurbier & Van de Vooren (2008) and Duffey and Stange (2011) point out that from the social perspective, Sugarcane cultivars have promoting rural development and employment, has improved the conditions and livelihoods of small farmers.

Azadi, Jong, Derudder, Maeyer, & Witlox (2012) remark that mechanization implies in fewer jobs, meaning that total elimination of burning harvest will generate unemployment in Brazilian agri-rural sector. Then, Ribeiro & Ficarelli (2010) warn about the urgent need to create an inclusive future for the population of cutters who will lose their jobs, relying on principles of environmental and social justice.

The change from livestock to sugarcane fields provides a better quality of economic and social indicators, according to Martinelli, Garrett, Ferraz, & Naylor (2011). These authors enumerate some factors that improve with the expansion of sugarcane cultivar: expanding employment, opportunities, public services, and infrastructure development.

Arndt, Benfica, & Thurlow (2010) agree with all this on the small scale of sugarcane production. They conclude that sugarcane can improve well-being and rural development by the creation of jobs, the access to energy improvement, poverty reduction and rural development. However, the authors clarify that for large-scale production, the influence will depend on the production characteristics, like harvest procedures.

In Petrini, Rocha, & Brown (2017) study, regarding different mill-cultivated and smallholding farming scenarios deployed in Brazil, the authors concluded sugarcane expansion brought distinct perspectives among smallholding farmers, where “the outlook for family farmers surrounded by sugarcane is not favorable, no matter whether they lease their land or not” and “the land lease contracts make it difficult for farmers to return to their former activities”.

2.2.2. *Work conditions and population's health*

The pollution caused by burning the harvest affects directly harvest cutters (Uriarte et al., 2009; Martinelli and Filoso, 2008). Therefore, workers' health will improve according to the crude harvest expansion.

In its work, Silveira et al., (2013) conclude that due to emissions exposure, “produced by the burning of sugarcane during harvesting, induces genomic instability in workers,” and reinforces “the necessity of adopting more advanced techniques of harvesting sugarcane to preserve human health.”

Zaubier and Van Vooren (2008), and Duffey and Stange (2011) denote the low level of training, the use of migrant labor in this sector, and the extreme physical effort that harvesting demands. For Monteiro et al. (2008), in social terms, the poor working conditions, the low wages, the use of seasonal labor, and the generation of inequalities in the field stands out. Smeets et al. (2008) report poisoning and death due to the use of pesticide in sugarcane fields.

2.2.3. *Use of crops for food vs. fuel production*

Food security is an important factor if crops are addressed to fulfill the fuel and other forms of energy markets’ demands, rather than to crops for food production (Duffey and Stange, 2011). According to Duffey and Stange (2011), “the links between biofuels and food security are beginning to be understood” even though it is not an extension but a distribution factor that affects food availability.

Although De Sá et al. (2013) conclude that the conversion increment of forestland to grass is significant, Ferreira-Filho & Horridge (2014, p. 603) infer that “the amount of new land required for sugarcane production would be relatively small.” Azadi et al. (2012) also express this uncertainty.

While the use of crops for fuel production expand, more land and water will be necessary, reducing the land and water availability for food crops (Gasparatos et al., 2013). Runge and Senauer (2007) conclude that competition will lead to less area available for food cultivars. Consequently, the prices will rise and poor people from developing countries will diminish their access to an adequate diet (that could end in malnutrition), especially because today these populations use a large part of their salaries in food and this share will increase. Second-generation ethanol presents itself as a strategy to decrease fuel and food crops competition (Carpio; & de Souza, 2017).

Next, there is a resume of impacts described in this section:

Table 1. Impacts resume, indicating actions and solutions. Elaborated by authors

Element	Impact	Action	Efforts
Air pollution	GHG emission increments	Harvest burning	Crude harvest
	Ozone depletion		
	Photochemical oxidation		
	Black carbon emission		
Land Use Change	Expansion to new states and bioma	Crop phase	Increment on production
	Indirect land use change in amazon bioma		
	Pressure on biodiversity		
Soil	Erosion	Intensive agriculture	Use of sugarcane straw to cover soil
	Compaction		

Element	Impact	Action	Efforts
	Soil exposure		
	Loss of nutrients		
Chemical contamination	Increment on toxicity, acidification, and eutrophication	Crop phase	Genetic improvement Use of sugarcane straw to cover soil
Rivers	Changes in chemical properties: low pH, electric conductivity, and so forth.	Vinasse discharges	Process vinasse by anaerobic digestion to produce energy
	Water heating, acidification, increase of turbidity, oxygen imbalance and increased bacteria levels	Use of fertilizers and agricultural pesticides in crop phase	Vinasse processed as nutrient and organic matter source to sugarcane crop (fertirrigation)
Social income and quality of life	Promotion of rural development and employment by better salary than other cultures.	Crop and industrial phase	
	Creation of Jobs, access to energy improvement, poverty reduction and rural development	Industrial phase	
Work conditions	Extreme physical effort; respiratory diseases; low level of training, use of migrant and seasonal labor	Crop phase	End of burning harvest

3. SUGAR AND ALCOHOL INDUSTRY SUSTAINABILITY

Concerning public initiatives stands out the certification developed by the IETHA- International Ethanol Association, and the INMETRO- National Institute of Metrology (INMETRO) (De Oliveira, 2012). The instrument contains environmental and social criteria, including labor issues (Goldemberg et al., 2008).

In April 2006, the Sugarcane Industry Union (UNICA) signed an agreement with the Ethos Institute, which provides for a diagnosis of the plant's stage in relation to the topics covered by the Institute's indicators: Transparency and Governance; Government and Society; Environment; Consumers and Customers; Providers; Community and Internal public. This agreement considered the Ethos indicators application on 98 plants in the interior of São Paulo (Ferraz, 2007).

The Institute for Forest and Agricultural Management and Certification (IMAFLOA) planned the creation of a Socio-Environmental Agricultural Certification Program, for which it chose the sugarcane crop as a pilot project, among orange and coffee plantations, after a study funded by the US NGO Rainforest Alliance.

The objective of this project was to define the evaluation and monitoring standards, to establish and implement the socio-environmental certification system, and to turn this system consistent with the

primary international certification initiatives (IFOA, Fair Trade, and ECO-OK) (Ferraz, 2007; Espíndola, 2009). The final document of this initiative serves as a basis for the discussion and execution of proactive public policies, aiming to give sustainability to the sector, as well to avoid the external markets non-tariff barriers impositions to Brazilian products (Ferraz, 2007).

Some plants have specific certifications, such as the San Marino plant, which uses Green Energy Bioethanol Sustainable Program (issued by Green Energy International Ltd, the leading supplier of biofuel in the United Kingdom).

The Better Sugarcane Initiative (BSI) is an enterprise of international groups, NGOs, oil companies and Brazilian producers through UNICA, which aims to establish socio-environmental principles and criteria for sugarcane-producing regions (De Oliveira, 2012).

There are also other projects focused on bioenergy research and development, such as the Bioenergy (BIOEN) program of the Foundation for Research Support of the State of São Paulo (FAPESP). This project aims to stimulate and articulate research and development activities to Promote the advancement of knowledge and its application in areas related to the production of bioenergy in Brazil.

Guimarães et al. (2010) tested the European indicators used in Sensor project, listed by Monteiro et al. (2008) for Mato Grosso do Sul state micro-regions, Brazil. They analyzed the sugarcane expansion along the municipal sustainability, using the method Barometer of Sustainability. As a result, the classification did not include micro-regions in the sustainable and unsustainable categories, it considered four of them in an intermediate status, and classified six as poor or potentially unsustainable. The four micro-regions with intermediate result are the ones with no sugarcane fields' increment and that have Pantanal biome, meaning that are legal restrictions on this crop cultivation. The regions with poor results have an expressive expansion of sugarcane. The final assessment indicates a moderate performance of municipalities regarding sustainability.

Gavioli (2011) elaborated a sustainability assessment for agricultural ecosystem families, using the MEMSIS method (Framework for the evaluation of natural resource management systems incorporating sustainability indicators.) According to this methodology, sustainability includes three dimensions: economic, environmental and socio-cultural, which are related to five agricultural ecosystems sustainability attributes: productivity, stability/resilience, adaptability, equity, and autonomy.

The authors selected four agricultural systems to apply the model. The results indicated that the full diversify agricultural ecosystem was the most sustainable, concluding that the “the diversification of subsystems and crop is an essential element in achieving high levels of sustainability” (Gavioli, 2011, p.109).

Tôsto and Pereira (2011) calculated the Environmental Sustainability Index of sugarcane that consists of 4 criteria (themes) and 12 sub-criteria (indicators). The authors used the USLE (Universal Soil Loss Equation) model to determine soil erosion rate, and they performed interviews with rural workers, functionaries of the Technical Assistance Coordination of São Paulo (CATI), mill managers, farmers, and researchers from EMBRAPA (Environment unit). Finally, they used the MACBETH (Measuring Attractiveness by Categorical Based Evaluation Technique) Software to determine the numerical model (linear programming). This study is an advance in sustainable assessment, but as the authors concluded, it is necessary to include new criteria, like diversity, water quality, and GHG emissions. In general, this study is weak for environmental aspects.

Rodrigues-Filho and Juliani (2013) present a complete evaluation model regarding environmental and socioeconomic monitoring, São Paulo state municipalities, focusing on sugarcane industry sector. This model includes socioeconomic and environmental aspects, through the creation of indexes.

Machado et al. (2014) applied the Barometer of Sustainability methodology to the municipalities of Jaboticabal (without sugarcane expansion) and Barretos (with an expressive sugarcane expansion), comparing the years 2000 and 2010. They analyzed 17 indicators for human dimension, divided into five criteria; and 16 indicators for exo-systemic dimension, distributed in four criteria. The 33 indicators ended in nine indexes, one for each criterion. As a general result, both municipalities have little improvement between the years 2000 and 2010 regarding sustainability. The authors concluded that both municipalities presented negative impacts on exo-systemic dimension and that with this methodology it is not possible to assess the impact of sugarcane and the exo-systemic quality in the municipalities.

Pereira and Ortega (2010) carried out an extended evaluation of agro-industry products, among which ethanol was included. In this work, he calculated emergy and a Life Cycle Assessment analysis. About emergy, the author elaborated a model of flow for the agricultural systems, to catalog each flow in one of the next categories: (R) renewable natural resources, (N) non-renewable natural resources, (M) economy materials and (S) economy services. In relation to the LCA, four phases were carried out: (a) definition of objective and scope; (b) inventory; (c) evaluation of the environmental impacts associated with the system; and (d) results' interpretation. The conclusion is that despite

ethanol from sugarcane performance "is better than other biofuels, it is not sustainable in the long run because it is a chain dependent on fossil fuel." (Pereira and Ortega, 2010, p.164)

Silaertrusksa et al. (2015) measured eco-efficiency to assess sustainability using the gross value added and total GHG emissions. They concluded that mechanized harvest, the use of sugarcane waste, and the vinasse recovery as fertilizer are the best combination to maximize eco-efficiency.

4. CONCLUSION

Sugarcane ethanol industry still must tackle enhancing environmental and social impacts, beyond burning harvest. Social conditions on crop and millwork are different; to the point, it has not been the millwork considered in any study referred here.

Progressively, there are preventive and mitigatory measures to deal with ethanol production impacts, but also new impacts or new sources of same impacts are found. Still, future or delay impact on food security and indirect land use change are the major concern impacts, considering that mechanization avoids other essential impacts, as workers health and labor conditions.

Sugarcane impacts research goes along with the development of sustainability criteria, indicators, and frameworks. There are many efforts, from the private and public sphere, to find the criteria to assess sustainability.

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CHAPTER II

BRAZILIAN ZONINGS OF SUGARCANE AS A BASE FOR A SPATIAL TOOL OF SUSTAINABILITY.

BRAZILIAN ZONINGS OF SUGARCANE AS A BASE FOR A SPATIAL TOOL OF SUSTAINABILITY

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ABSTRACT

Sustainability assessment requires using different data handling and formats, which can be quite complicated without adequate tools and procedures. For the Brazilian sugar-energy sector, the use of geographical information systems (GIS) has facilitated the creation of two essential assessment instruments: the Brazilian nationwide Agro-Ecological Zoning (AENZ) program and the Agro-Environmental Zoning of the São Paulo State (AECZ). In this paper, the potential of both zoning instruments as sustainability assessment tools is compared using a set of seven criteria selected for this purpose. AENZ meets two of the sustainability criteria considered, does not fully comply with four criteria, and fails one criterion. Meanwhile, AECZ meets two criteria, partially fulfills three criteria, and fails in the remaining two. Thus, the tools evaluated did not approach all dimensions of sustainability, as initially proposed. The identified weaknesses include the lack of information update, the non-existence of cumulative and synergistic impact considerations, as well as temporal analysis. Even if merged, the combined AENZ and AECZ are not able to fulfill all seven criteria.

Keywords: assessment, sustainability, criteria, geographical information systems, agriculture, bioethanol.

1. INTRODUCTION

Assessing sustainability requires a systemic approach, highlighting the relationships between the various dimensions inherent to sustainability (Silva, 2002). Geographic Information Systems (GIS) enhance data presentation, analysis, and communication of these relationships. Therefore, GIS has evolved into a valuable support tool in decision-making processes. Moreover, presents itself as a friendly and intuitive organizational database (Geoghegan, Wainger & Bockstae, 1997).

In this sense, GIS facilitates and simplifies the integral evaluation of many variables on a single interface. It also makes possible the rapid generation of information, as well as the collection of new, unforeseen variables and new interactions at any moment during analysis processes (Donha, Souza & Sugamosto, 2005). These systems also make

possible variables assembling and weighting, giving priority to different alternatives and optimizing decision-making (Francisco et al., 2007).

GIS permits the processing complex data divided into different layers, applying conditionals, and conducting other operations. There are several ways to incorporate socioeconomic and environmental factors, which are requirements for a sustainability diagnosing, in GIS platforms. However, efforts focus on exposing the principles and terms, while there are few advances related to applicability (Silva, 2002).

It is necessary to conduct planning on a territorial basis to use GIS, taking into account the fragility, resilience, and potential of each area (Donhas, Souza & Sugamoto, 2005; Duffey & Stange, 2011).

For the sugarcane sector, the Brazilian Federal Government developed the Agro-Ecological Zoning (AECZ) (Brazil, 2009) as an answer to “concerns about the expansion of the sugarcane frontier” (Kaup, 2011, p.5) and the State of São Paulo deployed the Agro-environmental Zoning (AENZ) in 2008 ahead of national sugarcane sector regulation initiatives. Both instruments were deployed in GIS platform and “seek to regulate the planting of sugarcane, for sugar and bioethanol production, based on land use sustainable planning in harmony with biodiversity” (Brazil, 2009, p.1)

The sugarcane sector's importance lies in its constant and expansive growth since the Brazilian PROALCOOL program in the 1970s. This program aimed to “minimize the country's high for importation expenditure, as well as a strong strategic need to curtail the high dependence on imported oil” (Matsuoka et al., 2011, p.373), by adding a 5% bioethanol to gasoline (used as fuel) and investing in its technological and distribution system improvement throughout the country. The 1990s began the period of self-regulation (privatization) that continues today, and it is possible to see both domestic and international market increments (Barros & Moraes, 2002). This increasing phase has continued in the post-devaluation of Brazilian currency (Real), with an 8% annual production increase in the last decade's first half (2000-2005). This increasing period was in response to large domestic market demand (primary consumers) and an external market opportunity, with oil price instability playing a crucial role. In 2016, Brazil is the second largest producer of bioethanol, with 80% of cars using blends of bioethanol and gasoline (Hira & De Oliveira, 2009).

In Brazil, 90% of sugarcane production comes from Center-South region (Matsuoka et al., 2011, Hira & De Oliveira, 2009, Rudorff et al., 2010), with the state of São Paulo providing nearly 60% of national production (Rudorff et al., 2010).

However, sugarcane sector's sustainability is debatable, due to social and environmental impacts identified by potential external markets, mainly from Europe (Janssen & Rutz, 2011; Lora et al., 2011; Torquato, 2013; Nassar et al., 2008; Balsadi, 2009).

To succeed in external markets, by reducing environmental impacts and increasing production, the sugarcane energy sector opted to invest in biotechnological improvements, invest in the production of second-generation bioethanol, and invest in high research efforts focusing on the third generation of bioethanol (Eisentraut, 2010; Soccol et al., 2010). In addition to increasing bioethanol production, these will better address the requirements of external markets, which typically require certification processes (Espindola, 2009).

Figure 1. Agro-Ecological Zoning (AECZ) for Brazil. It breaks down the Brazilian national territory into four degrees of aptitude for sugarcane cultivation. Adapted from Manzatto et al., 2009.

It was The Agro-Ecological Zoning (AECZ), presented in Figure 1, developed by the Brazilian Agricultural Research Corporation (EMBRAPA), in coordination with the Ministry of Agriculture, Livestock and Food Supply (MAPA) and the Ministry of

Environment (MMA) (Manzatto et al., 2009). According to the decree that gives its origin, the review and update of its database are under MAPA's decision (Brasil, 2009).

The AECZ intends “to provide a technical basis for public policy formulation with the aim of a planned expansion and sustainable production of sugarcane in Brazil” (Manzatto et al., 2009, p.7). Among other goals, the AECZ attempts to avoid the cultivation of sugarcane in unsuitable areas, considering soil and weather characteristics, and to prevent the cultivation of protected biomes, including the Amazon and Pantanal biomes.

1.1. Zonings of sugarcane production sector in Brazil (AECZ)

EMBRAPA considered various indicators in developing the AECZ, including land vulnerability, climate risk, current environmental legislation, and the potential for sustainable agricultural production. A significant feature is that the AECZ formalizes the exclusion of sugarcane production from the Amazon and Pantanal biomes. With the introduction of AECZ for sugarcane, however, the stakes have been raised to include important ecological criteria with a national requirement for all financing institutions to evaluate the loans essential for large farming enterprises based on their compatibility with that instrument (Leopold & Aguilar, 2009). Also, according to Leopold (2010), the government reserves the right to refuse the granting or renewal of permits to the local processing facilities that the farmers depend upon to buy their goods if there is evidence of illegal activity. That measure is an effective enforcement mechanism because the processing of sugarcane must occur within a few hours after harvest and farms usually do not have more than one processing plant close enough to work with.

1.2. Sugarcane production sector zoning in Sao Paulo State (AENZ)

In the State of São Paulo, the Secretary of Environment (SMA) has coordinated the “green ethanol” project, which seeks to set up a partnership with the sugar and bioethanol sector to develop a consensus on parameters to be adopted by producers and then monitored by the SMA.

Within this project, SMA published the AENZ in 2008. The AENZ became the base of SMA resolution 88 in December 2008. This resolution establishes parameters and guidelines for agro-industrial units environmental licensing to create sustainable conditions for development within the State of São Paulo (São Paulo, 2008b).

This instrument (Figure 2) divides São Paulo state into four different types of areas i) suitable for sugarcane crop; ii) adequate, but with environmental restrictions (focused on fauna impacts); iii) adequate, but with environmental limitations (focused on fauna impacts and protected areas conservation); and iv) inadequate. For the AENZ elaboration, the SMA also considered secondary data regarding climatic conditions, slope, and environmental protection areas (Ferriaciolli, Jacomini & Marquez, 2013).

Figure 2. Agro-Environmental Zoning (AENZ) for the sugarcane sector in the State of São Paulo, Brazil. Source: São Paulo, 2008.

This tool has the potential to exclude areas that, whether by the suitability of its soils, rainfall or the protection status/conservation, are not adequate for sugarcane crop development. It was the areas considered as a priority for biological corridors formation also excluded.

However, environmental competencies are not the only aspect to consider when it comes to assessing sustainability. It is also necessary to incorporate both social and economic issues. In the social field, it was the bioethanol industry response based on treaties,

certifications, as well as optional and voluntary commitments, which have become essential according to intended consumer market requirements.

The objective of this study is to evaluate the potential of both AECZ and AENZ as a spatial sustainability assessment tools for the bioethanol sector. Both AECZ and AENZ decrees, documents, and documentation were analyzed according to a system of criteria focusing sustainability.

2. METHODS

According to Haecking and Guthrie (2008), directed/centered sustainability evaluation systems characteristics relate to three aspects: context, process, and evaluation. The first two, although necessary, cannot be changed by the evaluator, since the evaluation context as well as questions about how, where, when, and to whom, are related to the promoter and the final assessment goal. However, assessment features – the evaluation content itself – can be modified by the evaluator: such as scope of assessment (themes/dimensions to be included in the evaluation), integration of the assessment (related to the technique used to combine themes and dimensions included in the assessment), and strategy (which refers to the approach and its perspective in terms of breadth and length).

On the other hand, for Pinter et al. (2012), the Bellagio's principles (Hardi & Zdan, 1997), now reformulated and renamed as principles of sustainability evaluation and measurement (STAMP), they present the characteristics that indicators of sustainable development assessment must follow. The STAMP includes seven topics that assessment systems must consider: vision guide, scope, appropriate breadth, conceptual framework, transparency, effective communication, and participation.

Based on Haecking and Guthrie's (2008) revision and Pinter et al. (2012) Bellagio's Principles, an evaluation system for AECZ and AENZ instruments is proposed, taking into account the information provided by federal and state governments on their online platforms. This evaluation enables determining whether AECZ and AENZ align with the need for a sustainability tool. Although, according to Haecking and Guthrie (2008), while it is not possible to evaluate the context and process' functions and characteristics, they could be improved through a dynamic process, meaning that an instrument should not only able to give a result but should have a feedback mechanism that allows it to adapt

itself to a new context. The first step was to combine both sets of criteria to establish a final standard for evaluating the AENZ and AECZ instruments.

2.1. Criteria for evaluation

It was the criteria used in this evaluation divided into three main features:

1. Context features: the instrument should show and specify its realization context.
2. Process features: the instruments, even when it could have mixed potential use, should specify the intended how, when, and whom (e.g., the intended users and the intended use).
3. Content features: refers to internal system evaluation parameters and includes three subcategories:
 - 3.1 The evaluation scope refers to topics coverage of what builds sustainability.
 - 3.1.1 The dimensions range: it is the three-bottom-line approach (environmental, social and economic) commonly used as a base for sustainability. In this work, it was these three dimensions emphasized along with their interactions because of their extensive acceptance.
 - 3.1.2 Vision: the evaluation should also be integrated in time, while benefits are intra and intergenerational.
 - 3.2 Strategy
 - 3.2.1 Integration of assessment: this criterion concerns the technique used, i.e., how they compare or combine topics or dimensions included in the evaluation. As Gibson (2013) indicates, it is necessary to consider how the assessment instrument will integrate, detect dependencies, identify trade-offs, and the "win-win" situations.
 - 3.2.2 Amplitude: the assessment should consider proper timescales, whether short or long term, as well as a geographical scale correct for the evaluation purposes.
 - 3.3 Transparency and communication
 - 3.3.1 Transparency: the evaluation must be transparent both in their methodologies and in providing data, indicators (and construction), and so forth.
 - 3.3.2 Effective communication: the language should be clear and have a direct and straightforward presentation.

As the evaluator cannot change the context and process features, it was they described considering how, when and whom the instruments are built for.

It was the content features evaluated considering three possible answers:

- a) Meets, which means that the instrument includes the criteria and complies with its full description;
- b) Partially meets, which indicates that the evaluation system includes the criterion, but it does not comply with the full description;
- c) Fails, when the evaluation system does not consider the criterion.

Then, it was the results discussed which criteria are consistent with the principles of sustainability and which should be improved or included to support the spatial assessment tool development.

3. RESULTS AND DISCUSSION

After analyzing both AECZ and AENZ instruments, it was these tools determined that partially meet the criteria set up in methodology. Despite the high level of similarity, essential differences between the two were found (Table 1) and will be discussed based on the evaluation system outcomes.

3.1. Context

The AECZ is linked to policies of public credit systems for new sugar and bioethanol processing plants, as well as to public policy aimed at creating sustainable production and expansion of sugarcane in Brazil. At the same time, the São Paulo state government uses AENZ in the process of licensing and environmental re-accreditation of sugarcane fields and processing plants. Its use was also set the basis of resolution SMA 88 drafting (São Paulo, 2008b), which establishes the limits and guidelines for the sugarcane production units, and to create conditions of sugarcane sector's sustainable development in São Paulo state. Both instruments allow for location planning of the production units and the use of natural resources such as water and soil. On the other hand, the AECZ covers all of Brazil and does not consider cumulative or synergistic impacts but does include parameters to reduce competing for land uses, such as food production, environmentally protected areas, and biofuel production.

Table 1. It is the differences between instruments presented. The below highlighted in gray criteria need to be improved when focusing on a spatial sustainability instrument.

Features			AENZ	AECZ
Context features	Origin		Developed by decree	The instrument was the base for a resolution elaboration.
	Planning purposes		Industry planning; environmental licensing	Industry planning; Formulation of public policies; for public funding policies
	Impacts		Does not consider synergies or cumulative impacts	Considers the cumulative impact
	Cover-range		Entire country, except the state of São Paulo	State of São Paulo
Process features	How		State map with zoning	National map with zoning
	When		Prior plant installation and / or extension	Prior plant installation and / or extension
	By who		Government; private company	Government; banks; private company
Content features	The scope of the evaluation	Range of dimensions	Partially. Considers environmental criteria; exclusion of indigenous territories (single cultural factor); Mechanization as social and environmental criteria;	Partially. Considers environmental criteria; exclusion of areas currently under anthropic use; It excludes direct competition with food production areas by limiting the areas for sugarcane; mechanization, as social and environmental criteria.
		Vision	Partially. Promotes the sugarcane cultivation in adequate areas focusing on 2030 but does not consider the social needs in the long term.	It fails. It does not consider future social needs.
	Strategy	Integration of assessment	Partially. There are overlap criteria and exclusion of areas	It meets. There is overlapping of criteria and limitations considering areas for food production.
		Amplitude	It meets. Considers a time horizon but does not consider scenarios.	Partially. It considers neither a time horizon nor scenarios.
	Transparency and communication	Transparency	Partially. Methodology and data are available online in GIS format. However, there is no information about how it was each layer created.	It fails. The methodology is available online, and the data is available, but there is no explanation how it was integrated.
		Updating	So far, it has no update. There is no provision for an update.	Updated once. There is no provision for further update.
		Effective communication	It meets.	It meets.

3.2. Process

Regarding the process characteristics, both the AECZ and the AENZ offer a zoning map (at national and state levels, respectively) as a final result query for different users (stakeholders), and intend to support the decision of installation or extension of a production unit (planning tool).

Both instruments have both the national and local government agents and the agro-industrial private sector as envisioned users. The target objective is to support the licensing and environmental re-accreditation procedures of bioethanol processing plants, as well as to plan production units and fields installation/expansion.

3.3. Content

Regarding themes/dimensions scopes, the AECZ indicates areas with agricultural potential for sugarcane cultivation without environmental restrictions. It excludes areas with native vegetation, areas under anthropic use, and areas in the Amazon and Pantanal biomes, such as the Alto Paraguay river basin. It also provides guidelines to reduce direct competition of sugarcane with food production areas. Also, it considers the mechanization process of sugarcane harvest as a part of social and environmental criteria.

On the other hand, the AENZ focuses on the limitations and conditions for sugar and bioethanol productions during the agricultural stage. This tool also designates territories occupied by indigenous populations as unsuitable for sugarcane production (the only social factor that is present in the AENZ).

About the guide-vision, both instruments focus on the medium and long-term benefits of setting goals and restrictions regard resources use. Neither instruments predict scenarios.

Regarding assessment's integration, both instruments overlap criteria and excluded areas. In general, they do not set up weights or complex interactions between the chosen components, giving the same weight to all variables.

Both, the AECZ and the AENZ are vector maps developed from a single period (year) information. They allow results' interpolation to the local scale.

About the availability, both AECZ and AENZ are available online, as well the method used for their data compilation. The AECZ presents its method and data by presidential

decree. The AENZ presents criteria and data on the state government websites, as well as the software's primary version used for its creation, allowing visualization in GIS environment. Both instruments are easy to interpret, and the presentation is a map generated on a GIS platform, enabling the determination of a classification in a region or locality. Internet sites hosting the tools explain the restrictions that each zoning class is subject to, as well as the essential features.

About the update, a presidential decree fixes the AECZ updating under MAPA's responsibility but without stipulating terms or conditions for its realization (Brasil, 2009). Therefore, there is no AECZ update. In 2009, the AENZ, a year after its first publication, was updated according to the request from sugar and ethanol industry sector, but without generating significant changes within areas classification. This instrument does not establish a date for updating process (São Paulo, 2008b).

In general terms, both zonings focused on diagnosis and planning, mainly taking into account environmental factors, with some interference from socioeconomic data. However, considering only these three dimensions is not enough. Social and Economic dimensions should be considered at least when the target is the sustainability discussion. Many authors add other dimensions to sustainability assessment, e.g., governance. Others subdivide a dimension to highlight topics of interest, e.g., the "framework of the five capitals" (natural, human, social, financial, and manufactured) (Bebbington, 1999), the social and ecological indicators for sustainability (Holmberg et al, 1996; Azar & Lindgren, 1996), and Gibson's principles (Gibson, 2006).

Neither AECZ nor AENZ focused on dimensions integration, as required by the decision-making that focuses sustainability, despite the availability of GIS tools that allow this integration of more complex relationships by performing complex analysis of layered data (Goodchild, Haining, & Wise, 1992).

Both instruments do not present a complete report of how it was the information crossed. There is no justification for the inclusion of each variable and its weighting. Also, there is no explanation of the method applied.

Moreover, if it is necessary to create an instrument for decision-making and planning, to focus on sustainability, then the sustainability concept should be planned and provided, not only by the user but also by the developer (who provides the information) (Goodchild,

1992). In other words, a sustainability assessment instrument must consider, from its inception an objective of reference and not only be limited to deliver poorly connected relevant information.

To stimulate these tools use based on Integrated Sustainability Assessment (Rotmans, 2006) it is necessary to apply forward-looking and long-term oriented goals, which include a more integrated analysis, considering social, environmental, economic, and, as Rametsteiner (2011) suggests, government issues and their interactions.

The long-term perspective is an essential aspect of sustainability, considering that future availability and accessibility of resources. In this sense, the decree establishes the AECZ update (regarding both criteria and data) by the Brazilian Ministry (MAPA) but it does not set a minimum period for its realization and, therefore, it is not mandatory. In the same way, the AENZ does not include a date for its actualization.

Expanding the scope also means observing goals from short to long-term, taking into account the different stages of product development (planting and harvesting, transportation, bioethanol production, consumption).

The current existence of free open internet databases, allow different kind of users to access information implying that instruments must measure different visions, goals, and purposes in one or more aspects of sustainability (De Oliveira et al., 2012).

4. CONCLUSION

Both zoning systems need improvement to be more efficient tools and to support sustainability assessments. Although both zonings partially attend to the objectives of an assessment tool, unfortunately even when combined, they fail to approach all sustainability dimensions.

Different aspects need to be improved to increase the capability of such tools including:

(a) updating information and incorporating new informational layers that allow the visualization of regional differences, considering environmental, social and economic criteria;

(b) establish a mandatory time horizon for updating and goals;

- (c) integrate data through models implemented in operations; and
- (d) The incorporation of mechanisms to promote transparency and synergies. For this, it is necessary to establish a more complete theoretical and operational framework.

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CHAPTER III.

SOCIOECONOMIC IMPLICATIONS OF SUGARCANE INDUSTRY EXPANSION IN SÃO PAULO STATE- BRAZIL¹.

¹ This chapter is a translation from the original, in Portuguese, “As implicações socioeconômicas da expansão do setor canavieiro nos municípios paulistas”. Its original draft can be seen in appendix 3.

SOCIOECONOMIC IMPLICATIONS OF SUGARCANE INDUSTRY EXPANSION IN SÃO PAULO STATE- BRAZIL

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ABSTRACT

In Brazil, sugarcane cultivation is country's economy main pillars. The sugarcane industry has explored new horizons in the Mid-West, Northeast, and North, with management that focuses on reducing costs and increase productivity. Nevertheless, tools to assess the influences on socioeconomic aspects of municipalities that locates crops and sugarcane industries are still superficial. The researchers aim at this study, to investigate the association between increased participation of sugarcane industry in the local economy and changes in demand for municipal services. Using the state of São Paulo as a case study, it was the indicators analyzed regarding sugarcane expansion, health, education, vulnerability, housing and the economy. For data's statistical analysis, it was the Kolmogorov-Smirnov, and Kruskal-Wallis tests ($p \leq 0.05$) used. The results allow concluding that there is significant variation in GDP per capita, but rather in the average income per capita and the Gini coefficient. That municipal spending on education significantly decreases as increase the sector in the local economy. The same behavior is found analyzing high vulnerability population. There is also an increase of very high vulnerability and no changes in hospital beds coefficients. The researchers concluded that the inclusion of sugarcane crops and industries is related to changes in socioeconomic indicators of the municipalities.

Keywords: sustainability, indicators, assessment, sugarcane, social demand

1. INTRODUCTION

The sugarcane cultivation began in the colonial period, XVIII century, in Brazil, for sugar production. However, it was not until 1975 that São Paulo state began to encourage its cultivation of alcohol automotive fuel production through the National Alcohol Program (PROÁLCOOL). The oil and sugar international market prices variation (Hira & De Oliveira, 2011) motivated this change. However, at the 1980s end, PROÁLCOOL lost credibility due to the supply crisis, the reduction in production incentives, and the fall in oil prices (Rudorff, 2010; Matsuoka et al., 2011).

The sugarcane sector deregulation and the flex car (cars who run both on alcohol and gasoline fuels) development in the early 1990s initiated a self-regulation phase with the

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objective of reaching more efficient management, lower cost and productivity optimization (Barros & Moraes, 2002; Oliveira et al., 2012b). Because of these events, a sugarcane crop expansion new period began at the 1990s end. Cultivation areas expanded in São Paulo, Paraná and Minas Gerais states, these are the primary producers in Brazil, and advanced vigorously to the Cerrado Biome Center, mainly in the states of Goiás, and Mato Grosso do Sul (Nassar *et Al.*, 2008; Silva *et Al.*, 2009; Ruddorff, 2010).

Figure 1. Brazil and São Paulo state sugarcane production evolution. Source: UNICA (2017).

In addition to sugarcane crop expansion, different environmental impacts were observed, such as increased concentrations of copper, zinc and organochlorine compounds in adjacent streams (Corbi et al., 2005); impacts resulting from land use (Gallardo & Bond, 2011); possible decrease in diversity, water availability and food security (Oliveira et al., 2012a). Regarding social impacts, there is an increment on acute and chronic respiratory diseases in harvest workers caused by smoke from burning sugarcane (Ribeiro, 2008), as well as prolonged stress and alteration in the autonomous system with resulting from an increase in cardiovascular diseases (De Moraes, 2013), excessive tiredness, irritability and dermatological problems due to the effort and working conditions (Alves, 2006).

In the local management scope, sugar-energy sector impacts have relation with both, the sugarcane plantations expansion and the sugar mills installation. The sector development is reflected in municipal GDP increase (Oliveira et al., 2012a), a more rapid urban growth

with an impact on income and social demands, an increase in the state's revenue transfer and an increase in the municipality's revenue (Shikida & Souza, 2009),

This article objective is to verify if it is possible to establish a relation between the increase of the participation of the sugar-energy sector in the local economy and changes in the demand for municipal services.

2. METHODS

They were two methods used to represent sugarcane expansion (see Table 1). The first consisted of creating categories of municipalities based on sugarcane cultivated area variation between the years of 2000 and 2010. The second method approached the categories of municipalities considering the increase of sugarcane production participation in the municipal GDP for the same period (2000 and 2010).

Table 1. Municipalities' characterization according to the variation in sugarcane cultivated area and the variation of the production value (PV) about the municipal GDP.

Municipalities groups description	Observations
A. classification by crop field variation:	
A1. Municipalities that in 2000 and 2010 did not have sugarcane crops.	No sugarcane crop
A2. Municipalities that presented sugarcane crops in 2000 and for 2010 decreased their extension by 50% or more.	Reduction $\geq 50\%$
A3. Municipalities that presented sugarcane crops in 2000 and for 2010 decreased their extension in less than 50%.	Reduction $< 50\%$
A4. Municipalities that s in 2000 and 2010 have the same extension of sugarcane crop.	No variation
A5. Municipalities that moderately increased the area of sugarcane crops between 2000 and 2010.	Increment $< 50\%$
A6. Municipalities that significantly increased the area of sugarcane crops between 2000 and 2010.	Increment $\geq 50\%$
B. Classification by sugarcane VP participation in municipal GDP:	
B1. Municipalities that do not have sugarcane sector participation in municipal GDP in 2000 and 2010.	No sugarcane share
B2. Municipalities that moderately decreased the sugar-energy sector share into municipal GDP.	Reduction $< 50\%$
B3. Municipalities that did not vary the sugar and energy sector share into municipal GDP between 2000 and 2010.	No variation
B4. Municipalities that moderately increased the sugar-energy sector share into municipal GDP.	Increment $< 50\%$
B5. Municipalities that significantly increased the sugar-energy sector share into municipal GDP.	Increment $\geq 50\%$

To investigate whether it is possible to establish an association between sugarcane expansion and local socioeconomic conditions in the São Paulo State, they were different

hypotheses formulated with the carefully chosen indicators. It was the variation between the years of 2000 and 2010 observed when there were the most significant increases in the sugarcane expansion of the State of São Paulo.

To obtain the indicators, it was the SEADE (2015) database available online consulted for the years 2000 and 2010. The information obtained was related to education (local expenses in this area), health (Coefficients of SUS and hospitalization beds per thousand inhabitants), economic (per capita GDP and per capita income) and income distribution equity (Gini coefficient). The percentage of total population living in urban areas is around 0.8% of the population. Table 2 shows the indicators and the consulted database.

Table 2. Indicators list

Indicadores
1. Municipal GDP <i>per capita</i>
2. Municipal Income <i>per capita</i>
3. Gini coefficient
4. Municipal expenditure on education
5. Coefficient of SUS beds per thousand inhabitants
6. Coefficient of hospitalization beds per thousand inhabitants
7. (a) IPVS- Percentage of population in high vulnerability category
8. (b) IPVS- Percentage of population at very high vulnerability category
9. (a+b) IPVS- Percentage of population in high vulnerability categories

The hypotheses observed whether there is a modification of the indicators as the relative percentage of sugarcane area, (H1 to H9) varies and when there is a variation on sector's production value (PV) share in the municipal GDP (H10-H18). The hypotheses are in Table 3.

Table 3. We present the hypotheses tested in the study for the municipalities' categories from table 1.

Hypotheses
<i>The variation in the relative percentage of area planted with sugarcane correlates with the:</i>
H1: Changes in municipal GDP <i>per capita</i> .
H2: Variation in income <i>per capita</i> .
H3: Variation on municipal Gini Coefficient.
H4: Variation on municipal Coefficient hospitalization beds (per 1000 inhabitants).
H5: Variation on municipal Coefficient SUS beds (per 1000 inhabitants).
H6: Variation on municipal education expenditure.
H7: Variation on population percentage in any high vulnerability category (total).
H8: Variation in population percentage in high vulnerability category.
H9: Variation in population percentage in very high vulnerability category.
<i>The sugarcane VP share in the municipal GDP correlates with the:</i>
H10: Changes in municipal GDP <i>per capita</i> .
H11: Variation in income <i>per capita</i> .

H12: Variation on municipal Gini Coefficient.
H13: Variation on municipal Coefficient hospitalization beds (per 1000 inhabitants).
H14: Variation on municipal Coefficient SUS beds (per 1000 inhabitants).
H15: Variation on municipal education expenditure.
H16: Variation on population percentage in any high vulnerability category (total).
H17: Variation in population percentage in high vulnerability category.
H18: Variation in population percentage in very high vulnerability category.

Since the data did not present normal distribution, after the Kolmogorov-Smirnov test analysis, It was the Kruskal-Wallis nonparametric variance test ($p \leq 0.05$) chosen. Through it was determined if there was a significant variation between the municipalities groups for each indicator. When observed a difference in statistical significance, it was a multiple-comparison test performed with the Z statistic test ($p \leq 0.05$), ranking averages for all groups.

3. RESULTS

After the tests, it was a difference in the per capita GDP among grouped municipalities by variation in the sugarcane cultivation area verified. Moreover, if it was a difference observed between the over 50% increase in cultures and other groups. Groups by sugarcane PV share in the municipal GDP do not present differences between them, with statistical significance meaning that the tests allow to accept the H1 hypothesis and reject the H10 hypothesis at a confidence level of 0.95. Figure 2 shows the results for GDP per capita according to the Multiple Comparison Test.

Figure 2. Economic Indicators. On the left, the indicators correlated with sugarcane field's variation groups. On the right, indicators correlated with municipalities groups of sugarcane PV share variation in municipal GDP.

The tests made it possible to accept the hypotheses H2 and H11 ($p < 0.05$) relative to the per capita income indicator. If it is the grouping by crop variation considered, it is this indicator shown increased proportionally to sugarcane cultivation area increment. A statement made after comparing the group's results without sugarcane (A1) moderate decrement (A3), without variation (A4) and with a moderate increase (A5). The group with a high increment (A6) presented a very high variability and therefore did not present

statistical significance with other groups. It was observed a significant variation between the moderate increase group (A5) and the group without sugarcane (A1), moderate decrement (A3) and without variation (A4). When considering the classification by participation in GDP, there was a trend towards an increase in per capita income between groups B1 to B4, with a slight decrease in group B5. The B6 group presented a significant variance. The group that did not present production value from sugarcane (B1) expressed a considerable difference about the group without variation (B4), and that had a moderate increase (B5). It was the trends described in Figure 2.

Also in Figure 2, it can be observed that the Gini coefficient indicator showed a tendency to decrease as the area cultivated with sugarcane and the participation of the PV in the municipal GDP increase. It was statistical significance differences observed between groups without sugarcane (A1), moderate (A3) and no (A4) and moderate (A5) and significant (A6) groups. There was also a difference between the moderately increased group (A5) and the group with a higher than 50% increase (A6). When considering the classification by sugarcane PV participation in municipal GDP, the group with a moderate increase (B5) showed differences with statistical significance about groups with no value of sugarcane production (B1), with a decrease (B3) and no variation in production (B4). The group with a significant increase (B6) also presented lower values than groups B1 and B4. Test results allow accepting the hypotheses H3 and H12, with a confidence level of 0.095.

As indicated in figure 3, there were no differences with statistical significance in Hospitalization beds and SUS beds coefficient (per thousand inhabitants) for both municipalities classifications, that is, municipalities grouped by variation in the areas of sugarcane sugar and municipalities by variation of VP in municipal GDP. Conclusions are that the tests rejected the hypotheses H4, H5, H13 and H14 ($p \leq 0.05$) and accepted the null hypothesis that the mean values do not present differences. There were also no statistical differences between the groups about municipal expenditure and education for groups by crop variation or variation in the share of the sector in municipal GDP. Therefore, hypotheses H6 and H15 were rejected ($p < 0.05$). Despite this, it is worth noting that there is a non-significant decrease in expenditure as the sector's share in municipal GDP increases.

Figure 3. Health and education indicators. On the left, the indicators correlated with sugarcane fields variation groups. On the right, indicators correlated with municipalities groups of sugarcane VP share variation in municipal GDP.

Figure 4. Vulnerability indicators. On the left, the indicators correlated with sugarcane fields variation groups. On the right, indicators correlated with municipalities groups of sugarcane VP share variation in municipal GDP.

Regarding the very high vulnerability (Figure 4a), the population percentage in a situation of high vulnerability varied little if the groups were observed by variation in the cultivation of sugarcane and by variation of the sugarcane industry share in municipal GDP. Therefore, the null hypotheses are accepted and the alternatives H9 and H18 rejected, with 95% confidence.

About the high vulnerability (figure 4b), there is a tendency to decrease, but it is the existence of a difference with statistical significance observed only between the group with a significant cultivation increase (A6) and the groups without sugarcane (A1) and variation (A4). If we observe the groups by the participation of sugarcane in municipal GDP, we can only observe a significant variation in the mean of the group with a significant increase (B6) and the non-sugarcane crop.

For the total of high vulnerability graphs (4c), the non-sugarcane group (A1) presented differences with statistical significance with the groups with a moderate decrease (A3), a moderate increase (A5) and significant increase (A6). Moreover, it does not present differences with the non-variation (A4). Groups A1 and A5 differed considerably from each other. Groups A1 and A4 also present differences with the significant increase group (A6). When analyzing the municipalities for participation in municipal GDP, there was a decrease in the high vulnerability as the share of the sugar-energy sector in municipal GDP increases. It was the inexistence of difference with statistical significance observed between the municipalities with decreasing or without areas of sugarcane (B1 to B3), but all these present a statistical significance with groups B4 to B5. The groups B4 and B5 did not present difference with statistical significance between them. Based on these results, the hypothesis H7 and H16 ($p \leq 0.05$) were accepted.

4. DISCUSSION

The study's results allow inferring that sugar-energy sector expansion in the State of São Paulo did not interfere with municipal per capita GDP between 2000 and 2010 that moderately adopted or abandoned this crop. This fact is explained by migration phenomena that accompanies the manual harvesting of sugarcane plantations (DE MORAES, 2013) and municipalities industrialization, as this process accelerates the migration to urban areas (Shikida & Souza, 2009). The significant increase of sugarcane crops would imply a higher GDP due to the economic drift that the crop takes to the municipalities, mainly in consumer demand for goods given the population increase, which in this case becomes significant.

Moraes (2007) points out that between 1992 and 2005 the employment rate of uneducated people declined consistently from 46.2% to 29.4%, while jobs for people with 11 or more years of schooling increased by 0.5% in 1992 to 6.8% in 2005. The author also pointed

out that sugarcane sector wages varied, at current 2005 prices, from 3,263.44 reais for workers with higher education to 578.45 reais for workers illiterates. Another exciting fact given by the author is that in this same period the number of informal jobs decreased, reaching the figure of 6.2% for the year 2005.

The data shown above implies that employment structure improved between 1992 and 2005, formal employment increased. It is the trend observed in 2005 expected to continue and accentuate, since the sector's harvesting means is increasingly mechanized (Torquato, 2013) and requires employees with a full average level of education, reducing the percentage of illiterate employees.

Consequently, and in agreement with this work results, the conclusion is that sugarcane expansion in State of São Paulo is related positively with per capita income increment since there were differences between the group that does not have the sugarcane industry participation in its economy and those that present an increment of this sector. Only the municipalities with no variation (B4) and with increase (B5 and B6) in sugarcane share of GDP can observe a decrease, which is not yet significant, since in 2010 the mechanized harvest implementation have increase requiring fewer, more educated employees, that resulted in the process of wealth concentration (and thus inequality in income distribution). The economic spill that leads to the creation of other lower-income jobs explains the high variation in A6. The positive correlation observed in the crop variation is lower if the classification by it is the local GDP participation evaluated.

The sugarcane expansion in the São Paulo state is negatively related to an increase in Gini coefficient, if we consider the groups by crop and sector participation in the local GDP variation because wages in the agricultural phase tend to be higher about other crops, while at the same time requiring fewer workers, which is more expressive in the groups with a significant increase (above 50%).

The tests carried out allowed us to infer that there is no interference from the expansion of the sugarcane sector in social indicators related to health. However, this observation is contradictory to the literature (Ribeiro, 2002; Arbex et al., 2004, Roseiro & Assunção, 2004; Ribeiro, 2008; Ronquim, 2010), since substantial health impacts the harvest phase with sugarcane burning. However, it is necessary to consider that in 2010 the harvest with mechanization was still a minority (44.4%), according to CANASAT (INPE, 2010), so De Moraes's (2013) observations on interviews with workers gain strength: the hours of

attendance do not follow the working hours in the field, which does not allow timely consultation and encourages self-medication. However, the chosen indicators are not optimal to describe the health of the migrant, with the understanding that the number and type of emergency consultations at health posts should include the diseases generated by excessive physical effort, exposure to smoke from the burning, and the injuries derived from the use of cutting tools.

The tests carried out allows concluding that education expenses are inversely related to the expansion of the sugarcane sector, although there is no statistical difference. This indicator decreased in the municipalities, that, grouped by area of sugarcane, showed a significant increase of the crops. According to De Moraes (2013), the cane worker profile is young and without family, so that migration does not generate significant educational demand. Regarding PV, the differences remain among all groups and the group with municipalities significant increment. This difference may indicate that, because there is an increase in income, the use of non-municipal education systems decreases because there are resources to use other education networks (private education).

Regarding the vulnerability indicators, it can be observed that along with the increase in sugarcane production; there is no variation of the very high vulnerability, accompanied by a decrease in the population in high vulnerability as sugarcane crops increase and the participation of the sector in municipal GDP. The behavior of total vulnerability is similar to that of high vulnerability.

Some of the high vulnerability population may have moved into the very high vulnerability category or other types of vulnerabilities not considered in this study (medium vulnerability and low vulnerability). It is possible that working conditions for sugarcane affected a percentage of workers and increased their vulnerability, while it decreased to another portion because of better wages and economic output. Interesting that this phenomenon appears when considering the increase of sugarcane plantations (agricultural phase) and when the PV of the sugarcane sector in the municipal GDP (agricultural phase and industrial phase) increases. One hypothesis is that the economic pillage and wages effects on a segment may counteract the condition of the population in very high vulnerability when analyzed the total vulnerability.

In general, the analysis still needs to be reviewed and should consider other territorial scales, such as administrative regions and micro and mesoregions. In future studies, it is

expected to compare municipalities with different types of crops such as soybean, pasture, and fruit, with the objective of observing differences and similarities in socioeconomic indicators among municipalities with a predominance of different cultures.

5. CONCLUSIONS

- From the tests carried out, we conclude sugarcane industry generates both positive and negative impacts in the municipalities where it has expanded.
- The increment in per capita income, as well as the decrement in the population percentage classified as having high vulnerability status are some of the positive impacts.
- However, there are also negative impacts, such as the income concentration, verified by the municipal Gini coefficient and the vulnerability increment in a population segment, which went from high to very high.
- The sugar-energy sector expansion did not affect the hospital beds demand, but, as indicated in the discussion, it is still necessary to deepen this theme with new studies.

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CHAPTER IV.

SUGARCANE SUSTAINABILITY ASSESSMENT: AN INTEGRATIVE MULTI- CRITERIA PROPOSAL

SUGARCANE SUSTAINABILITY ASSESSMENT: AN INTEGRATIVE MULTI-CRITERIA PROPOSAL

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ABSTRACT

Sugarcane is an ethanol precursor, which is a renewable fuel produced in industrial quantities as fossil fuels substitute. Brazil produces near 27.44% and 43% of worldwide ethanol and sugar production, respectively. São Paulo state is responsible for over significant part of these numbers: 63.74% of sugar and 48.23% of ethanol (RFA, 2017). In São Paulo, the Agro-Environmental Zoning (AEZ) establishes the areas that allow sugarcane crop with the aim of sustainability, but only considering environmental criteria. In this study, it was a method to derive indicators proposed considering the integrative framework Gibson's principles. As a result, it is an atlas related to sugarcane sustainability production in São Paulo state presented with the inclusion of social, economic, municipal policies, and environmental criteria, performing 18 indicators. These indicators, grouped into three domains (environmental, socioeconomic, and municipal policies) generate a final index of sustainability. It was elimination factors added to diminish tradeoffs. We concluded that over half of the state has the environmental condition to sugarcane cultivars. High sustainability performance is the predominant category (n=196) along with moderate (n=187). Very low performance is the third abundant performance (n=136), while very high is the less abundant category (n=4), followed by low performance (n=26).

Keywords: *Sugarcane, sustainability, elimination-factors, indicators.*

1. SUSTAINABILITY ASSESSMENT FRAMEWORK FOR SUGARCANE CROPS IN BRAZIL

Sugarcane (*Saccharum officinarum*) is an important culture, considering it is an ethanol precursor, a renewable fuel produced in industrial quantities and that can eliminate the fossil sources use in automotive fuels production. In Brazil, ethanol has arisen and consolidated as a domestic market product, but also with external demand (Smeets et al., 2008), strengthening the sugarcane cultivation importance.

According to DEPEC – Bradesco (2017), in the 2015/2016 harvest, Brazil produced 685 million tons of sugarcane, which resulted in the first worldwide place on sugar production (53%) and second place in ethanol production (47%). In the 2015/2016 harvest, Brazil produced 685 million tons of sugarcane, which resulted in the first worldwide place on sugar production (53%) and second place in ethanol production (47%). São Paulo state is

responsible for 63.74% of national sugar production and 48.23% of ethanol production. At the international level, São Paulo state accounted for 33.78% and 22.67% of all world sugar and ethanol production, respectively.

The leading region to cultivate sugarcane in Brazil is the São Paulo state due to its adequate environmental conditions such as rainfall pattern and temperature. Those characteristics permit the crop growth even without irrigation. Currently, it concentrates 52.7% of all sugarcane planted area at the national level (UNICA, 2016b) and accounts for over 53% of Brazilian production (UNICA 2016).

Ethanol production from sugarcane has a positive net energy balance as a biofuel (Morales et al., 2015) because it diminishes global warming and climate change modulators, as GHG, sulfur, particulate matter, and carbon monoxide emissions efficiently. Another significant advantage regarding pollution decrease is by using ethanol the fuel industry could dispense lead additives and MTBE (methyl tertiary butyl ether) which at low concentrations can contaminate large quantities of groundwater (Goldemberg, 2007, p.809). From this perspective, the use of sugarcane-based ethanol rather than gasoline could be one-step forward to increase society's sustainability (Goldemberg *et al.*, 2008).

However, the above assumption needs to be carefully addressed because there are still other environmental impacts to analyze closely (Neto; Baraldi, 2010; Martinelli; Filoso, 2014) like soil degradation, aquatic systems' deterioration, contamination with nitrogen (by nitrogen fertilizers use) in sugarcane crops, and the indirect pressure on sensitive biomes, like Pantanal or Amazonas.

The sustainability concept lays on the understanding that development only can occur when interdependence between different aspects is understood and considered, meaning society development is linked, at least, to environmental and economic matters. It is necessary to add and evaluate social and economic impacts, like working conditions, income equity, and quality of life.

These impacts and the sugarcane crop's sustainability status are the reason why Brazilian ethanol product has confronted uneconomic barriers to gain external consumer markets, mainly in Europe. In this aspect, there are many efforts to measure sugarcane sustainability in Brazil with focus on São Paulo state (Guimarães et al., 2010; Gavioli,

2011; Tôsto and Pereira, 2011; Rodrigues-Filho and Juliani, 2013; Machado et al., 2014; Pereira and Ortega, 2010, and Silaertrusksa et al., 2015). Some of those efforts focus on sustainability certifications (De Oliveira, 2012; Goldemberg et al., 2008; Ferraz, 2007; Espíndola, 2009).

Sustainability assessments can be done using different methods and criteria. For example, it can consider the direct and indirect impacts of economic activity, while others can include the proper legislation. Furthermore, sustainability can be observed beyond the link production-environment, adding the relations with society, institutions, and local economy.

Dissociating an economic activity from territory simplifies its analysis, and this tends to homogenize territories, which is inadequate in both the environmental and the social perspectives. Then, it should not be the economic activity evaluated alone but assessed in a social, political, and environmental context considering its interaction with other economic systems, because many activities happen at the same time in each territory. Nevertheless, the set to analyze requires a limit and, if it predicts and includes all economic activities, the analysis would become too complicated and, therefore, it would avoid the very purpose of a decision-model elaboration.

Sustainability analysis should include territory (environment) and local context (social, municipal policy and management). Therefore, in this work, we focus on sugarcane producer municipalities by studying this activity in its territory, and social context.

It is necessary to use a framework that promotes this mixing to develop an assessment model that includes integration of different kind of indicators. Gibson's principles (2005) have been used in different sectors (Gaudreau & Gibson, 2010; Shah & Gibson, 2013) including sugarcane mills (Duarte *et al.*, 2013) but not in an agricultural system. Also, it offers the possibility to assess sustainability with a systemic focus and emphasis on different dimensions interaction (e.g., environmental, municipal policies) as critical aspects. To develop this work, we used the Gibson's principles and translated them to sugarcane economic system and municipal level (Table 1).

Table 1. Basic principles of sustainability and significant generic considerations (adapted from the Gibson's principles of sustainability).

Principles of Sustainability		Description	Study Context
P1	The integrity of the socio-ecological system:	To build societal-environmental relationships that establish and maintain the integrity of long-term socio-environmental systems and protect ecological functions.	In this principle, we will find indicators related to environmental conditions to sugarcane production implementation: slope and superficial water quality, in addition to already existent environmental planning tools.
P2	Sufficient resources for subsistence and access to opportunities:	To ensure that each and community has sufficient quality of life and the opportunity to seek improvements.	For this principle, we will consider an indicator that focuses on social conditions and opportunities: IPVS, WSWD, and Security index. These indicators show the families' resilience, housing conditions, and social security as indicators of necessary conditions to improve opportunities.
P3	Intra-generational equity:	To ensure that quality of life and opportunity are being pursued all to reduce gaps between the wealthy and poor.	In this principle, the indicators focus on critical aspects of social equity (gender, quality of life, Gini coefficient)
P4	Intergenerational equity:	To favor options and actions in the present that are more likely to maintain or increase the opportunities and capacities of future generations.	This principle is related to those indicators that focus on an instrument to grant future equity. It includes municipal policies and initiatives.
P5	Maintenance of natural resources and efficiency:	Provide a more significant base to ensure sustainable livelihoods for all by the minimization and mitigation of impacts throughout the life cycle and considering eco-efficiency.	This principle includes indicators with a focus on sugarcane industry actions and decisions and their results at mill level.
P6	Socio-environmental civility and democratic governance:	To ensure open and inform decisions, collective responsibility, education, and the use of more integrated practices in decision-making.	In this principle, the indicator focuses on the legal instruments, and situation to grant participation (environmental legislation, social participation).
P7	Precaution and adaptation:	To respect uncertainties; avoid risks of severe or irreversible damage, even if they are poorly understood.	These principle's indicators are related to planning and limits. To this study's context, it means how much cane an area can hold.
P8	Integration between current and long-term situation:	Apply all the principles of sustainability at the same time, seeking mutual benefits and many gains. Identify opportunities for positive synergies and question whether the current scenario is leading to a desirable future.	In this principle, the indicators focus on those instruments that with a current diagnosis develop goals and scenarios for future. At the municipal level, these instruments are planning tools and master plan, while at production unit it can be and plan or program at short, middle and long term.

It is necessary to develop a framework employing the above-suggested sustainability principles in which the sustainability criteria are defined, and quantitative values can be attributed. A basis for sustainability principles application is the Agro-Environmental Zoning (AENZ), a planning instrument with a focus on environmental aspects (SMA, 2009) that currently guides the São Paulo state's sugarcane production, in Brazil. As an

improvement to that instrument, this work aims to create a method that permits allocate production and address the sugarcane industry efforts to sustainability accounting for broadly available data.

2. METHODS

The method to create a sustainability model for municipalities with sugarcane production requires a framework that includes sustainability's different aspects. For the atlas, we used Gibson's principles (Gibson, 2005) as the framework. Following the methodology proposed in previous works (Duarte et al., 2013; Gaudreau & Gibson, 2010; Shah & Gibson, 2013), 18 indicators were selected to integrate this model.

Gibson's Principles showed in Table 1 are used (except by principle 5, because it is related to the situation of each processing plant, and therefore not possible to extrapolate to a whole region due to lack of data) to establish the first level. Different indicators were grouped to generate an index of sustainability, according to a given sustainability principle and integrated within a specific domain (IA: environmental; IB: socioeconomic or IC: municipal policies), which generate a sustainability index (Figure 1) by their aggregation.

When a minimum score for a given indicator is mandatory in the sustainability context (e.g., burning of sugarcane fields is prohibited), then it was assumed as an elimination factor. The elimination factor is determinant to the assessment and to avoid, through the mathematical procedures, an unsustainable situation (related to a single indicator) linked to an acceptable ranking.

The indicators, principles, and domains were integrated into a Geographical Information System (GIS) for the São Paulo state using ArcGIS 10.3 (ESRI, 2015) and QGIS (QGIS, 2016). Therefore, it was the indicators transformed according to the rules in Table 2. This conversion helped to build a dimensionless dataset that permitted to create an index.

Figure 1. Framework including the indicators (based on selected criteria), principles (derived from Gibson's principles of sustainability) and domains (A: environmental; B: socioeconomic and C: municipal policies) used for the sustainability index construction. Indicators in black rectangles contain elimination factors (factors that require a minimum score to validate the respective principle).

Domain A and its indicator are the only ones used under municipal level. Consequently, the dominant value was adopted (that corresponds to more than 50% of the municipal area) and included in the sustainability index (at the municipal level).

The domains (A, B and C) were combined to calculate the local results in a final classificatory index. This final evaluation index is the B and C domains mean when the final value of domain A is >1 . In the case of the environmental domain is one, the value "1" will be attributed to the final index, similarly the elimination factors. The mathematical relation between principles, domains, and the index is in Table 2.

It is important to highlight that Domain A is out of the Index calculation because, as elimination factor, it already has an enormous influence in the index and its addition to the mean would opaque the other two domains.

Table 2. Results' classification (principles, domains e final index)

Values' rank	Classification
1	Very low
>1 and ≤ 1.5	Low
>1.5 and ≤ 2.0	Moderate
>2.0 and ≤ 2.5	High
>2.5 and ≤ 3.0	Very high

Table 3. Brazil and São Paulo state sugarcane production evolution. Source: UNICA (2017).

Domain	Formulation	Principle	Calculation
A	←	P1	If ((A1=1 or A2=1) then "1", if not (A3))
B	← Mean	P2	If ((S2=1) then "1", if not (mean (S2, S5, S6)))
		P3	If ((S1=1) then "1", if not (mean (S1, S3, E1)))
		P4	If ((I6=1) then "1", if not (mean (I6, I2)))
C	← Mean	P6	If ((S4=1) then "1", if not (mean (I4, I3)))
		P7	If ((E2=1) then "1", if not (mean (E2, I5)))
		P8	If ((I7=1) then "1", if not (mean (I1, I7)))

2.1. Selected indicators

Each indicator received a letter, according to its nature (“A” for environmental, “S” for social, “E” for economic and “I” for municipal policies, respectively) and a sequential number for identification purposes. Table 4 shows the indicators values and their correlation or transformation.

It is essential to keep in mind that to aggregate different nature indicators they must present a common language. As shown in Table 4, most of the indicators used are quantitative hierarchical, except for Economic Dependence and Gini coefficient, which are nominal quantitative. Others, mainly those focused on municipal policies (such as sustainability initiatives, gender equity, local agenda 21, adherence to the millennium objectives, environmental prevention of risks, the master plan of the municipality), are qualitative information used to elaborate indexes. To do this, we considered the number of actions, phases, or instruments.

It is essential to indicate that municipality’s policy, economic, and social indicators, are chosen not because of their proximity to sugarcane, but because they describe local conditions in which sugarcane grows.

Table 4. List of principles, indicators, scales, decision rules, and remarks. The scale values, when separated by a comma, indicate that the scale uses absolute numbers (1, 2 or 3); when separated by an “-,” values are a continuous range from one (1) to three (3). Indicators containing a minimal threshold (elimination factor) are in gray.

Principle	Indicator	Scale	Decision rules	Remarks
	A1- AEZ	1,2,3	3: Adequate;	

Principle	Indicator	Scale	Decision rules	Remarks
P1: Socioecological integrity			2: Adequate with limitations or Adequate with restrictions;	Areas classified as "adequate with limitations" have stricter environmental requirements and areas in "adequate with restrictions" category need to reduce water consumption and to have a wildlife-safeguarding requirement.
			1: Inadequate.	
	A2- Slope	1,3	3: Slope below or equal to 12%;	When the slope is higher than 12%, machines cannot harvest. Therefore, harvests are manual with the use of fire (so far). Thus, over 12% the area is considered unsuitable for sugarcane crop.
			1: Slope over 12%.	
	A3- Water quality	1,2,3	3: Excellent or good quality;	Based on CETESB ³ original classification, it is considered the samples mean for the same watershed.
			2: Regular quality; 1: Bad or very low quality.	
P2: Sufficient resources and opportunity access	S2- IPVS	1,2,3	3: Lowest, very low or low vulnerability;	There are seven categories in the original classification. In the Atlas, the value "three" is for municipalities in Low, Lower and Lowest vulnerability's categories; the value "two" for municipalities in intermedia vulnerability, and the value "one" for municipalities in High, Higher (urban sub-normal agglomerates) and Highest (rural areas) vulnerability's categories.
			2: Regular vulnerability;	
			1: High, very high or higher vulnerability.	
	S5- Security index	1,3	3: Below or equal to 10;	It corresponds to the sum of five kinds of violent acts per thousand inhabitants. An insecure area is related with low perspectives on social improvement and lack of quality of life
			1: Over ten violent acts.	

³ São Paulo State Environmental Company

Principle	Indicator	Scale	Decision rules	Remarks
	S6- WSWD	1-3	It is a continuous scale of three variables mean, in percentage.	The lack of water supply and waste disposal indicates low social quality of life and is related to less social opportunities
P3: Intragenerational Equity	S1- IPRS	1,2,3	3: High and very high levels;	The levels of social responsibility are according to SEADES ⁴ (2014).
			2: Regular level;	
			1: Low and very low social.	
	S3- Gender equity	1-3	Is a continuous scale according to sub-indicators mean	-
	E1- GINI coefficient	1-3	A continuous scale converted to a range 1-3 by multiplying original GINI coefficient by two and adding a unit.	-
P4: Intergenerational Equity	I6- Local Agenda 21	1-3	2.5: Implementation.	
			2.0: Sustainable development program elaboration;	
			1.5: Sensitize phase;	
			1.0: No agenda;	
			+0.5 if there is a meeting in less than a year	
	I2- Sustainability initiatives	1-3	Four main categories were included to add a point plus the category “other initiatives.” Each category gives 0.4 points, and an extra point is added to fit in the rank.	The meeting should occur in less than a year periodicity.
P6: Social-environmental civility	S4- Social participation	1,3	3: Any kind of participation;	-
			1: No social participation.	
	I4- Adhesion to Millennium objectives	1-3	1: No adhesion to any millennium objective; + 0.25 for each objective adhesion.	There are 8 Millennium objectives, and each one contributes with 0.25 to the indicator.

⁴ São Paulo State Social Development and Assitency Secretary

Principle	Indicator	Scale	Decision rules	Remarks
	I3- Environmental legislation	1,2,3	3: There are environmental legislation and a partnership with the watershed committee; 2: There is environmental legislation or partnership with the watershed committee; 1: There is no legislation.	-
P7: Precaution and adaptation	E2- Economic dependency	1,2,3	3: Below 10% of sugarcane share of municipal GDP; 2: Between 10-20% of the share of municipal GDP; 1: Over 20% of sugarcane share of municipal GDP.	-
	I5- Natural Disaster planning	1,3	3: If there is at least one instrument to prevent disaster or there are no identify threats; 1: If there is at least one threat identified and there is no prevention instrument.	-
P8: Actual situation and long-term integration	I7- Masterplan	1,2,3	3: Existence of master plan; 2: In elaboration process; 1: No existence of a master plan.	It is considered the elaboration process and the existence of a master plan.
	I1- Planning instruments	1-3	1: No planning instruments; Each planning instrument adds 0.2 units until 3.	This indicator contemplates ten planning tools.

Each indicator listed in Table 3 requires data from specific sources. Depending on the indicator, values can be directly used without any transformation, while for other indicators transformations or calculations (like composite indicators) needs to be done.

In the following sequence, it is the description of each indicator specified. It was a justification added for each elimination factor.

2.1.1. *A1: Agro-Environmental zoning-AENZ*

Developed to support environmental decision-making for the sugarcane sector (SMA, 2009). The AENZ categorizes the São Paulo State in four Agro-ecological zones: a) adequate to sugarcane crops, b) adequate with limitations for sugarcane crops, c) adequate with restrictions for sugarcane crops and d) inadequate for sugarcane crops. The AENZ adequate area is into the atlas with a value of “3”, as well the areas that belong to adequate with restriction or limitations and inadequate areas are rated as “1”. In inadequate areas, sugarcane cultivation is forbidden. Adequate areas should observe environmental conditions according to legal requirements, considering a water consumption limit of $1 \text{ m}^3 \cdot \text{ton}^{-1}$ of processed sugarcane; areas characterized as adequate with limitations have higher requirements regarding conservation of reminiscent native flora and the acquisition and use of pollution control equipment for industrial purposes. Adequate with restrictions areas must consider the formation of ecological corridors with permanently protected areas. The production in these areas have some restrictions: the sector has a water consumption limit of $0,7 \text{ m}^3$ per ton of sugarcane, must compromise to employ the best technology in existence and to apply prevention plans to diminish the disturbance to fauna and reduce roadkill.

This indicator is an elimination factor for P1 because the agro-environmental zoning (AEZ) is an official instrument that determines which areas are suitable for sugarcane crop. According to AEZ, inadequate areas have no environmental conditions for this activity and, therefore, cultivation in this area cannot be sustainable.

2.1.2. *A2- Slope*

Until 2017, the previous field burning process required for manual sugarcane harvest should be extinct, meaning that all the sugarcane production will use only mechanical harvest. As the harvesters cannot operate on a slope over 12%, these areas would then be considered inappropriate for sugarcane cultivation. The burning process has an impact not only on air quality but also in labor conditions because it is the manual harvest done in very harsh conditions (prolonged exposition to the sun, long working journeys, temporary contracts with limited benefits for health and family issues among other)

(Torquato, 2013). For this work, the slope was derived from the digital elevation model available at the CPLA (2013) website and is the average of each field.

The slope is the P1 second elimination factor, not only due to environmental issues but also has a relation with work conditions and economic factors. The mechanized harvest, impossible when the slope is above 12%, implies the use of harvesters, training, formal contracts, better work schedule, and better work environment. For 2017, all the São Paulo State should stop using manual harvest, meaning that areas with a slope over 12% are no more suitable to cultivate sugarcane.

2.1.3. *A3- Water Quality Index –WQI*

The WQI is an index designed to classify a watershed water quality (CETESB, 2014). According to its range, WQI indicates if a watercourse has excellent, good, moderate, bad or very bad quality. For the atlas, the categories excellent and good were rated as “3”, while the moderate situation with a “2” and bad and very bad quality with a “1”.

2.1.4. *S1- São Paulo Index of Social Responsibility- IPRS*

This indicator is developed only for São Paulo State (SEADES, 2014) and it is a Human Development Index (HDI) adaptation. It classifies the State in five different zones according to the social responsibility level, ranging from very high to very low. The first two levels (very high and high) are into the atlas with a “3”, the moderate level with a “2” and the bad and very bad levels with a “1”.

This index is a local variation of HDI and shows the general condition of a district regarding social life quality. A district with a low index indicates that there are no acceptable conditions in health, education, and income. This situation cannot be considered sustainable in any hypothesis; therefore, this indicator is a threshold for Principle 2.

2.1.5. *S2- São Paulo Index of Social Vulnerability- IPVVS*

This indicator is available only for the São Paulo State (SEADES, 2012). Its purpose is to evaluate the vulnerability of families to poverty. It considers variables as the family income range, and the family chief education degree, age, and gender. It classifies the municipalities into seven categories of vulnerability: extremely low, very low, low, moderate, high, very high and extremely high. It was three categories were considered to

include this aspect into the atlas: municipalities categorized with extremely low to low vulnerability are into the atlas with a value of “3”, municipalities with a moderate vulnerability classification with a “2”, and municipalities categorized as high to extremely high vulnerability with a “1”.

The vulnerability is a significant factor, and therefore a P2 elimination factor because sustainability considers that resilience from different dimensions is an asset to affront different conditions (market, social, climatic, and so forth). A high vulnerability implies in households with fewer opportunities to affront changes and to tackle life quality improvements. A district cannot be sustainable if there is a high level of vulnerability.

2.1.6. S3- Gender equity

This indicator corresponds to an index created with information from the IBGE Municipal database for 2013. It measures the number of gender equity in a municipality, by giving points to every fulfillment. It includes five sub-items: (a) the existence of a municipal gender equity plan or program; (b) a municipal council about gender's rights and its attributes, (c) different structures related to gender issues; (d) partnerships with NGO's, other government levels, or institutions, and (e) specific budget for gender equity programs. The five sub-indicators are summed and, to transform them in a scale range from 1-3, the sum is multiplied by a factor of 0.2 and added a unit, according to Equation 1:

$$I_G = ((a + b + c + d + e) * \frac{2}{5} + 1)$$

Equation 1. Gender equity index

Where (a) is a binary component related to the Municipal Gender Plan or Program existence (1 if positive, 0 if negative); while (b) is the combination of i) the existence of a Gender Rights Council and ii) how many functions it performs (consultative, deliberative, normative and audit). Zero (0) means no existence of the council, one (1) to four (4) the number of functions of the Council. The final (b) component is divided by four before being included in Equation 1. The (c) component relates to six different structures available to support gender equity actions, as i) women's shelters, ii) specialized services, iii) support to domestic violence victims, iv) forensic and legal medicine institute, v) daycare centers and vi) natural birth delivery centers. The presence of each structure added a point to this component. Then, the result of this component is

the sum of its variables divided by 6. The component (d) refers to the existence of partnerships involved in gender equity actions. Institutions such as organs from the Public Administration (at federal, state and municipal level), NGOs, Private Institutions, International Organizations, Religious organizations, workers' entities and others integrate this component. If at least one partnership exists, then this component has the value one (1). If there is no partnership, the value is zero (0). Component (e) refers to the existence (1) or not (0) of a specific budget to gender equity actions.

2.1.7. *S4- Social participation*

This indicator is related to the municipal level and follows a binary classification. The existence of any social participation gives the value three (3) to the indicator, while the inexistence of social participation is a one (1).

Social participation is a crucial factor when sustainability is in question, and consequently an elimination factor in Principle 6. Channels of communication should be encouraged, and any initiative should be considered as a step forward to increase social participation. The inexistence of any social participation is the only situation that cannot be sustainable.

2.1.8. *S5- Security index*

This index includes five kinds of violent acts per thousand inhabitants: robbery with homicide, intentional homicide, rape, burglaries, and robberies. For each municipality, it was the values summed. The municipalities were classified considering a limit of 10-violence acts per a thousand people as an elimination factor. If the result is equal or below the limit of 10 violent acts per thousand inhabitants, then the index value is three (3). If above 10, then the index value is one (1).

2.1.9. *S6- Water Supply and Waste disposal- WSWD*

It was this indicator developed considering three variables: coverage (in percentage) of a) water supply network, b) waste collection and c) sanitary sewage. The mean of all coverages is multiplied by two (2), and to fit on a scale of one to three a unit was added.

2.1.10. *E1- GINI coefficient*

The GINI coefficient focus on inequity in the income distribution (Ceriani & Verme, 2012). The index ranges from zero (0) to one (1) (being one (1) the perfect distribution), and it was converted to a scale of 1-3 by multiplying it for two (2) and adding a unit.

2.1.11. *E2- Economic dependency*

This indicator considers a) the total municipal GDP and b) the share of sugarcane production in the municipality's GDP. If sugarcane share is below 10%, then to the indicator value attributed is three (3); if it was between 10 and 20%, the value is two (2); if it is over 20%, it was the value one (1) assigned for this indicator.

An economy heavily dependent on an activity may present a decline in its ability to cope with economic crises (Christopherson *et al.*, 2010) since it requires the displacement of activities and the capacity to re-absorb labor to avoid social and economic effects in medium and long-term (Briguglio *et al.*, 2009). To this work, it was the local economy arbitrarily assumed depends on sugarcane should not be over 20% in financial terms. Therefore, E2 is an elimination factor in Principle 7.

2.1.12. *I1- Planning instruments*

It was ten categories considered as basic planning instruments: a) urban perimeter law; b) building codes and legislation; c) zones or areas of social interest; d) zones or areas of particular interest; e) land parceling; f) zoning or land use and occupation; g) land reclamation; h) investment taxes; i) urban operations; and j) neighborhood impact study. As each one of the planning instruments accounts for one (1) point, the result must be the points sum divided by ten (10). The result is multiplied by two (2), and a point is added to fit on the 1-3 scale.

2.1.13. *I2- Sustainability initiatives*

They were five aspects considered to build this indicator: a) shopping plastic bags use prevention; b) impulsion of environmental initiatives adoption by public offices and institutions; c) reduction of water and electricity consumption; d) relevant environmental criteria existence when acquisition of materials or services for the public sector; and e) other initiatives. A positive value in each category gives one (1) point. The result is

multiplied by two (2), divided by five (5) and added a point to fit the result on a scale 1-3.

2.1.14. *I3- Environmental legislation*

For this indicator two aspects were considered: a) if there is any legislation related to environmental issues and b) if there is any partnership with the management unit of the hydric resources watershed committee. A yes in each question gives a point, and it is an additional point added to set the scale in format 1-3.

2.1.15. *I4- Adhesion to millennium objectives*

It was the municipal government adhesion to UN millennium objectives (UN Assembly, 2000) considered I this indicator. The adhesion to each goal gives to one (1) point. The sum is divided by eight (8), and one point is summed to set a scale 1-3. The objectives are: a) eradication of extreme poverty and hunger; b) achievement of universal primary education; c) promotion of gender equality and empower women; d) reduction of child mortality; e) improvement of maternal health; f) combat HIV/AIDS, malaria, and other diseases; g) ensure environmental sustainability; h) and deployment of a global partnership for development.

2.1.16. *I5- Natural disaster prevention plan*

This indicator considers the existence of at least one instrument to prevent society from being affected by natural disasters. If there are no apparent threats, the indicator is automatically assumed to be three (3); in the case that there is an identified threat, but no prevention plans the indicator is one (1). If there is a threat, but there is a natural disaster prevention plan, then the indicator gets the value of three (3)

2.1.17. *I6- Local Agenda 21*

The phases of local Agenda 21 (Weiss, 1992) are sensitized (value 1.5), elaboration of a sustainable development program (2.0) and implementation (2.5). It also was considered that regular meetings should occur. If there was a meeting in the last year, the indicator gets one (0.5) point. If there is no Agenda 21 implementation, the indicator gets 1.0. The Agenda 21 principles development presents fundamental sustainability goals. It includes future generations' well-being, and it has been a basic instrument in the Brazilian process to promote sustainability at the municipal level by implementation of laws, actions and

planning with a long-term view. After 25 years since Rio'92, different phases of its implementation should get different points, but only the current execution phase should receive a satisfactory value. Thus, I6 is a Principle 8's elimination factor.

2.1.18. *I7- Municipality's master plan*

The municipal master plan is a critical document that integrates the current situation with a long-term view. The existence of a valid plan gives the value three (3) to this indicator, while the masterplan inexistence confers a value of one (1) to this index.

The municipal master plan addresses the development considering the actual situation and goals for short, medium and long-term. The existence of a municipal master plan is crucial to the existence of any other form of planning instruments. In the plan's absence case, it is no action assumed that the municipality does not promote the sustainable development. So, I7 is classified as a Principle 8's elimination factor.

2.2. Data collection

The information required to fill the indicators included environmental, economic, social and infrastructure information. To choose which indicator describes each criterion, it was information available from open, online, and public sources used. This aspect importance is that it allows free data access and reliable input information.

Data from different sources were selected to cover all 18 indicators and to complete the atlas. Municipal policies data was collected from IBGE (2014), while socioeconomic data is from IBGE (2014) and SEADE (2015, 2014, 2012). Both datasets have data at municipality scale.

Environmental data are from São Paulo state's Secretary of Environment (SMA, 2009; CPLA, 2013), and sugarcane spatial information data is derived from National Institute of Spatial Research (CANASAT- INPE) (Rudorff et al., 2010), based on the methodology of Aguiar *et al.* (2011). Table 5 presents a list of all the indicators, including its code, indicator name, year of data availability and the source.

Table 5 Indicators used to describe Gibson's principles. The indicators are grouped according to their nature: A for environmental aspects; E for economic aspects; S for social aspects; I for municipal policies aspects.

Code	Indicator	Data year	Source
A1	Agro-environmental Zoning (AEZ)	2009	SMA (2009)

Code	Indicator	Data year	Source
A2	Slope	2013	CPLA (2013)
A3	Water quality	2013	CETESB (2014)
I1	Planning instruments	2013	IBGE (2014)
I2	Sustainability initiatives		
I3	Environmental legislation		
I4	Adhesion to Millennium objectives		
I5	Natural disaster planning		
I6	Local agenda 21		
I7	Municipal master plan		
S3	Gender equity		
S4	Social participation		
S5	Security index		
S6	Water Supply and Waste disposal (WSWD)		
S1	São Paulo Index of Social Vulnerability (IPVS)	2010	SEADE (2014)
S2	São Paulo Index of Social Responsibility (IPRS)	2013	
E1	GINI coefficient	2013	
E2	Economic dependency	2013	

3. RESULTS

As results, maps are showing the distribution of different domains and principles presented.

Regarding the principles, different performances were observed across the municipalities. Almost all municipalities present low and very low performances regarding the principle P2 (sufficient resources and opportunity access), with the exception at the west, where sugarcane cultivation is a relatively recent activity (Figure 2a). About 53% of the municipalities are included in the category very low performance, while 6% are in high performance and 41% in very high performance. No municipalities presented low or moderate performance, indicating that municipalities in São Paulo state have a dichotomy: or they have a lousy quality of life or a good one, without the existence of an intermediary situation. The presence of ethanol production process industrial phase, which increases the income in the municipalities and the surrounding area could explain this dichotomy.

Moderate performance is the primary category result regarding intragenerational equity (P3), followed by low category. Those two classifications are distributed in all state, from center to west with almost no interruption. Very low classification is homogeneously distributed across the state, along with high category. The high category is also observed on the east side. Only one municipality (Bauru) classify as Very high performance.

Figure 2. Figure with the maps of São Paulo state concerning the Gibson's principles. a) Principle of sufficient resources and opportunity access (P2), b) principle of intragenerational equity (P3), c) principle of intergenerational equity (P4), d) principle of socioecological civility and democratic governance (P6); e) principle of precaution and adaptation (P7), and f) principle of actual situation and long-term integration (P8). The results are presented at municipality level and scaled in five performance categories: very low, low, moderate, high and very high.

The most frequent performance classification regarding intergenerational equity principle (P4) is very low, with 77.4% of the municipalities in this situation (Figure 2c). High performance was observed in 7.9% of the municipalities, while low and moderate performances account for 5.7 and 5.6%, respectively. Only 4% of the municipalities presented a very high performance in this aspect. These results indicate that decisions and actions are directed to present conditions context than foreseeing future conditions.

About 9.1% of the municipalities are included in the very low-performance category in social- environmental civility and democratic governance principle (P6), while 0.2% is in a Low category and 30.5% in moderate performance. 23% presented a very high performance and 60.8% a high performance (Figure 2d). These results indicate that most municipalities have some social participation processes. It also indicates the most municipalities have advanced in millennium goals and participation in the watershed committee.

65% of the municipalities have a very high performance in precaution and adaptation principle (P7), while 12% and 23% have high and low performance (Figure 2e), respectively. Only three municipalities have moderate performance, and there are no municipalities in the low-performance category indicating that most municipalities have prevention and precaution instruments regarding social and environmental issues. As the maps show, all the municipalities with very low performance are in the north/northeast region, where sugarcane fields are in expansion, far from the most important urban centers and on less densely occupied land.

Municipalities are mainly in two different categories in immediate and long-term integration principle (P8): very high performance (37%) and very low performance (36%). The rest of the municipalities have high (16%) and moderate (11%) performance (Figure 2f). There are no municipalities with low-performance. As it was the results observed only 64% of the municipalities comply with the integration principle, even if they are not entirely satisfactory.

Results related to domain A (environmental aspects) shows the adequacy of São Paulo state to sugarcane cultivation (Figure 3a). As the indicators used to elaborate this map are environmental parameters, they do not follow administrative borders. In the southeast area, where there is no aptitude for sugarcane cultivation, the law forbids this crop cultivation (no colored area). The additional unsuitable area for sugarcane is no significant, and it is almost all around rivers.

There are no municipalities with very high performance, and 35% have high performance (n=191) in Domain B- socioeconomic aspects (figure 3b). Regarding this domain, the municipalities with moderate performance (n=136) are in the center of São Paulo state, where sugarcane crop initiate its expansion, and municipalities with low performance (203) and very low category (n=18) are distributed mostly at center and north of the state.

For the Domain C- municipal policies aspects (Figure 3c), municipalities with very low to moderate performances are distributed mostly in the north-west of the state, while high and very high performances incidence increase in the center.

Figure 3. Maps with the performance for a) Domain A and Principle P1, concerning socioecological integrity for São Paulo State and environmental aspects; b) Domain B – socioeconomic aspects (on top), focusing on economic and social indicators; c) Domain C – municipalities' policies aspects (bottom); and d) Sustainability Index- Map with the final evaluation of sugarcane sustainability for São Paulo state. The results of figures a and d are presented continuously (not restricted to municipal boundaries) and the results of “b” and “c” are presented by the municipality. The figure a) is scaled in three categories Low, moderate and high, while the others are scaled in five categories of performance: very low, low, moderate, high and very high.

Figure 3d presents the overall sustainability evaluation. In this map, it is possible to observe the final index considering all three domains. The results do not follow administrative boundaries because the assessment includes environmental indicators.

Regarding the indexes, the domain A is equal to Principle 1 (Figure 3a), as it involves exclusively environmental criteria (Table 4), while the Domains B and C combine different principles. Domain B – socioeconomic aspects (figure 4 left) is divided into five

categories of performance: very low (n=18), low (n=203), moderate (n=136), high (n=191), and very high (n=0). The assessment indicates that 40% of the municipalities have poor performance (very low and low performance) about societal livelihood quality, social equity and opportunity to improve social quality, 25% moderate performance and 35% has a high performance. Domain C- municipal policies aspects (Fig. 4 right), with essentially municipal policies criteria, is also classified in five categories: Very low (n=8); low (n=87), moderate (n=191), high (n=223), and very high (n=39) performance. Only 17.3% of municipalities present poor performance (low and very low categories), while 34.9% are in a moderate performance and 47.8% is classified in the higher category, meaning that precaution, prevention, and planning are municipalities concerning.

Figure 4. Percent (%) of performance classes for Domain B – socioeconomic aspects (left), composed mainly of social indicators; and performance of Domain C – Municipal policies aspects (right).

Concerning the overall sustainability index, high and moderate categories dominate the results in the state. The Very low category is 8.93% of state territory that allows sugarcane cultivation in addition to the AENZ inadequate areas. It predominates on river's sides. Only Charqueada municipality has a significant area classified as Very low sustainability. The Low category is 5,44% of suitable for sugarcane cultivation. The main areas belong to moderate and high categories, with 40.94% and 43.90% respectively. These last both areas are across the state, but moderate has more incidence at center. Very high sustainability area accounts for 0.79% of the suitable area for sugarcane cultivation, according to the AENZ.

During the study, we focused on territory that allows sugarcane cultivation, but not all municipalities developed this industry (mills or sugarcane cultivars). Therefore, the comparison between areas with and without sugarcane cultivars allows the analysis under which sugarcane grows.

Figure 5. Map and table with sustainability Index results and presence of sugarcane cultivars (in red) for the suitable sugarcane area.

In figure 5, the red area corresponds to sugarcane cultivars, and the other colors indicate the sustainability index performance. This figure shows that cultivars are distributed mainly in areas with moderate and low performances.

The most extensive group is High classification, with 43.90% of all suitable area for sugarcane cultivars, followed closely by Moderate classification group (40.93%). Very low classification describes 9.94% of all suitable land, while Low describer 5.44% and Very high 0.79%. These data include areas with and without sugarcane.

Considering all suitable area for sugarcane in São Paulo state, the area with sugarcane is up to 30.54%, while the remaining area (69.46%) is without sugarcane cultivars.

In comparison, the areas with sugarcane cultivars have less area classified as Very high, High, and Very low sustainability performance, while it presents an increment on Moderate and Low sustainability performance.

Figure 6. Comparison between areas with and without sugarcane, considering the sustainability index performance

4. DISCUSSION

The final results (index of sustainability) are similar to other analysis such as the one carried out by Rodrigues Filho and Juliani (2013). Although the municipalities sample for this analysis was much more restricted, 306 municipalities, their results indicate only one municipality with a high level of environmental sustainability and socio-economic development indexes. In our results, the same municipality presented a poor performance in socioeconomic and municipal policies domains, mainly due to the elimination factors inclusion, such as the São Paulo index of social vulnerability (P2), the local agenda 21 existence (P4) and the social participation existence (P6). In this work, also few municipalities have very high performance (only four), all in low categories of sugarcane production and sugarcane share in municipal GDP.

Considering sugarcane planted area, the results obtained in this assessment indicate that an increment in sugarcane activity diminish the sustainability performance from Very high and High to moderate and low categories, but increases the performance from Very low to Low and moderate classifications.

Our results disagree with Machado et al. (2015) that approached only socioeconomic indicators and found a significative improvement when sugarcane cultivation increases and with Goldember et al. (2008) that considered the increment on rural jobs and salaries and settled that sugarcane cultivation increases environmental sustainability and local

development. Also, our results are similar to Walter *et al.* (2011), that measured socioeconomic indicators, land use change impacts, and GHG emissions, among other issues, and concluded that a significant share of ethanol production could be sustainable.

Guimarães *et al.* (2010) tested European sustainability indicators used in the project Sensor, listed by Monteiro *et al.* (2008), in micro-regions of Mato Grosso do Sul state. In their assessment, no microregions were classified as sustainable or unsustainable, while four were considered intermediate and six were weak or potentially unsustainable. Like their, our results indicate that moderate and high performance, intermediate results, are the main categories regarding sustainability.

Since our sustainability index does not include AENZ forbidden areas for sugarcane, it new inadequate areas for sugarcane cultivation found in a very (terracotta color) in the center and west side of São Paulo state. Nevertheless, moderate and high sustainability performances are the main categories of the state. Finally, only four municipalities presented very high performance, all of them with the Very low presence of sugarcane fields ($\leq 10\%$) in the south of the state.

AENZ is an instrument that classifies São Paulo state according to its environmental conditions as an instrument to improve the sustainability of the sugarcane sector, while the assessment here developed classifies the same area given its sustainability conditions. More categories permit us a more precise classification, inside the adequate areas.

Based on this study, we can confirm that the sugarcane production in allowed areas is not necessarily sustainable. Where sugarcane cultivars are the most, the sustainability index reaches lower categories of sustainability, in the center west of São Paulo state, meaning sugarcane cultivation diminish social, economic, and municipal sustainability.

The intermediate results allow to better understand the municipalities in different themes as economic, social, and environmental. This understanding permits to address efforts if the producer unit implementation not only aims a better use of natural resources but focus social and economic aspects to those areas with low classification, which is an improvement concerning the only AENZ use. In the same line, it highlights the conditions provided by municipalities, mainly the deficiencies, to address the efforts in the right direction. A full preview of all territory is an asset for full and correct planning, and hence proper decision-making.

The multifaceted systems assessment, such as the sugarcane sector (cultivation and processing phases), requires the many variables consideration. This complexity increases when sustainability is in the context, which is why databases are needed. As Guimarães *et al.* (2010) remark, the most prominent problem to develop indicators is the availability of reliable, systematized, periodically verified, disaggregated data in the national database, and compatible databases. Moreover, it is this fault observed in all the dimensions. It is also important to highlight that socioeconomic information below municipal level is usually not available, which prevents any attempt to analysis with higher spatial resolution.

Meanwhile, São Paulo state has a handy instrument that helps to reduce (with the objective to end) the burning in the harvest and improve working conditions with the introduction of mechanized harvest (De Jesus & Torquato, 2015).

5. CONCLUSIONS

In this study, it was a sustainability assessment developed for sugarcane sector in São Paulo, Brazil. Environmental, social, and economic indicators, were reunited in principles, domains and a final sustainability index. The indicators of sustainability employed in this assessment are robust and provide substantial evidence about the performance on different aspects of sustainability.

Regarding our results, the sugarcane expansion does not improve the municipalities' sustainability conditions. Even more, with sugarcane cultivars tend to present lower sustainability classifications.

The inclusion of elimination factors permitted to highlight specific but crucial aspects of sustainability, diminishing the trade-off between domains. Therefore, this work development is a step forward in the integration of variables from different nature, considering environmental, municipal policies, social and economic data in the quantitative and qualitative analysis.

The use of this assessment provides essential insights to guide the planning of sugarcane sector, diminishing its negative impacts primarily on economics and social aspects. Moreover, this framework for sustainability assessment can compare distinct production systems and be adapted to others.

Conceived as an improvement to AENZ, this sustainability assessment presents new inadequate areas to sugarcane expansion, new perspectives by adding socioeconomic conditions and a panoramic view of the state and its regions, while presents an accurate perspective to each municipality. The use of maps allows going further in results communication and assessment presentation.

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CHAPTER V.

SENSITIVITY ANALYSIS OF A SUSTAINABILITY ASSESSMENT FRAMEWORK FOR SUGARCANE PRODUCER MUNICIPALITIES

SENSITIVITY ANALYSIS OF A SUSTAINABILITY ASSESSMENT MODEL FOR SUGARCANE PRODUCER MUNICIPALITIES

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ABSTRACT

Sensitivity analyses is a model building process important step, which corresponds to the methods to perceive the model outputs considering the model inputs variation. Considering the importance of sugarcane industry to São Paulo state and Brazil, we developed a model of assessment for sugarcane producer municipalities. In this study, we aim to analyze the model sensitivity, as the final part of its construction. According to our results, social indicators explain 19.2% of the result, while municipal policies indicators influence 15.7%, economic indicators 5.7% of the result. Finally, environmental indicators correspond to 59.4%, being A3 responsible for 19.7% of it.

Keywords: *sustainability, sensitivity analysis, sugarcane*

1. INTRODUCTION

Sugarcane cultivation is an essential economic activity in Brazil, due to its use as a precursor of ethanol fuel and sugar. It is both products, the ethanol, and the sugar, commercialized to domestic and foreign markets in large scale, and play important roles as goods for the national economy (Leite et al., 2009).

In 2015, Brazil was responsible for 27.7% of all ethanol world production (second in the USA, and 43% of sugar production (1st place) (Crago et al., 2010). In 2015/2016 harvest, Brazilian sugarcane production reached 685 million tons, which resulted in sugar (53%) and ethanol (47%), according to DEPEC- BRADESCO (2017) study.

The same study shows that São Paulo state production was 63.74% of total national sugar production and 48.23% of total ethanol production. These data translate that São Paulo accounted for 27.67%, and 13.36% of all sugar and ethanol produced in the world, respectively.

São Paulo state includes an area of almost 24 million hectares, less than 1 hectare correspond to urban areas and other 7.8 hectares for agriculture purposes. Sugarcane crops cover over 5 million hectares, more than 65,5% of São Paulo state' cultivated area.

The São Paulo state is the most central sugarcane producer in Brazil, due to its soil and climate conditions for this crop to grow without irrigation. This grants sustainability, which is a requirement to the sugarcane industry extend its market.

There are many efforts to measure sugarcane crop sustainability in São Paulo state (Guimarães et al., 2010; Gavioli, 2011; Tôsto and Pereira, 2011; Rodrigues-Filho and Juliani, 2013; Machado et al., 2014; Pereira and Ortega, 2010, and Silaertrusksa et al., 2015). Some efforts focus on sustainability certifications, as explained in different works, like De Oliveira, (2012), Goldemberg et al. (2008), Ferraz, (2007), and Espíndola (2009).

These initiatives are essential tools to predict climate-change scenarios and, therefore, to develop new strategies for sugarcane crop's adaptation and mitigation. According to Bergonovo and Plishke (2016), models to support decision making are helpful tools to find solutions strategically to several problems. The authors also highlight that both, uncertainty and sensitivity analyses (SA) are relevant steps of the model building process. When the complex models' development, a sensitivity analysis' performance is even more critical (Campolongo et al., 2007).

The SA is “a set of methods to perceive the response of model outputs to the variation in the model inputs” (Bergonovo and Plischke, 2016). There is a wide-open range of methods, each one proper to a different kind of model. If the model includes a low number of factors and is a highly efficient, the best choice is the use of variance-based methods, while if the model presents nonlinearity, global methods are more suitable (Cariboni et al., 2007).

Heiselberg et al. (2009) grouped SA methods into three classes: "local" sensitivity methods, global sensitivity methods, and screening methods. "Local" sensitivity methods are also often based on the one-parameter-at-the-time (OAT) approach. In the OAT, the model outputs results depend on an input parameter change, while all other parameters are held constant (Nguyen and Reiter 2015).

In this study, researchers aim to analyze the sensitivity of a sustainability assessment model for municipalities that produce sugarcane, as the final part of its construction.

2. METHODS

The model to analyze includes 18 indicators, from environmental, social, municipal policies and economic dimensions, reunited in seven of the eight principles proposed by Gibson (2006) as can be seen in figure 3. The final index is a combination of the three dimensions (environmental, socioeconomic and municipal policies) that group those principles.

Each principle includes at least one eliminatory factor to avoid trade-offs. An eliminatory factor is a critical indicator of sustainability and, therefore, must present value over the lowest to the final index calculation proceed over the minimum result.

In Table 1 it is possible to see the indicators used and their source, while in figure 3 there is a diagram of the final index composition.

Table 1. Indicators used to feed the 18 criteria. The indicators are grouped according to their nature: A for environmental aspects; E for economic aspects; S for social aspects; I for municipal's policy aspects.

Code	Indicator	Data year	Source
A1	Agro-environmental Zoning (AEZ)	2009	SMA (2009)
A2	Slope	2013	CPLA (2013)
A3	Water quality	2013	CETESB (2014)
I1	Planning instruments	2013	IBGE (2014)
I2	Sustainability initiatives		
I3	Environmental legislation		
I4	Adhesion to Millennium objectives		
I5	Natural disaster planning		
I6	Local agenda 21		
I7	Municipal master plan		
S3	Gender equity		

S4	Social participation		
S5	Security index		
S6	Water Supply and Waste disposal (WSWD)		
S1	São Paulo Index of Social Vulnerability (IPVS)	2010	SEADE (2014, 2015)
S2	São Paulo Index of Social Responsibility (IPRS)	2013	
E1	GINI coefficient	2013	
E2	Economic dependency	2013	

The environmental domain (A) is equal to the principle Integrity of the socioeconomic system (P1). This principle includes AENZ adequacy, water quality and appropriate slope for mechanized harvest (until 12%).

The Socioeconomic domain (B) includes two principles: Sufficient resources for subsistence and access to opportunities (P2) and Intra-generational equity (P3). It includes social indicators of well-being, resilience, and indicators of equity, like Gini coefficient.

The Domain C refers to several municipal instruments that deal with improvement, gender equity, initiatives of sustainability and risk prevention, among others. All these municipal policies indicators along with social participation and economic dependency are in the other four principles: Intergenerational equity (P4), Socio-environmental civility and democratic governance (P6), Precaution and adaptation (P7), and Integration between current and long-term situation (P8).

The final index is equal to “1” if any domain is “1” and corresponds to the three domains mean if not. It was the model performed according to the relationships presented in the next diagram (Figure 3):

Figure 3. Diagram of the Sustainable index construction. Source: authors

It was these relations translated into mathematical language according to the next table (Table 2):

Table 2. Principles, domains and sustainability index formulas.

Principles' formulas:
P1: (If (A1=1 or A2=1) Then P1= “1”, if not (P1=mean(A3)))
P2: (If (S2=1) Then P2 = “1”, if not (P2=mean(S2,S5,S6)))
P3: (If (S1=1) Then P3 = “1”, if not (P3=Mean(S1,E1,S3)))
P4: (If (I6=1) Then P4 = “1”, if not (P4=Mean(I6,I2)))
P6: (If (S4=1) Then P6 = “1”, if not (P6=Mean(I6, I2)))
P7: (If (E2=1) Then P7 = “1”, if not (P7= Mean(E2,I5)))

P8: (If (I7=1) Then P8 = “1”, if not (P8=Mean(I1,I7)))
Domains' formulas:
A: P1
B: Mean (P2, P3)
C: Mean (P4, P5, P6, P7)
Sustainability index formula
Index: (If (Domain A=1) then Index = “1”, if not (Index = Mean (Domain B, Domain C)))

2.1. Sensitivity analysis

It was a one-at-time (OAT) sensitivity analysis performed on the Sustainability assessment model for São Paulo state' sugarcane crop. Considering the model, and the fact it uses several indexes for its construction along with dichotomic indicators and eliminatory-factors, researchers decided to use the one-parameter-at-a-time OAT approach by comparing the sustainability index variability (output data) with the change in indexes and their internal parameters (input data) (Gan et al., 2014).

In this method, there are reference values to set the parameters (Borgonovo and Plischke, 2016). Then a variation is applied to a single parameter, then the difference in final and intermediate results from reference result is measured.

A proportion measures the influence according to the formula 1:

$$\Delta S_{i_r \rightarrow i_a} = \frac{(S_a - S_r)}{S_r}$$

Equation 1. Influence formula. Output model variation according to an indicator's variation. ΔS is the increment or reduction attributed to the indicator's change; (S_r) is the reference scenario; (S_a) is the alternative scenario; (i_r) is the reference value; and (i_a) is the alternative value.

The OAT analysis measures the change in sustainability assessment result (ΔS) from the reference scenario (S_r) to the alternative scenario (S_a) when an indicator changes from a

reference value (i_r) to an alternative value (i_a) (Gan et al., 2014). The subtraction of the difference between both scenarios is divided by the reference scenario value (S_r).

3. RESULTS AND DISCUSSION

In figure 4, it is possible to see indicator's contribution on principles, each principle's influence on domains, and the domains' influence on the sustainability index. In table 3 there is a resume of the different contributions.

Figure 4. Influence of each indicator/ principle/ domain to the final assessment index/ domain/ principle.

Three domains form the sustainability index, so each one contributes with a third of the final value. The domain A is equal to P1, which has only environmental indicators. The indicators A1 (AENZ classification) and A2 (slope) are eliminatory-factors therefore if any is "1", then P1 result is "1". Otherwise, if both indicators are more than 1, then P1 is giving A3 (water quality).

P2 and P3 influence the Domain B in proportion 1:1 (50% each). Both principles include three indicators apiece. Each indicator corresponds to a third of the respective principle, 16.67% of Socioeconomic Domain (B), and influences in 5.55% the Sustainability Index.

The principles P4, P6, P7, and P8 influence Domain C at equal levels (25% each). Principles P4, P7, and P8 have two indicators, meaning each one influences its principle results in 50%, the Domain C in 12,5%, the Sustainability Index in 4,17%. On the other hand, three indicators compose P6, but like in P1, S4 does only work as a threshold. The other two principles influence Domain C in 12.4% each, and the Sustainability Index in 4,2%.

Table 3. Output's variations (final and middle results) by input fluctuation. "Ia": indicator value in set a; "Ib": indicator value in set b; "Pv": principle's absolute difference; "Pa": principle value in set a; "Pb": principle value in set b; "Pv%": principle's percentage change from set a to b; "Dv": domain's absolute difference; "Da": Domain value in set a; "Db": Domain value in set b; Dv%: domain's percentage change from set a to b; "Sa": Sustainability index value in set a; "Sb": Sustainability index value in set b; "Sv%" percentage of sustainability index variation.¹ Indicator results increment until it is significant to pass the model classification. ² Reduction of violence in sufficient numbers to move from the category; ³ 50% increment on the average services' coverage; ⁴ Increase in one action in favor of equity. ⁵ 50% increase in the primary indicator. ⁶ The increment of an initiative in favor of sustainability. ⁷ The increment in a legal instrument.

Indicator	Ia – Ib	Pv	Pv%	Dv (Da-Db)	Dv%	Sa-Sb	Sv%
A3	2-3	P1: 2 – 3	50.0%	DA: 2-3	50.0%	1.689-2.022	19.7%
S2 ¹	2-3	P2: 1.333-1.667	25.0%	DB: 1.333- 1.500	12.5%	1.689-1.744	3.2%
S5 ²	1-2	P2: 1.333-1.667	25.0%	DB: 1.333-1.500	12.5%	1.689-1.744	3.2%
S6 ³	2-3	P2: 1.333-1.667	25.0%	DB: 1.333-1.500	12.5%	1.689-1.744	3.2%
S1 ¹	1-2	P3: 1.3 - 1.700	30.8%	DB: 1.333-1.500	12.5%	1.689-1.744	3.2%
S3 ⁴	1-1.4	P3: 1.3 – 1.400	7.7%	DB: 1.333-1.733	30.0%	1.689-1.711	1.3%
E1 ⁵	1-2	P3: 1.3 – 1.500	15.4%	DB: 1.333-1.733	12.5%	1.689-1.744	3.2%
I6	1.0-1,5	P4: 1.0-1.25	25%	DC: 2.250-2.313	2.8%	1.861-1.882	1.1%
I2	1-1.4	P4: 1.0-1.4	40%	DC: 2.313-2.363	2.2%	1.882-1.899	0.9%
I4	1-1.25	P6: 1.0 - 1.125	12.5%	DC: 1.563-1.594	2.0%	1.632-1.642	0.6%
I3 ⁶	1-2	P6: 1.5-2.0	33.3%	DC: 1.688-2.313	37%	1.674-1.882	12.4%
E2	1.5-2	P7: 1-1.5	50%	DC: 1.594-1.719	8.3%	1.642-1.884	14.6%
I5	1-3	P7: 2.0-3.0	66.7%	DC: 1.719-1.969	15.3%	1.684-1.762	4.6%
I7	1-3	P8: 1-3.0	110%	DC: 1.594-2.094	31.4%	1.642-1.809	10.2%
I1 ⁷	2.0-2.2	P8: 2.5-2.6	9.5%	DC: 1.968-1.994	1.5%	1.767-1.776	0.5%

Table 3 shows that an indicator can affect from 0.5 to 19.7% the sustainability index final result. The indicator variation that most affects sustainability index is A3 (19.7), followed by far by I7 (5.8) and I5 (5.1), while the indicator's change that affects the less is I4 (0.6), followed by I1 (0.5) and I2 (0.9).

All the results above consider that eliminatory factors are over the minimum value. In the next table (Table 4), we can observe the variation observed in principles when an eliminatory factor indicator changes to the minimum value.

Table 4. Output's variations (elimination-factors results) by input fluctuation. "Ia": indicator value in set a; "Ib": Indicator value in set b; "Pv": principle's absolute difference; "Pa": Principle value in set a; "Pb": Principle value in set b; "Pv%": principle's percentage change from set a to b; "Dv": domain's absolute difference; "Da": Domain value in set a; "Db": Domain value in set b; Dv%: domain's percentage change from set a to b; "Sa": Sustainability index value in set a; "Sb": Sustainability index value in set b; "Sv%" percentage of sustainability index variation.

Indicator	Ia – Ib	Pv	Pv%	Dv (Da-Db)	Dv%	Sa-Sb	Sv%
A1	1-3	P1:1-2	100%	DA:1-2	100%	1-1.688	68.8%
A2	1-2	P1:1-2	100%	DA:1-2	100%	1-1.688	68.8%
S2 ^I	1-1.33	P2: 1.3-1.7	25.0%	DB: 1.2- 1.3	12.5%	1.1- 1.333	3.6%
S1 ^I	1-1.3	P3: 1.3 - 1.7	30.8%	DB: 1.2- 1.3	12.5%	1.- 1.333	3.6%
I6	1-1.25	P4: 1-1.2	25%	DC: 1-1.1	6%	1- 1.030	3%
S4	1-1.67	P6: 1-2	100%	DC: 1.-1.5	50%	1-1.250	25%
E2	1-1.5	P7: 1-1.5	50%	DC: 1-1.1	12.5%	1-1.062	6.2%
I7	1-2.5	P8: 1-2.1	110%	DC: 1-1.3	27.5%	1-1.138	13.8%

Comparing both tables, even if elimination-factors indicators are a limitation to the sustainability index improvement their influence into the formulas are different, with only a light increment. However, the exception are the indicators A1 and A2, that can influence Environmental domain (A) and sustainability index in a 100%. Far from those indicators, the second more influent elimination-factor us I7, that influences the Domain C in a 20,3% and the final index in 8%.

4. CONCLUSIONS

According to our results, social indicators (S1 to S6, except S4 that is out of this part of the analysis) influence the sustainability index in a 3.2% each. At total, social indicators correspond to 19.2% of the result. The municipal policies indicators influence with different proportions the sustainability index, from 0.5% of I4 to 5.8% of I7. In total, municipal policies indicators sum 15.7% of the result. Economic indicators influence the sustainability index in 3.2% (E1) and 2.5% (E2), and together both sum 5.7% of the result. Finally, environmental indicators correspond to a third of the sustainability index, being A3 responsible for 19.7% of it.

When evaluated with “1”, elimination factors have a substantial effect on the principles and the final index calculation, turning them to the minimum value. Environmental indicators A1 (AENZ adequacy) and A2 (slope) have an influence of 68.8% on the sustainability index, while S4 has 25%. Once those indicators move from the lowest score, their influence on the final index is similar to the regular ones.

Environmental indicators present high influence (68.8%) on the final index, while S4 (social participation) has an influence of 25%. Different domains affect the final sustainability index differently, while environmental indicators present high influence (68.8%) on the final index, S4 (social participation) has an influence of 25%.

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FINAL CONSIDERATIONS

FINAL CONSIDERATIONS

Like all projects, the initial proposal of this study went through alterations, adaptations, and even mutations, but the objective remained intact: to generate a decision-making support tool for the sugarcane sector to direct it towards sustainability.

Currently, the sector has been the answer to reduce and avoid GHG emissions, ozone layer decrease, among other atmospheric contaminants, but sugarcane ethanol industry still must tackle enhancing environmental and social impacts, beyond burning harvest.

It faces an expansion that directly affects the Cerrado biome and indirectly puts pressure on the Pantanal and Amazon biomes. Focusing on social criteria the sugar industry affects, mainly in the industrial processing phase, the local economy, encouraging commerce and the establishment of new services.

Social conditions on crop and millwork are different; to the point, it was not the millwork considered in any study referred here. Today, the most prominent challenge is with working conditions in the sugarcane manual harvest.

Nowadays, São Paulo state guides its expansion through the AENZ, which uses environmental criteria to classify the state territory in adequacy categories. This instrument allows some improvement to increase its effectiveness and to support sustainability assessments. In chapter two, it was some of those gains discussed. Now, ending this project, we can understand and reinforce some requests regarding information availability (see limits subsection). However, AENZ is a powerful tool because it is easy to understand and permits a whole vision of São Paulo state, while gives accurate information for all the area. These benefits, which derive from its map format, impelled the development of a tool in an atlas format.

Never the less, with the available information, during this study it was an integrative model developed to assess sugarcane production that discriminates geographic areas, adds social, economic and municipal policies, and some new environmental indicators to the AENZ.

As part of these goals, it was the Gibson's principles (Gibson, 2005) framework used. This, because it focuses on dimension's interaction, through eight principles that cover

different sustainability aspects. For example, principle one pretends not only measure environmental quality but its quantity and quality for society's various uses. Also, the Gibson's principles were used before to assess sugarcane mills in São Paulo state (Duarte et al., 2013), but not to the complete agricultural system. There are some other works using Gibson's principles in other areas; (Gaudreau & Gibson, 2010; Shah & Gibson, 2013). However, it is a framework poorly used because it forces you to think out of the box. This frame has significant potential, considering the possible uses and its adaptability to a different context.

Sugarcane impacts research goes along with the development of sustainability criteria, indicators, and frameworks. There are many efforts, from the private and public sphere, to find the requirements to assess sustainability. However, almost all attempts focus on same indicators, being the difference on their result more related to the method than to the evaluation of a new aspect.

In chapter three, we present an effort to find some relations between sugarcane expansion (agricultural and industry phase) with municipal indicators. As shown before, there are no substantial correlations between the considered indicators and sugarcane expansion, even if sugarcane industry has a well-known effect on local income increase. Therefore, it was decided to guide this work's indicators selection considering two aspects: a) the indicators must fulfill the intention of each Gibson's principles and b) it must describe at least the municipal level.

In the beginning, it was almost fifty indicators chosen, but after rethinking the model not trying to fulfill all principles, we decided to keep only the relevant. Moreover, to do this, we considered these questions: 1) is it the main subject of this principle? 2) Is it a main subject of sustainability? 3) Can we obtain the information regarding this indicator in public databases? Those indicators that fulfill with a "yes" the three questions were considered elimination-factors, while those that satisfy the first and third query are regular indicators. The remaining indicators were eliminated.

Principle 5 was an exception, its inclusion would significate some prediction level about sugarcane entrepreneur's conduct and decisions, increasing the uncertainty. So, it was the principle level eliminated, and the model's objective focused on sugarcane industry level, instead of the mill level.

Sadly or happily, there were few sources to find these indicators. It could be a reflection of the insufficient quantity of data generation, or that these data are on the same platform (which facilitates the search work). In case of Brazil, the real reason is a mix of both explanations, while few institutions concentrate the information acquisition, there is also a common platform to use it, at least for São Paulo state.

With the indicators selected, it was established a model to integrate them. In this point, as a real contribution to diminishing tradeoffs, the elimination factors were added. Their use permitted not to follow in transactions, mainly between the environmental criteria and the other domains' criteria. As indicated in chapter four, elimination factors also allowed to highlight specific but crucial aspects of sustainability.

Our assessment model includes social, environmental, economic, and municipal policies indicators, each one with a different influence on sustainability index (from 0,4 to 19.7%), which also implies in a different weight of dimensions. Municipal policies indicators are the fewer influencers, while environmental indicators are the most. This difference also gave a differentiation according to relevance and direct association.

The presentation in an atlas format allowed to see, for each principle, domain, and the final index, the performance across the state in a didactic and very understandable way. It was the socioeconomic information highlighted during the last interview because sugarcane industry's many efforts on this matter do not present a favorable or satisfactory result. The interviewed saw the atlas as a decision tool considering it permits the decision to address those effort to municipalities with the lowest performance or to change the kind of intervention in the localities currently supported.

During this study, former characteristic of municipalities and sugarcane industry came into discussion. Silva Netto (2010) pointed out that municipalities' environmental system was incipient, while the personnel presented lack of preparation. In the other hand, Cetrulo (2010) indicated that it was government- entrepreneur's relationship characterized by government command and control position and sugarcane industry's strategic vision with a focus on the economic gain from environmental improvements. Regra (2013) highlighted the lack of social participation and emphasizes the importance of scenario tool as a space for dialog between stakeholders and the municipalities' environmental system improvement.

Dibo (2014) evaluated how it was the cumulative impacts included in environmental assessment studies. She concludes those impacts are not adequately cover, there is a time-based analysis absence, and it is required clarify definitions to separate indirect from cumulative impacts. Also, Gomes (2014) focused on sustainability strategic description by stakeholders. Her conclusions pointed out the participation and dialog absence, characteristics reflected on sugarcane framework selection by the sector. As Gomes indicate, “the lack of dialog and participation is revealed with the use of the triple bottom line, while integrative visions that can diversify the focus now in economic matters are left aside (Gomes, 2014, p.220).”

Dibo (2014) and Gomes (2014) distinguishes the need for an integrative framework, while Regra (2013) concludes the importance of a scenario tool as a participatory situation that could add to democratic planning while considering the time horizon in planning.

The sugarcane sector has been emblematic of increasingly stringent environmental standards implementation and adaptation. Its development has been a conjuncture of the search for more sustainable products and of the economic benefits that the ethanol transformation in a sustainable product for the new consumer markets opening. Because of that, there are many efforts to evaluate its environmental sustainability and to certified ethanol precedence, which maintains the conclusion that sugarcane industry primary drivers are the economic gains.

According to our results, there is still a path to be followed by sugarcane industry, considering the sustainability performance is moderate in municipalities with sugarcane cultivars. This can be explained because the focus on industry level does not consider the municipal policies context, which has been included in this study.

The development of this work is a step forward on different nature variables' integration, considering environmental, municipal policies, social and economic data in an integrative framework. The use of the atlas can provide valuable insights to guide the sugarcane industry planning, diminishing its negative impacts primarily on economics and social aspects. Moreover, this tool can be used to compare distinct production systems or to analyze other regions or cropping systems.

This project also met with participation as the main obstacle to further progress. The lack of communication between the stakeholders affects the sugarcane sector's advance to sustainability because they keep in particular the answers to a global concern.

Nowadays, there is a dichotomy when environment and sustainability are taking into account. Social or economic advantages are always put on top when situations society versus environment or society versus sustainability. This fact is a threshold to any sustainability improvement. The Atlas presents the current situation, focusing on medium and long-term planning and leaving aside the sugarcane sector short-term planning. Its advantage came from elimination factors use, that helps to not bargain environment one aspect by other.

To future studies, it is interesting to focus on improvement and social participation. Even when scenarios tool, in previous studies (Regra, 2013), is a space to construct relations and share points of view, the sugarcane sector needs instruments and new areas to strengthen the ties on a regular basis.

A. Limitations

During the project, methods were established and restored and then transformed into methodologies derived from the difficulties that emerged along the way. There are two main difficulties to consider: Data availability and the sugarcane producers' participation.

Data Availability

In Brazil, there is a significant amount of data from federal, state, municipal, and private effort results. However, private origin information is not always available to the public, and public data mostly do not "talk to each other." That is, they do not share scope, scale, period and measurement unit. This data disparity delays and avoids more in-depth analysis. However, more important is their little updating and the two or more years of update delay.

Not only the national census data are collected every decade, but state bases such as LUPA about agricultural economic activities extension, consequently, do not allow a precise study, but an estimate of their evolution, general diagnostic and, therefore, different forecasts are possible with the same data use.

It is necessary a national database, previously defined in its construction, publication, and periodicity. Also, it is a homogeneous state, and local bases needed not as substitutes for current bases, but to improve analysis at different levels, such as state, municipal or, if possible, at lower scales.

The sugarcane industry

A significant restriction to this work, which defined the methodology from the first year, was the stakeholders' lack of willingness to participate, particularly the private sector. This interest's absence resulted in the impossibility to generate a consensus tool.

From other stakeholders, there was little interest in sharing real concerns, on the contrary, almost all opinions came from and addressed to generalities published in the media rather than the sector contribution to sustainability.

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ANNEX

ANNEX

I. INDICATORS METADATA

Domain	A- Environmental
<i>Description</i>	The environment is all the natural habitats and resources that provide services for life on the planet. Its quality and availability are crucial to any being, including human.
Principle	1- The integrity of the socio-ecological system
<i>Description</i>	To build social-environmental relationships that establish and maintain the integrity of long-term socio-environmental systems and protect ecological functions.
Indicator	A1- Agro-Environmental Zoning (AENZ)
<i>Definition</i>	The AENZ is an instrument developed to direct sugarcane crop considering climatic, soil, hydrologic and other features.
<i>Justification</i>	Developing sugarcane crop on adequate areas (adequate, adequate with restriction and adequate with limitations) means that it fits environmental conditions, complies current environmental legislation, and follows some mandatory guidelines (volume water use, advanced procedures, and machines, flora and fauna protection programs, among others).
<i>Description</i>	It categorizes São Paulo State in four Agro-ecological zones: a) adequate to sugarcane crop, b) adequate with limitations for sugarcane crop, c) adequate with restrictions for sugarcane crop and d) inadequate for sugarcane crop. In inadequate areas, it is the sugarcane cultivation forbidden. Adequate areas should present regular environmental requirements according to the law, considering a water consumption limit of 1 m ³ *ton ⁻¹ of sugarcane processed; adequate with limitations areas have higher requirements regarding conservation of reminiscent native flora and the acquisition and use of pollution control equipment for industrial purposes. Adequate with restrictions areas must consider the formation of ecological corridors with permanently protected areas. The production in these areas have some restrictions: the industry has water consumption limit of 0,7m ³ per ton of sugarcane, must compromise to use the best technology available, and to apply prevention plans to diminish the disturbance to fauna and reduce roadkill (SMA, 2008)
<i>Atlas method</i>	If the area that is categorized in any adequate classification then for the atlas, it will receive a value of “3” and inadequate areas rated as “1”.
<i>Remarks</i>	This indicator is an elimination factor for P1 because the agro-environmental zoning (AEZ) is an official instrument that determines which areas are suitable for sugarcane

	crop. According to AEZ, inadequate areas have no environmental conditions for this activity and, therefore, cultivation in this area cannot be sustainable
<i>Geographical breakdown</i>	Continuous to all São Paulo state
<i>Periodicity</i>	No update
<i>Source</i>	SMA-Secretary of Environment of São Paulo state
<i>Year</i>	2009
<i>Link</i>	SMA, 2016
Indicator	A2-Slope
<i>Definition</i>	It is the inclination of territory in relation to a settled surface.
<i>Justification</i>	Until 2017, the previous field burning process required for manual harvest of sugarcane to be extinct, meaning that all sugarcane production will use only mechanical harvest. As the harvesters cannot work over 12% slope, it was these areas considered inappropriate for sugarcane cultivation. The burning process has an impact not only on air quality but also in labor conditions because it is the manual harvest done in very harsh conditions (prolonged exposure to the sun, long working journeys, temporary contracts with limited benefits for health and family issues among other) (Torquato, 2013).
<i>Description</i>	It corresponds to an area inclination regarding a horizon. It is the slope measured in angles or percentage.
<i>Atlas method</i>	It was the slope calculated using the São Paulo state's Digital Elevation Model. Then a classification category was created with the following rule: If the slope is over 12% then "1", if not the value is "3."
<i>Remarks</i>	Considering the impact of burning harvest, land with a slope over 12% is unsustainable, while below or equal to 12% can use mechanized harvest and therefore avoid burning.
<i>Geographical breakdown</i>	Continuous for all São Paulo state
<i>Periodicity</i>	No update
<i>Source</i>	CPLA
<i>Year</i>	2013
<i>Link</i>	MDE model
Indicator	A3- Water quality

<i>Definition</i>	The WQI is an index designed to classify the water quality in a watershed (CETESB, 2014). According to its range, WQI indicates if a watercourse has excellent, good, regular, bad or very bad quality.
<i>Justification</i>	Water quality is an essential factor, considering that influences the residual water amount to be assimilated by rivers and lagoons.
<i>Description</i>	Its construction includes the next parameters: Turbidity, total residue, dissolved oxygen, total nitrogen, total phosphorus, temperature, pH, total coliforms, and Biochemical Oxygen Demand (BOD).
<i>Atlas method</i>	For the atlas, the categories excellent and good correspond to a “3”, while the regular situation to a “2”, and bad and very bad quality to a “1”.
<i>Remarks</i>	
<i>Geographical breakdown</i>	Watershed
<i>Periodicity</i>	Annual
<i>Source</i>	CETESB
<i>Year</i>	2014
<i>Link</i>	Superficial water quality reports
Domain	B- Socioeconomic
<i>Description</i>	This domain includes mainly social and economic indicators. Its inclusion obeys to evaluate society aspects that indicate their quality and opportunities
Principle	2- Sufficient resources for subsistence and access to opportunities
<i>Description</i>	To ensure that each person and community has sufficient quality of life and the opportunity to seek improvements.
Indicator	S2- São Paulo Social Vulnerability Index (IPVS)
<i>Definition</i>	IPVS is an instrument developed for São Paulo’s municipalities. It measures the families’ vulnerability to poverty.
<i>Justification</i>	"According to Katzman (1992), an individual, family or social group vulnerability refers to their greater or less capability to control the forces that affect their well-being. [Not only consider] income deprivation, but the family composition, health conditions and access to medical services, (...), etc. [Also], spatial segregation is a phenomenon (...) that contributes decisively to the social inequality patterns permanence." (SEADE, 2014)
<i>Description</i>	This indicator is available only in the state of São Paulo (SEADES, 2012). Its purpose is to evaluate the vulnerability of families to poverty. It considers variables as the family income range, and the family chief education degree, age, and gender. It

	classifies the municipalities into seven categories of vulnerability: extremely low, very low, low, regular, high, very high and extremely high.
<i>Atlas method</i>	It was three categories considered to include this aspect into the atlas: municipalities categorized with an extremely low to a low vulnerability correspond to a value of “3”, municipalities with a regular vulnerability classification received a value of “2” and municipalities categorized as a high to an extremely high vulnerability correspond to a “1”.
<i>Remarks</i>	The vulnerability is a significant factor, and therefore a P2 elimination factor because sustainability considers that resilience from different dimensions is an asset to affront different conditions (such as market, social, and climatic). A high vulnerability implies in households with fewer opportunities to affront changes and to get improvements in their life quality. A district cannot be sustainable if there is a high level of vulnerability.
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	10 years
<i>Source</i>	SEADE
<i>Year</i>	2010
<i>Link</i>	IPVS
Indicator	S5- Security index
<i>Definition</i>	Number of violent acts in thousand inhabitants
<i>Justification</i>	It was the quality of life-related, in some grade, to the violence and to how we notice it. High levels of an opportunity, low education, low income, among others are key factor for violence increment in Latinamerica (Buvinic et al., 2005)
<i>Description</i>	This index includes five kinds of violent acts per thousand inhabitants: robbery with homicide, intentional homicide, rape, burglaries, and robberies.
<i>Atlas method</i>	This index includes five kinds of violent acts per thousand inhabitants: robbery with homicide, intentional homicide, rape, burglaries, and robberies. For each municipality, it was the values added. It was the municipalities classified considering a limit of 10-violence acts per a thousand people as an elimination factor. If the result is equal or below the limit of 10 violent acts per thousand inhabitants, then the value of the index is three (3). If above 10, then the index value is one (1).
<i>Remarks</i>	The most recent shape with sugarcane crop and production is from 2013. For this reason and adequately correlate the indicators, it was decided to use 2013 indicators or the closest data for this year. Nevertheless, some indicators as Security index have an update in recent years (2015)

<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	SEADE
<i>Year</i>	2013
<i>Link</i>	SEADE
Indicator	S6- Water Supply and Waste disposal (WSWD)
<i>Definition</i>	Mean of water supply, waste collection, and sanitary sewage coverage
<i>Justification</i>	We included this indicator to measure the housing quality, as it is an aspect that leads to poverty conditions and, therefore, to lesser opportunities.
<i>Description</i>	It was this indicator developed considering three variables: coverage (in percentage) of a) water supply network, b) waste collection and c) sanitary sewage. The mean of all coverages is multiplied by two (2), and to fit on a scale of one to three a unit was added.
<i>Atlas method</i>	The mean of all coverages is multiplied by two (2), and to fit on a scale of one to three a unit was added.
<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	annual
<i>Source</i>	SEADE
<i>Year</i>	2013
<i>Link</i>	SEADE IPVS 2010
Principle	3-Intra-generational equity
<i>Description</i>	To ensure that quality of life and opportunity are being pursued all to reduce gaps between the wealthy and poor.
Indicator	S2- São Paulo Social Responsivity Index (IPVS)
<i>Definition</i>	A social index that measures families' vulnerability to poverty into São Paulo state
<i>Justification</i>	It is possible to describe vulnerability as a contrary concept of resilience. While more vulnerability, less the capacity to affront changes and keep the social quality of life.
<i>Description</i>	It was this indicator developed only for São Paulo State, as a local adaptation of Human Development Index (HDI). It classifies the State in five different zones according to the level of social responsibility, ranging from very high to very low.
<i>Atlas method</i>	For the Atlas, it was the first two levels (very high and high) classified with a "3" into the atlas, the regular level as "2", and the bad and very bad levels as "1".

<i>Remarks</i>	This index is a local variation of HDI and shows the general condition of a district in quality of life. A district with a low index indicates that there are not adequate conditions for health, education, and income. This situation cannot be considered sustainable in any hypothesis; therefore, this indicator is an elimination factor for Principle 3.
<i>Geographical breakdown</i>	Censitary districts
<i>Periodicity</i>	2 years
<i>Source</i>	SEADE
<i>Year</i>	2014
<i>Link</i>	SEADE- IPRS 2014
Indicator	S3- Gender equity
<i>Definition</i>	Number of municipal government actions to guarantee gender equity among its inhabitants
<i>Justification</i>	Not only access to health, education, and housing implies equity in a generation. Other aspects should be considered, like gender issues. Equal opportunities and safety
<i>Description</i>	It was this indicator calculated with information from the IBGE Municipal database for 2013. It includes five sub-indicators: (a) the existence of a current municipal gender equity plan or program; (b) municipal council about gender's rights and its attributes, (c) different structures related to gender issues; (d) partnerships with NGO's, other government levels or institutions and; (e) specific budget for gender equity programs.
<i>Atlas method</i>	It was the five sub-indicators added and, in order to transform them in a scale range from 1-3. Then the sum is multiplied by a factor of 0.2 and added a unit, according to Equation 1: Where (a) is a binary component related to the existence of a Municipal Gender Plan or Program (1 if positive, 0 if negative); (b) is the combination of i) the existence of a Gender Rights Council and ii) how many functions it performs (consultative, deliberative, normative and audit). Zero (0) means no existence of the council, one (1) to four (4) the number of functions of the Council. The final (b) component is divided by four before being included in Equation 1. The (c) component relates to six different structures available to support gender equity actions, like i) women's shelters, ii) specialized services, iii) support to victims of violence, iv) forensic and legal medicine institute, v) daycare centers and vi) normal birth delivery centers. The presence of each structure added a point to this component. Then, the result of this component is the sum of its variables divided by 6. The component (d) refers to the existence of partnerships involved in gender equity actions. Institutions

	such as organs from the Public Administration (at federal, state and municipal level), NGO, Private Institutions, International Organizations, Religious organizations, workers' entities and others integrate this component. If at least one partnership exists, then this component has the value one (1). If there is no partnership, the value is zero (0). Component (e) refers to the existence (1) or not (0) of a specific budget to gender equity actions.
<i>Remarks</i>	There is new information available to the public. We kept the 2013 year to be by open information on sugarcane sector.
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	E1- Gini coefficient
<i>Definition</i>	This indicator measures the income equity by the comparison between an ideal situation and real a cumulative salary in a group
<i>Justification</i>	Access to goods and services are related to income, while more inequity between incomes, more inequity in quantity and quality acquisitions
<i>Description</i>	The GINI coefficient related to inequity in the distribution of income index (Ceriani & Verme, 2012). The index ranges from zero (0) to one (1) (being one (1) the perfect distribution).
<i>Atlas method</i>	It was this coefficient converted to a scale of 1-3 by multiplying it by two (2) and adding a unit.
<i>Remarks</i>	The information is from 2010; there is no new information.
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	10 years
<i>Source</i>	IBGE
<i>Year</i>	2010
<i>Link</i>	Gini coefficient 2010
Domain	C – Municipality policy
<i>Description</i>	This domain includes mainly municipal policy indicators. Its inclusion obeys to evaluating government aspects that indicate local instruments establishment to achieve sustainability
Principle	4- Intergenerational equity

<i>Description</i>	To favor options and actions in the present that are more likely to maintain or increase the opportunities and capacities of future generations.
Indicator	I2- Sustainability initiatives
<i>Definition</i>	types of initiatives existing in a municipality
<i>Justification</i>	In some words, it is the sustainability defined as our generation development without extinguishing the resource for future generation's development. Any initiative directed to sustainability balances the current natural resources use with the future generations' requirements is a step forward this direction.
<i>Description</i>	It includes different basic initiatives that are monitored by federal government.
<i>Atlas method</i>	A positive value in each category gives one (1) point. The result is multiplied by two (2), divided by five (5) and added a point to fit the result on a scale 1-3.
<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	I6- Local Agenda 21
<i>Definition</i>	The Local Agenda 21 is an initiative with a focus on sustainability programmes implementation by local governments.
<i>Justification</i>	The Agenda 21 is one of the four treaties approved in 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, also known as Earth Summit. "The overall goal of LA21 is to engage multiple stakeholders within a community in sustainability decision-making through participatory target setting and assessment. As determined by the International Council for Local Environmental Initiatives (ICLEI), LA21 municipalities must fulfill several criteria like (1) the process must include the participation of multiple constituencies in the community, (2) stakeholders need to reach a consensus regarding social, environmental, and economic objectives, (3) the process must provide a forum for discussion and overseeing, (4) the process must include a long-term action plan, and (5) the process must establish a framework for reporting and monitoring." (Owen and Videras, 2008)
<i>Description</i>	Considering intergenerational equity, the development of the Agenda 21 principles presents fundamental sustainability goals. It includes future generations' well-being, and it has been a fundamental instrument in Brazilian process to promote

	sustainability at the municipal level by implementation of laws, actions and planning with a long-term view.
<i>Atlas method</i>	The phases of local Agenda 21 (Weiss, 1992) are sensitized (value 1), elaboration of a sustainable development program (2) and implementation (3). It was regular meetings also considered should occur. If there was a meeting in the last year, the indicator gets one (1) point; no meeting in the last year means zero (0) points. All points are summed, divided by two (2) and added a unit to fit the indicator on a 1-3 scale.
<i>Remarks</i>	After 25 years since Rio'92, different phases of its implementation should get different points, but only the current execution phase should receive a satisfactory value. Thus, I6 is a Principle 8 elimination factor.
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Principle	6- Precaution and adaptation
<i>Description</i>	To ensure open and informed decisions, collective responsibility, education, and the use of more integrated practices in decision-making.
Indicator	S4- Social participation
<i>Definition</i>	Existence of social participation channel at Municipal level
<i>Justification</i>	It is very difficult to government represent all affected inhabitants at any scale. Therefore, it was the different groups' participation, especially the ones affected, considered essential for a real solution to take place regarding sustainability. (Paavola & Adger, 2006)
<i>Description</i>	It considers any participation at municipal government level
<i>Atlas method</i>	This indicator follows a binary classification. The existence of any social participation gives the value three (3) to the indicator, while the inexistence of social participation is a one (1).
<i>Remarks</i>	Social participation is a crucial factor when sustainability is in question, and consequently an elimination factor in Principle 6. Channels of communication should be encouraged, and any initiative should be considered as a step forward to increase social participation. The inexistence of any social participation is the only situation that cannot be sustainable.

<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	I4- Adhesion to millennium goals
<i>Definition</i>	The UN Assembly developed eight-millennium goals to be pursued by all level governments as part of achieving minimal conditions of sustainability
<i>Justification</i>	The adhesion to Millennium goals shows the intention of diminish to eliminate poverty objective
<i>Description</i>	It was the municipal government adhesion to UN millennium objectives (UN Assembly, 2000) considered: a) eradication of extreme poverty and hunger; b) achievement of universal primary education; c) promotion of gender equality and women empowerment; d) reduction of child mortality; e) improvement of maternal health; f) combat HIV/AIDS, malaria, and other diseases; g) ensure environmental sustainability; h) and development of a global partnership for development.
<i>Atlas method</i>	It was each millennium goal adhesion evaluated with "1". Then the values were summed and divided by eight (8), and one point is summed to set a scale 1-3.
<i>Remarks</i>	Currently, Sustainable Development Goals replace Millennium Goals. Sadly, not in time to be included in this work.
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	I3- Environmental legislation
<i>Definition</i>	Policies, plans, and programs with emphasis on environment
<i>Justification</i>	The existence of environmental legislations indicates there are efforts to preserve, conserve or rational use of natural resources.
<i>Description</i>	For this indicator, it was two aspects considered: a) if there is any legislation related to environmental issues and b) if there is any partnership with the watershed committee of the management unit of hydric resources.
<i>Atlas method</i>	A yes in each question gives a point. To set the scale in format 1-3, it is one (1) additional point added.

<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Principle	7- Precaution and adaptation
<i>Description</i>	To respect uncertainties; avoid risks of severe or irreversible damage, even if they are poorly understood.
Indicator	I5- Natural disaster prevention
<i>Definition</i>	This indicator considers the existence of at least one instrument to prevent society from being affected by natural disasters.
<i>Justification</i>	
<i>Description</i>	Considers the existence of a natural disaster prevention plan in those municipalities that treats were identified.
<i>Atlas method</i>	If there are no apparent threats, the indicator is automatically assumed to be three (3); in the case, that there is an identified threat the indicator is valued at one (1). If there is a threat, but a natural disaster prevention plan is ongoing, then the indicator gets the value of three (3)
<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	E2- Economic dependence
<i>Definition</i>	Sugarcane industry's Product Value (PV) share in municipal GDP
<i>Justification</i>	An economy heavily dependent on an activity may present a decline in its ability to cope with economic crisis (Christopherson et al., 2010) since it requires the displacement of activities and the capacity to re-absorb labor to avoid social and economic effects in the medium and long-term (Briguglio et al., 2009).
<i>Description</i>	This indicator considers a) the total municipal GDP and b) the share of sugarcane production in the municipality's GDP. If sugarcane share is below 10%, then to the

	indicator value attributed is three (3); if it was between 10 and 20%, the value is two (2); if it is over 20%, the value is one (1).
<i>Atlas method</i>	To this work, it was the local economy assumed arbitrarily that dependence on sugarcane should not be over 20% in financial terms. So, E2 is an elimination factor in Principle 7.
<i>Remarks</i>	E2 is an elimination factor in Principle 7, considering the importance of a diversified economy to local resilience
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	SEADE
<i>Year</i>	2013
<i>Link</i>	SEADE
Principle	8- Integration between the current and long-term situation
<i>Description</i>	Apply all the principles of sustainability at the same time, seeking mutual benefits and many gains. Identify opportunities for positive synergies and question whether the current scenario is leading to a desirable future.
Indicator	I1- Planning instruments
<i>Definition</i>	Existence of any planning instrument at municipal level
<i>Justification</i>	The existence of planning instruments indicates a current situation diagnosis and the generation of goals to a desirable future.
<i>Description</i>	It was 10 categories considered as planning instruments: a) urban perimeter law; b) building codes and legislation; c) zones or areas of social interest; d) zones or areas of particular interest; e) land parceling; f) zoning or land use and occupation; g) land reclamation; h) investment taxes; i) urban operations; and j) neighborhood impact study.
<i>Atlas method</i>	As each one of the planning instruments accounts for one (1) point, the result must be the sum of the points divided by ten (10). The result is multiplied by two (2), and a point is added to fit on the 1-3 scale.
<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Annual
<i>Source</i>	IBGE
<i>Year</i>	2013

<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013
Indicator	I7- Municipal master plan
<i>Definition</i>	Existence of a municipal masterplan
<i>Justification</i>	A master plan is a crucial document that integrates the current situation with a long-term view. It is the final document that guides a community to its future goals.
<i>Description</i>	The existence of a valid plan gives the value three (3) to this indicator, while the inexistence of the masterplan confers a value of one (1) to this index.
<i>Atlas method</i>	A Municipal master plan addresses development considering the actual situation and goals for short, medium and long-term. The existence of a municipal master plan is crucial to the existence of any other form of planning instruments. In the case of the plan absence, it is no action assumed to promote sustainable development into a municipality. So, I7 is classified as a Principle 8 elimination factor.
<i>Remarks</i>	
<i>Geographical breakdown</i>	Municipal level
<i>Periodicity</i>	Anual
<i>Source</i>	IBGE
<i>Year</i>	2013
<i>Link</i>	IBGE, Pesquisa de Informações Básicas Municipais 2013

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II. SUMMARY OF RESULTS

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	1	3502606	APARECIDA D'OESTE	22	0,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				17887	99,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	1	3503950	ASPASIA	4	0,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				6762	99,9%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	1	3513850	DIRCE REIS	36	0,4%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
				8954	99,6%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
1	1	3514205	DOLCINOPOLIS	21	0,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	4	H	4	H	1	VL	3	M
				7791	99,7%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	4	H	4	H	1	VL	3	M
1	1	3524808	JALES	572	1,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	3	M	5	VH	5	VH
				36346	98,4%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	3	M	5	VH	5	VH
1	1	3529104	MARINOPOLIS	18	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	5	VH	1	VL
				7877	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	2	L	4	H	5	VH	1	VL
1	1	3529658	MESOPOLIS	55	0,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	3	M
				15940	99,7%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	5	VH	1	VL	3	M
1	1	3532843	NOVA CANAA PAULISTA	21	0,2%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
				12497	99,8%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
1	1	3535200	PALMEIRA D'OESTE	71	0,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	1	VL
				31700	99,8%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	5	VH	1	VL
1	1	3535903	PARANAPUA	18	0,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				12823	99,9%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	1	3540259	PONTALINDA	85	0,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	3	M	5	VH	1	VL
				20898	99,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	3	M	5	VH	1	VL
1	1	3540408	POPULINA	142	0,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M
				31058	99,5%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	3	M
1	1	3544509	RUBINEIA	107	0,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	4	H
				21776	99,5%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	4	H
1	1	3545704	SANTA ALBERTINA	315	1,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				27133	98,9%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	1	3546108	SANTA CLARA D'OESTE	203	1,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				17300	98,8%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	1	VL
1	1	3546603	SANTA FE DO SUL	112	0,5%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				20964	99,5%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
1	1	3547403	SANTA RITA D'OESTE	403	1,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				20446	98,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	1	3547650	SANTA SALETE	12	0,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	1	VL
				7947	99,9%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	3	M	5	VH	1	VL
1	1	3547205	SANTANA DA PONTE PENSA	37	0,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				13058	99,7%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
1	1	3549003	SAO FRANCISCO	32	0,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	5	VH	1	VL
				7521	99,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	2	L	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	1	3554904	TRES FRONTEIRAS	24	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				15303	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	1	3555802	URANIA	27	0,1%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	4	H
				20883	99,9%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	4	H	4	H	5	VH	4	H
1	1	3556958	VITORIA BRASIL	13	0,3%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				4914	99,7%	3	M	2,0	L	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
1	2	3515202	ESTRELA D'OESTE	463	1,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				29556	98,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
1	2	3515509	FERNANDOPOLIS	931	1,7%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				54070	98,3%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
1	2	3518008	GUARANI D'OESTE	10	0,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				8521	99,9%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	2	3520707	INDIAPORA	281	1,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	3	M
				27685	99,0%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	3	M
1	2	3528205	MACEDONIA	119	0,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	1	VL	3	M
				32494	99,6%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	2	L	4	H	1	VL	3	M
1	2	3529609	MERIDIANO	831	3,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				21817	96,3%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	2	3530003	MIRA ESTRELA	127	0,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				21407	99,4%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	2	L	1	VL	4	H	5	VH	1	VL
1	2	3534757	OUROESTE	444	1,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	3	M
				27957	98,4%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	3	M
1	2	3536901	PEDRANOPOLIS	159	0,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				25905	99,4%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	3	M
1	2	3549201	SAO JOAO DAS DUAS PONTES	191	1,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	1	VL
				12820	98,5%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	1	VL
1	2	3555307	TURMALINA	33	0,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	3	M	4	H	5	VH	4	H
				14692	99,8%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	3	M	4	H	5	VH	4	H
1	3	3501202	ALVARES FLORENCE	506	1,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	1	VL
				35551	98,6%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	3	M	5	VH	1	VL
1	3	3501806	AMERICO DE CAMPOS	434	1,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				24987	98,3%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	3	3510708	CARDOSO	185	0,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	4	H
				63712	99,7%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	5	VH	5	VH	4	H
1	3	3512902	COSMORAMA	747	1,7%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				43698	98,3%	2	L	1,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	1	VL	1	VL
1	3	3536257	PARISI	44	0,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				8546	99,5%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	3	3540309	PONTES GESTAL	295	1,3%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				21556	98,7%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	3	3544202	RIOLANDIA	813	1,3%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
				61920	98,7%	3	M	1,5	VH	2,0	L	2,0	L	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
1	3	3556107	VALENTIM GENTIL	415	2,8%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	3	M
				14500	97,2%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	3	M	5	VH	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	3	3557105	VOTUPORANGA	907	2,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				41249	97,8%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
1	4	3500204	ADOLFO	141	0,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				21101	99,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
1	4	3500907	ALTAIR	605	1,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	4	H
				31280	98,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	4	H
1	4	3504602	BADY BASSITT	491	4,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	2	L	5	VH	5	VH	1	VL
				10584	95,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	2	L	5	VH	5	VH	1	VL
1	4	3504800	BALSAMO	257	1,7%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	4	H	1	VL	5	VH	1	VL
				14848	98,3%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	4	H	1	VL	5	VH	1	VL
1	4	3511300	CEDRAL	708	3,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				19021	96,4%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	2	L	1	VL	4	H	5	VH	1	VL
1	4	3517505	GUAPIACU	455	1,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	5	VH	1	VL
				32276	98,6%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	2	L	4	H	5	VH	1	VL
1	4	3517901	GUARACI	716	1,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	4	H	4	H	1	VL	3	M
				62672	98,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	4	H	4	H	1	VL	3	M
1	4	3519402	IBIRA	1048	3,9%	1	VL	2,0	L	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	1	VL	5	VH	3	M
				26067	96,1%	2	L	2,0	L	1,0	VL	3,0	M	1	VL	1	VL	1	VL	1	VL	5	VH	3	M
1	4	3519808	ICEM	230	0,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
				35576	99,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
1	4	3521150	IPIGUA	241	1,8%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	5	VH	1	VL	5	VH	1	VL
				13510	98,2%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	5	VH	1	VL	5	VH	1	VL
1	4	3524501	JACI	410	2,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				14188	97,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	5	VH	1	VL
1	4	3525706	JOSE BONIFACIO	521	0,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	5	VH
				85259	99,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	5	VH
1	4	3529500	MENDONCA	284	1,5%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	3	M
				19256	98,5%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	3	M
1	4	3530300	MIRASSOL	649	2,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				23904	97,4%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
1	4	3530409	MIRASSOLANDIA	255	1,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
				16138	98,4%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
1	4	3532801	NOVA ALIANCA	407	1,8%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	1	VL	1	VL
				21683	98,2%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	1	VL	1	VL
1	4	3533007	NOVA GRANADA	1244	2,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	4	H	3	M
				51355	97,6%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	4	H	3	M
1	4	3533908	OLIMPIA	2594	3,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				77772	96,8%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
1	4	3534005	ONDA VERDE	346	1,4%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				23860	98,6%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	4	3534203	ORINDIUA	212	0,9%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	1	VL	4	H
				24512	99,1%	3	M	2,0	L	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	1	VL	4	H
1	4	3535002	PALESTINA	632	0,9%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	1	VL	3	M
				69192	99,1%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	1	VL	3	M
1	4	3536604	PAULO DE FARIA	1816	2,5%	1	VL	1,0	VL	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	1	VL	1	VL
				70626	97,5%	2	L	1,0	VL	2,0	L	2,0	L	5	VH	1	VL	1	VL	1	VL	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	4	3539608	PLANALTO	176	0,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				29058	99,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	4	3540804	POTIRENDABA	1007	3,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	3	M
				32880	97,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	3	M
1	4	3549805	SAO JOSE DO RIO PRETO	1074	2,5%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	4	H	5	VH
				42202	97,5%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	4	H	5	VH
1	4	3553401	TANABI	900	1,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	5	VH
				73633	98,8%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	1	VL	5	VH
1	4	3555356	UBARANA	76	0,4%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				21073	99,6%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
1	4	3555604	UCHOA	298	1,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	5	VH	4	H	1	VL	1	VL
				25148	98,8%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	5	VH	4	H	1	VL	1	VL
1	4	3557154	ZACARIAS	91	0,3%	1	VL	1,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	2	L	3	M	1	VL	1	VL
				31774	99,7%	2	L	1,5	VH	1,0	VL	3,0	M	1	VL	1	VL	2	L	3	M	1	VL	1	VL
1	5	3503703	ARIRANHA	378	2,8%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	5	VH	5	VH	3	M
				13151	97,2%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	4	H	5	VH	5	VH	3	M
1	5	3509304	CAJOBI	429	2,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	1	VL	3	M
				17111	97,6%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	2	L	1	VL	4	H	1	VL	3	M
1	5	3511102	CATANDUVA	878	3,0%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	5	VH	5	VH	5	VH
				28266	97,0%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	3	M	5	VH	5	VH	5	VH
1	5	3511201	CATIGUA	194	1,3%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	1	VL	1	VL
				14308	98,7%	2	L	1,5	VH	1,5	VH	2,0	L	1	VL	2	L	1	VL	4	H	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	5	3514924	ELISIARIO	457	4,9%	1	VL	1,0	VL	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	1	VL	1	VL
				8931	95,1%	3	M	1,0	VL	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	1	VL	1	VL
1	5	3514957	EMBAUBA	272	3,2%	1	VL	1,0	VL	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
				8115	96,8%	2	L	1,0	VL	1,5	VH	2,0	L	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
1	5	3533254	NOVAIS	263	2,2%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				11668	97,8%	2	L	1,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	1	VL	1	VL
1	5	3535101	PALMARES PAULISTA	292	3,5%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				7986	96,5%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	2	L	1	VL	4	H	1	VL	1	VL
1	5	3535705	PARAISO	401	2,6%	1	VL	1,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	1	VL	1	VL
				15206	97,4%	3	M	1,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	1	VL	1	VL
1	5	3538105	PINDORAMA	676	3,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				18030	96,4%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	1	VL
1	5	3545605	SANTA ADELIA	801	2,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	5	VH	4	H	1	VL	3	M
				32224	97,6%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	2	L	5	VH	4	H	1	VL	3	M
1	5	3551900	SEVERINIA	767	5,4%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	5	VH	4	H
				13348	94,6%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	2	L	4	H	5	VH	4	H
1	5	3552601	TABAPUA	825	2,4%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	1	VL	4	H
				33848	97,6%	3	M	2,0	L	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	1	VL	4	H
1	6	3504206	AURIFLAMA	1074	2,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
				42583	97,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
1	6	3515905	FLOREAL	530	2,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	1	VL	3	M
				19734	97,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	6	3516804	GASTAO VIDIGAL	104	0,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				17798	99,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	6	3516903	GENERAL SALGADO	1989	4,0%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
				47239	96,0%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
1	6	3518909	GUZOLANDIA	132	0,5%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	4	H	5	VH	5	VH	1	VL
				25116	99,5%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	4	H	5	VH	5	VH	1	VL
1	6	3528304	MAGDA	586	2,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				28469	98,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
1	6	3532868	NOVA CASTILHO	252	1,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M
				18047	98,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	3	M
1	6	3533304	NOVA LUZITANIA	149	2,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	5	VH	5	VH	1	VL
				7424	98,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	5	VH	5	VH	1	VL
1	6	3549250	SAO JOAO DE IRACEMA	271	1,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	4	H	5	VH	1	VL	3	M
				16952	98,4%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	4	H	5	VH	1	VL	3	M
1	7	3528106	MACAUBAL	627	2,5%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	1	VL	5	VH
				24340	97,5%	3	M	2,0	L	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	1	VL	5	VH
1	7	3531001	MONCOES	50	0,5%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	3	M	5	VH	5	VH	4	H
				10537	99,5%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	3	M	5	VH	5	VH	4	H
1	7	3531407	MONTE APRAZIVEL	1875	3,9%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				46655	96,1%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
1	7	3532504	NEVES PAULISTA	775	3,3%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	3	M
				22501	96,7%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
1	7	3532603	NHANDEARA	698	1,6%	1	VL	1,0	VL	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
				43220	98,4%	2	L	1,0	VL	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
1	7	3532702	NIPOA	201	1,4%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				13890	98,6%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
1	7	3539905	POLONI	551	4,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	3	M
				12919	95,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	3	M
1	7	3551306	SEBASTIANOPOLIS DO SUL	389	2,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	4	H
				16286	97,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	5	VH	4	H
1	7	3555703	UNIAO PAULISTA	56	0,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	2	L	4	H	1	VL	1	VL
				7690	99,3%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	2	L	4	H	1	VL	1	VL
1	8	3521507	IRAPUA	233	0,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				25506	99,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
1	8	3521903	ITAJOBI	600	1,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	3	M
				49723	98,8%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	3	M
1	8	3528858	MARAPOAMA	137	1,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	4	H	4	H	5	VH	3	M
				11038	98,8%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	4	H	4	H	5	VH	3	M
1	8	3533502	NOVO HORIZONTE	786	0,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				88737	99,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
1	8	3544806	SALES	200	0,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M
				28412	99,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	3	M
1	8	3556008	URUPES	905	2,8%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	3	M
				31683	97,2%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
2	9	3505500	BARRETOS	1749	1,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				151344	98,9%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
2	9	3512001	COLINA	839	2,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH
				41325	98,0%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
2	9	3512100	COLOMBIA	829	1,2%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
				69792	98,8%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
2	10	3517406	GUAIRA	299	0,2%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	1	VL	5	VH
				123197	99,8%	3	M	2,0	L	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	1	VL	5	VH
2	10	3521309	IPUA	331	0,7%	1	VL	2,0	L	1,0	VL	1,0	VL	1	VL	1	VL	4	H	4	H	1	VL	1	VL
				46800	99,3%	2	L	2,0	L	1,0	VL	3,0	M	1	VL	1	VL	4	H	4	H	1	VL	1	VL
2	10	3524204	JABORANDI	79	0,3%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				27702	99,7%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
2	10	3529708	MIGUELOPOLIS	587	0,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	5	VH
				80557	99,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	5	VH
2	10	3531902	MORRO AGUDO	474	0,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	4	H	5	VH	4	H	1	VL	5	VH
				137490	99,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	4	H	5	VH	4	H	1	VL	5	VH
2	10	3533601	NUPORANGA	2573	7,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	1	VL	1	VL
				31809	92,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	1	VL	1	VL
2	10	3534302	ORLANDIA	1166	3,9%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				28594	96,1%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
2	10	3544905	SALES OLIVEIRA	1989	6,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				28409	93,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
2	10	3549409	SAO JOAQUIM DA BARRA	1391	3,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				39941	96,6%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
2	11	3503000	ARAMINA	489	2,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				19391	97,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
2	11	3508207	BURITIZAL	4004	18,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				18114	81,9%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
2	11	3517703	GUARA	1755	4,8%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	5	VH
				34508	95,2%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	5	VH
2	11	3520103	IGARAPAVA	5789	13,5%	1	VL	2,5	VH	2,5	VH	1,0	VL	4	H	3	M	1	VL	3	M	5	VH	4	H
				37089	86,5%	4	H	2,5	VH	2,5	VH	3,0	M	4	H	3	M	1	VL	3	M	5	VH	4	H
2	11	3524105	ITUVERAVA	4864	7,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	1	VL	5	VH
				62658	92,8%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	1	VL	5	VH
2	12	3513207	CRISTAIS PAULISTA	8063	23,1%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH
				26909	76,9%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
2	12	3516200	FRANCA	13651	24,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				41955	75,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	12	3523701	ITIRAPUA	3587	24,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				11362	76,0%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H
2	12	3525409	JERIQUEARA	1824	13,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	4	H	3	M	1	VL	4	H	5	VH	3	M
				12243	87,0%	4	H	2,5	VH	2,5	VH	3,0	M	4	H	3	M	1	VL	4	H	5	VH	3	M
2	12	3536307	PATROCINIO PAULISTA	13304	24,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				42140	76,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	4	H	5	VH
2	12	3537008	PEDREGULHO	17857	32,1%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	5	VH	5	VH	4	H
				37815	67,9%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	5	VH	5	VH	4	H
2	12	3542701	RESTINGA	5419	22,5%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				18647	77,5%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
2	12	3543105	RIBEIRAO CORRENTE	2242	15,8%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	4	H
				11956	84,2%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	4	H
2	12	3543600	RIFAINA	2960	21,9%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	2	L	5	VH	5	VH	4	H
				10561	78,1%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	2	L	5	VH	5	VH	4	H
2	12	3549508	SAO JOSE DA BELA VISTA	4878	17,9%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	1	VL	1	VL
				22433	82,1%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	1	VL	1	VL
2	13	3506102	BEBEDOURO	1475	2,1%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	5	VH	5	VH	5	VH	5	VH
				67278	97,9%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	5	VH	5	VH	5	VH	5	VH
2	13	3510104	CANDIDO RODRIGUES	170	2,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				6898	97,6%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	2	L	1	VL	4	H	5	VH	1	VL
2	13	3515608	FERNANDO PRESTES	583	3,5%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
				16131	96,5%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
2	13	3518602	GUARIBA	1327	4,9%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	4	H
				25605	95,1%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	4	H
2	13	3524303	JABOTICABAL	1515	2,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				69100	97,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	13	3531308	MONTE ALTO	3808	11,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				29023	88,4%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	13	3531506	MONTE AZUL PAULISTA	875	3,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
				25533	96,7%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
2	13	3539004	PIRANGI	739	3,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				20676	96,6%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	1	VL
2	13	3539509	PITANGUEIRAS	247	0,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	5	VH
				42949	99,4%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	5	VH
2	13	3546504	SANTA ERNESTINA	188	1,4%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	1	VL	1	VL
				13200	98,6%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	1	VL	1	VL
2	13	3553104	TAIACU	269	2,5%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	3	M	5	VH	1	VL
				10581	97,5%	3	M	2,0	L	2,0	L	2,0	L	5	VH	2	L	1	VL	3	M	5	VH	1	VL
2	13	3553203	TAIUVA	498	3,7%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	1	VL	4	H
				12904	96,3%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	2	L	1	VL	4	H	1	VL	4	H
2	13	3553658	TAQUARAL	97	1,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	4	H	4	H	1	VL	3	M
				5219	98,2%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	4	H	4	H	1	VL	3	M
2	13	3553708	TAQUARITINGA	1352	2,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				57985	97,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
2	13	3554409	TERRA ROXA	191	0,9%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	3	M
				21995	99,1%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	3	M
2	13	3556800	VIRADOURO	141	0,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				21499	99,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	4	H
2	13	3556909	VISTA ALEGRE DO ALTO	238	2,5%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	1	VL
				9167	97,5%	3	M	2,0	L	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	1	VL
2	14	3505609	BARRINHA	217	1,5%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	2	L	1	VL	5	VH	4	H
				14583	98,5%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	2	L	1	VL	5	VH	4	H
2	14	3507803	BRODOSQUI	5920	23,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	4	H	4	H	5	VH	1	VL
				19093	76,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	4	H	4	H	5	VH	1	VL
2	14	3513108	CRAVINHOS	3780	12,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	5	VH
				26735	87,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	5	VH
2	14	3514601	DUMONT	450	4,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	4	H
				10487	95,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	4	H
2	14	3518859	GUATAPARA	887	2,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	5	VH	5	VH	1	VL	1	VL
				40607	97,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	5	VH	5	VH	1	VL	1	VL
2	14	3525102	JARDINOPOLIS	3697	7,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				45696	92,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	14	3527603	LUIS ANTONIO	2489	4,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				49238	95,2%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
2	14	3540200	PONTAL	89	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				35851	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
2	14	3540903	PRADOPOLIS	254	1,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	5	VH	3	M
				16604	98,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	2	L	4	H	5	VH	3	M
2	14	3543402	RIBEIRAO PRETO	3974	6,1%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	5	VH	5	VH	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				61084	93,9%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	5	VH	5	VH	5	VH	5	VH
2	14	3547502	SANTA RITA DO PASSA QUATRO	12069	17,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				56859	82,5%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	14	3547601	SANTA ROSA DE VITERBO	4905	17,6%	1	VL	3,0	M	1,0	VL	1,0	VL	1	VL	1	VL	3	M	5	VH	5	VH	5	VH
				22885	82,4%	3	M	3,0	M	1,0	VL	3,0	M	1	VL	1	VL	3	M	5	VH	5	VH	5	VH
2	14	3550902	SAO SIMAO	9024	15,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	5	VH	5	VH	1	VL	1	VL
				48873	84,4%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	5	VH	5	VH	1	VL	1	VL
2	14	3551405	SERRA AZUL	3232	11,8%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	3	M
				24060	88,2%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	1	VL	3	M
2	14	3551504	SERRANA	1410	11,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				10949	88,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	14	3551702	SERTAOZINHO	490	1,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				37632	98,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
2	15	3501004	ALTINOPOLIS	14565	16,7%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				72689	83,3%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H
2	15	3505906	BATATAIS	14091	17,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				68426	82,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
2	15	3509403	CAJURU	11969	19,7%	1	VL	2,5	VH	2,5	VH	1,0	VL	4	H	3	M	1	VL	5	VH	5	VH	5	VH
				48895	80,3%	4	H	2,5	VH	2,5	VH	3,0	M	4	H	3	M	1	VL	5	VH	5	VH	5	VH
2	15	3510906	CASSIA DOS COQUEIROS	4532	25,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				13193	74,4%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	3	M
2	15	3546256	SANTA CRUZ DA ESPERANCA	2222	15,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	4	H
				12163	84,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	1	VL	4	H
2	15	3547908	SANTO ANTONIO DA ALEGRIA	6283	23,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	4	H
				20713	76,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	4	H
3	16	3502101	ANDRADINA	62	0,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				96217	99,9%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
3	16	3511003	CASTILHO	27	0,0%	1	VL	3,0	M	2,0	L	1,0	VL	4	H	3	M	5	VH	4	H	5	VH	4	H
				102567	100,0 %	4	H	3,0	M	2,0	L	3,0	M	4	H	3	M	5	VH	4	H	5	VH	4	H
3	16	3517802	GUARACAI	240	0,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	1	VL	4	H
				53719	99,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	1	VL	4	H
3	16	3520442	ILHA SOLTEIRA	420	0,7%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				64221	99,3%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
3	16	3523008	ITAPURA	80	0,3%	1	VL	1,5	VH	2,0	L	1,0	VL	4	H	1	VL	1	VL	4	H	1	VL	1	VL
				30590	99,7%	3	M	1,5	VH	2,0	L	3,0	M	4	H	1	VL	1	VL	4	H	1	VL	1	VL
3	16	3530102	MIRANDOPOLIS	817	0,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	4	H
				90223	99,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	4	H
3	16	3532108	MURUTINGA DO SUL	38	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				24885	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
3	16	3533205	NOVA INDEPENDENCIA	15	0,1%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	4	H
				23952	99,9%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	4	H
3	16	3537404	PEREIRA BARRETO	120	0,1%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
				97392	99,9%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
3	16	3552304	SUD MENUCCI	116	0,2%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	3	M
				59272	99,8%	3	M	2,0	L	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	3	M
3	16	3552551	SUZANAPOLIS	52	0,2%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
				32728	99,8%	3	M	1,5	VH	2,5	VH	2,0	L	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
3	17	3502804	ARACATUBA	934	0,8%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				115921	99,2%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
3	17	3506201	BENTO DE ABREU	818	2,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	1	VL	1	VL
				29205	97,3%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	2	L	4	H	1	VL	1	VL
3	17	3518206	GUARARAPES	1692	1,8%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	5	VH
				93030	98,2%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	1	VL	5	VH
3	17	3526506	LAVINIA	585	1,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	1	VL	4	H
				53147	98,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	1	VL	4	H
3	17	3544400	RUBIACEA	697	3,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				22568	97,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
3	17	3548054	SANTO ANTONIO DO ARACANGUA	1470	1,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	3	M	4	H	1	VL	1	VL
				129126	98,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	3	M	4	H	1	VL	1	VL
3	17	3556305	VALPARAISO	792	0,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				83003	99,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	4	H
3	18	3501103	ALTO ALEGRE	1528	4,8%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	2	L	1	VL	3	M	1	VL	1	VL
				30346	95,2%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	2	L	1	VL	3	M	1	VL	1	VL
3	18	3504404	AVANHANDAVA	263	0,8%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	1	VL	1	VL
				33960	99,2%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	2	L	4	H	1	VL	1	VL
3	18	3505104	BARBOSA	44	0,2%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	4	H	4	H	1	VL	1	VL
				20500	99,8%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	4	H	4	H	1	VL	1	VL
3	18	3506409	BILAC	357	2,3%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	4	H
				15188	97,7%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	4	H
3	18	3506508	BIRIGUI	397	0,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	4	H
				52445	99,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	4	H
3	18	3507704	BRAUNA	679	3,5%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				18746	96,5%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
3	18	3507753	BREJO ALEGRE	8	0,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	4	H
				10353	99,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	4	H
3	18	3508108	BURITAMA	215	0,7%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	2	L	3	M	4	H	5	VH	4	H
				32697	99,3%	4	H	2,5	VH	2,0	L	3,0	M	4	H	2	L	3	M	4	H	5	VH	4	H
3	18	3511904	CLEMENTINA	583	3,4%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
				16317	96,6%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
3	18	3512506	COROADOS	110	0,4%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				24960	99,6%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
3	18	3516507	GABRIEL MONTEIRO	445	3,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	3	M
				13431	96,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
3	18	3517109	GLICERIO	143	0,5%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				27378	99,5%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
3	18	3527256	LOURDES	93	0,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	1	VL	3	M
				11368	99,2%	4	H	2,0	L	2,5	VH	2,0	L	5	VH	3	M	2	L	4	H	1	VL	3	M
3	18	3527702	LUIZIANIA	706	4,2%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
				16183	95,8%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
3	18	3537305	PENAPOLIS	376	0,5%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	5	VH
				70456	99,5%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	5	VH
3	18	3537701	PIACATU	914	4,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	1	VL	1	VL
				21435	95,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	1	VL	1	VL
3	18	3548401	SANTOPOLIS DO AGUAPEI	435	3,4%	1	VL	1,5	VH	2,0	L	1,0	VL	4	H	2	L	1	VL	3	M	1	VL	1	VL
				12522	96,6%	3	M	1,5	VH	2,0	L	3,0	M	4	H	2	L	1	VL	3	M	1	VL	1	VL
3	18	3555208	TURIUBA	230	1,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	4	H	4	H	1	VL	1	VL
				15061	98,5%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	4	H	4	H	1	VL	1	VL
4	19	3508801	CAFELANDIA	3446	3,8%	1	VL	1,0	VL	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
				87621	96,2%	2	L	1,0	VL	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
4	19	3517000	GETULINA	2710	4,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				65063	96,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
4	19	3517208	GUAICARA	560	2,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	3	M
				26334	97,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	3	M
4	19	3517307	GUAIMBE	712	3,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	3	M
				21041	96,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
4	19	3525805	JULIO MESQUITA	148	1,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	2	L	5	VH	1	VL
				1136	8,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				11521	90,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
4	19	3527108	LINS	2265	3,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				55102	96,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
4	19	3541604	PROMISSAO	1487	1,9%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	5	VH	5	VH	5	VH	5	VH
				76885	98,1%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	5	VH	5	VH	5	VH	5	VH
4	19	3544608	SABINO	231	0,8%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	3	M	4	H	1	VL	1	VL
				28594	99,2%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	3	M	4	H	1	VL	1	VL
4	20	3500709	AGUDOS	8451	9,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				85809	91,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
4	20	3503406	AREALVA	1533	3,0%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				49288	97,0%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
4	20	3503604	AREIOPOLIS	676	7,9%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
				7863	92,1%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
4	20	3504305	AVAI	5287	9,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				49186	90,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
4	20	3504701	BALBINOS	485	5,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				8926	94,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
4	20	3506003	BAURU	6085	9,3%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	5	VH	4	H	5	VH	4	H	5	VH
				59071	90,7%	4	H	3,0	M	2,0	L	3,0	M	1	VL	5	VH	4	H	5	VH	4	H	5	VH
4	20	3507456	BOREBI	1162	3,4%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	2	L	1	VL	1	VL	3	M
				33446	96,6%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	2	L	1	VL	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
4	20	3508306	CABRALIA PAULISTA	2382	10,0%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	5	VH	4	H	1	VL
				21528	90,0%	3	M	2,0	L	2,0	L	3,0	M	5	VH	2	L	1	VL	5	VH	4	H	1	VL
4	20	3514502	DUARTINA	5687	21,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				20581	78,4%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
4	20	3518107	GUARANTA	3811	8,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				42399	91,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
4	20	3519105	IACANGA	1774	3,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	4	H
				52904	96,8%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	4	H
4	20	3526803	LENCOIS PAULISTA	3744	4,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				77255	95,4%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
4	20	3527504	LUCIANOPOLIS	1675	8,7%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	4	H
				17478	91,3%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	4	H
4	20	3536570	PAULISTANIA	2410	9,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				23368	90,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
4	20	3538907	PIRAJUI	8943	11,2%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	4	H
				70984	88,8%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	4	H
4	20	3539400	PIRATININGA	4929	12,5%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	5	VH	5	VH
				34521	87,5%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	5	VH	5	VH
4	20	3540101	PONGAI	565	3,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M
				17730	96,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	3	M
4	20	3541109	PRESIDENTE ALVES	6852	25,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				20005	74,5%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
4	20	3542503	REGINOPOLIS	1229	3,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
				38743	96,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
4	20	3555505	UBIRAJARA	3119	11,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	3	M	5	VH	5	VH	1	VL
				24678	88,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	3	M	5	VH	5	VH	1	VL
4	20	3555901	URU	412	2,8%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
				14458	97,2%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
4	21	3505203	BARIRI	651	1,5%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	2	L	5	VH	4	H	5	VH	4	H
				42744	98,5%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	2	L	5	VH	4	H	5	VH	4	H
4	21	3505302	BARRA BONITA	1757	11,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				13229	88,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
4	21	3506805	BOCAINA	2730	8,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				29952	91,6%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
4	21	3507308	BORACEIA	752	6,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	1	VL
				11110	93,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	1	VL
4	21	3514106	DOIS CORREGOS	6840	11,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				53576	88,7%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
4	21	3520004	IGARACU DO TIETE	570	5,9%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	2	L	1	VL	3	M	5	VH	5	VH
				9095	94,1%	4	H	2,5	VH	2,0	L	3,0	M	4	H	2	L	1	VL	3	M	5	VH	5	VH
4	21	3522000	ITAJU	700	3,1%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	1	VL
				21845	96,9%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	1	VL
4	21	3522901	ITAPUI	424	3,0%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				13614	97,0%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
4	21	3525300	JAU	5553	8,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	4	H	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				62470	91,8%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	4	H	5	VH
4	21	3528007	MACATUBA	1247	5,5%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	3	M
				21358	94,5%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	3	M
4	21	3529807	MINEIROS DO TIETE	2643	13,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	5	VH	1	VL	1	VL
				17729	87,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	5	VH	1	VL	1	VL
4	21	3536703	PEDERNEIRAS	2395	3,3%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				69572	96,7%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	5	VH
4	22	3500550	AGUAS DE SANTA BARBARA	2014	5,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				35275	94,6%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
4	22	3503109	ARANDU	3560	12,7%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	4	H
				24473	87,3%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	4	H
4	22	3504503	AVARE	11009	10,0%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	5	VH
				99119	90,0%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	5	VH
4	22	3511409	CERQUEIRA CESAR	4088	8,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				46387	91,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
4	22	3519253	IARAS	1262	3,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				38193	96,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
4	22	3521804	ITAI	12834	11,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				96289	88,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
4	22	3523503	ITATINGA	12220	16,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				62496	83,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
4	22	3535804	PARANAPANEMA	9218	9,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				91734	90,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	5	VH	4	H
4	23	3502309	ANHEMBI	14601	20,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	5	VH
				56623	79,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	5	VH
4	23	3506904	BOFETE	18658	33,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				36594	66,2%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
4	23	3507506	BOTUCATU	17965	16,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	4	H	5	VH
				90110	83,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	4	H	5	VH
4	23	3512308	CONCHAS	7402	15,8%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	5	VH	5	VH	3	M
				39353	84,2%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	5	VH	5	VH	3	M
4	23	3536109	PARDINHO	3503	29,0%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				8592	71,0%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
4	23	3541059	PRATANIA	1119	7,1%	1	VL	1,0	VL	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
				14586	92,9%	2	L	1,0	VL	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	1	VL	1	VL
4	23	3550100	SAO MANUEL	6906	10,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				56479	89,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
5	24	3501707	AMERICO BRASILIENSE	614	5,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	4	H
				11575	95,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	4	H
5	24	3503208	ARARAQUARA	5973	6,0%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	4	H	5	VH	4	H	5	VH
				92899	94,0%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	4	H	5	VH	4	H	5	VH
5	24	3506706	BOA ESPERANCA DO SUL	1988	3,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
				61888	96,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
5	24	3507407	BORBOREMA	567	1,0%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	1	VL	4	H
				54876	99,0%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	1	VL	4	H
5	24	3514007	DOBRADA	198	1,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	1	VL	5	VH
				15020	98,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	1	VL	5	VH
5	24	3516853	GAVIAO PEIXOTO	681	2,8%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				23219	97,2%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
5	24	3519600	IBITINGA	765	1,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	5	VH
				66751	98,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	5	VH
5	24	3522703	ITAPOLIS	974	1,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				98988	99,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
5	24	3529302	MATAO	1183	2,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				50082	97,7%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
5	24	3532058	MOTUCA	572	2,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	1	VL	1	VL
				22594	97,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	1	VL	1	VL
5	24	3532900	NOVA EUROPA	128	0,8%	1	VL	2,0	L	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	5	VH	1	VL
				15656	99,2%	2	L	2,0	L	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	5	VH	1	VL
5	24	3543709	RINCAO	409	1,3%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				31301	98,7%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
5	24	3546900	SANTA LUCIA	1016	6,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
				14064	93,3%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	1	VL	1	VL
5	24	3552700	TABATINGA	729	2,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	3	M
				35196	98,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	3	M
5	24	3554755	TRABIJU	550	6,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	2	L	4	H	1	VL	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				7747	93,4%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	2	L	4	H	1	VL	4	H
5	25	3502002	ANAL FÉNDIA	7752	28,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				19931	72,0%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
5	25	3513702	DESCALVADO	12757	18,2%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	1	VL	5	VH	3	M
				57529	81,8%	3	M	2,0	L	2,0	L	3,0	M	1	VL	4	H	1	VL	1	VL	5	VH	3	M
5	25	3514304	DOURADO	2945	16,3%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
				15156	83,7%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
5	25	3519303	IBATE	3085	11,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				24735	88,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
5	25	3542909	RIBEIRÃO BONITO	6020	14,2%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	2	L	4	H	1	VL	1	VL
				36419	85,8%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	2	L	4	H	1	VL	1	VL
5	25	3548906	SÃO CARLOS	11601	10,8%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				95671	89,2%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	5	VH
6	26	3507902	BROTAS	11097	10,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				91980	89,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
6	26	3512704	CORUMBATAI	7919	32,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	2	L	5	VH	5	VH	1	VL
				16396	67,4%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	2	L	5	VH	5	VH	1	VL
6	26	3521101	IPEUNA	5577	32,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				11518	67,4%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	1	VL
6	26	3523602	ITIRAPINA	9827	20,0%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	5	VH	1	VL
				39316	80,0%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	2	L	4	H	5	VH	1	VL
6	26	3543907	RIO CLARO	7103	14,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				42301	85,6%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	4	H	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
6	26	3554706	TORRINHA	4297	14,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	5	VH	5	VH	3	M
				24805	85,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	5	VH	5	VH	3	M
6	27	3503307	ARARAS	3397	5,3%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	4	H	4	H	4	H	5	VH
				61294	94,7%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	4	H	4	H	4	H	5	VH
6	27	3512209	CONCHAL	666	3,6%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	5	VH
				17910	96,4%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	5	VH	5	VH
6	27	3512407	CORDEIROPOLIS	936	6,7%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				13020	93,3%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
6	27	3521408	IRACEMAPOLIS	993	8,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	3	M	5	VH	5	VH	3	M
				10499	91,4%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	3	M	5	VH	5	VH	3	M
6	27	3526704	LEME	2423	6,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	4	H
				37966	94,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	4	H
6	27	3526902	LIMEIRA	7897	13,7%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				49890	86,3%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
6	27	3546207	SANTA CRUZ DA CONCEICAO	3788	25,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	4	H
				10918	74,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	4	H
6	27	3546702	SANTA GERTRUDES	667	6,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				9379	93,4%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
6	28	3500600	AGUAS DE SAO PEDRO	78	21,5%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	2	L	4	H	5	VH	1	VL
				284	78,5%	3	M	2,0	L	2,0	L	2,0	L	1	VL	4	H	2	L	4	H	5	VH	1	VL
6	28	3510401	CAPIVARI	3513	10,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				29313	89,3%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
6	28	3511706	CHARQUEADA	3990	23,0%	1	VL	1,0	VL	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	1	VL	1	VL	1	VL
				13358	77,0%	1	VL	1,0	VL	1,0	VL	2,0	L	1	VL	1	VL	1	VL	1	VL	1	VL	1	VL
6	28	3525854	JUMIRIM	1047	18,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	4	H	4	H	5	VH	3	M
				4686	81,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	4	H	4	H	5	VH	3	M
6	28	3530904	MOMBUCA	1519	11,4%	1	VL	1,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	2	L	4	H	1	VL	1	VL
				11795	88,6%	2	L	1,5	VH	1,0	VL	2,0	L	1	VL	1	VL	2	L	4	H	1	VL	1	VL
6	28	3538709	PIRACICABA	20518	15,3%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				113519	84,7%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
6	28	3542107	RAFARD	1885	15,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	4	H	4	H
				10349	84,6%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	1	VL	4	H	4	H
6	28	3544004	RIO DAS PEDRAS	3231	14,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				19738	85,9%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
6	28	3545159	SALTINHO	1400	14,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	5	VH	4	H
				8188	85,4%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	2	L	4	H	5	VH	4	H
6	28	3547007	SANTA MARIA DA SERRA	3729	16,5%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	5	VH
				18811	83,5%	3	M	2,0	L	2,0	L	2,0	L	5	VH	2	L	1	VL	4	H	1	VL	5	VH
6	28	3550407	SAO PEDRO	13147	23,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				41803	76,1%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
6	28	3554508	TIETE	6293	15,4%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	5	VH	5	VH	5	VH
				34457	84,6%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	5	VH	5	VH	5	VH
7	29	3500303	AGUAI	2489	5,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				44849	94,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	4	H	5	VH
7	29	3539301	PIRASSUNUNGA	4647	6,4%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
				67586	93,6%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	5	VH
7	29	3540705	PORTO FERREIRA	2087	8,9%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				21401	91,1%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	5	VH
7	29	3546306	SANTA CRUZ DAS PALMEIRAS	3303	11,4%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	5	VH	5	VH	5	VH
				25659	88,6%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	5	VH	5	VH	5	VH
7	30	3508702	CACONDE	17561	55,1%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
				14337	44,9%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
7	30	3510807	CASA BRANCA	5962	6,9%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	5	VH	5	VH	4	H
				80531	93,1%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	5	VH	5	VH	4	H
7	30	3513900	DIVINOLANDIA	2876	69,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
				1278	30,8%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	1	VL
7	30	3515186	ESPIRITO SANTO DO PINHAL	4681	23,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				15394	76,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
7	30	3523800	ITOBI	2997	26,3%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	5	VH	3	M
				8399	73,7%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	1	VL	5	VH	3	M
7	30	3530508	MOCOCA	14447	17,8%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	4	H
				66736	82,2%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	4	H
7	30	3549102	SAO JOAO DA BOA VISTA	6953	22,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	5	VH	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				24515	77,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	5	VH	5	VH	5	VH
7	30	3549706	SAO JOSE DO RIO PARDO	13553	40,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				20130	59,8%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
7	30	3550803	SAO SEBASTIAO DA GRAMA	444	55,7%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	5	VH	4	H
				353	44,3%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	5	VH	4	H
7	30	3553302	TAMBAU	8108	15,0%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	5	VH	5	VH
				45844	85,0%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	5	VH	5	VH
7	30	3553609	TAPIRATIBA	7345	40,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				10656	59,2%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
7	30	3556404	VARGEM GRANDE DO SUL	3318	16,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	5	VH	5	VH	4	H
				16917	83,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	5	VH	5	VH	4	H
7	31	3503802	ARTUR NOGUEIRA	1928	10,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				16033	89,3%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
7	31	3515152	ENGENHEIRO COELHO	932	8,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	4	H
				9984	91,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	4	H
7	31	3557303	ESTIVA GERBI	592	8,2%	1	VL	2,0	L	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	5	VH	1	VL
				6625	91,8%	2	L	2,0	L	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	5	VH	1	VL
7	31	3522604	ITAPIRA	15230	37,1%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	4	H	4	H	5	VH	4	H
				25797	62,9%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	4	H	4	H	5	VH	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
7	31	3530706	MOGII-GUACU	5811	7,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				74524	92,8%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
7	31	3530805	MOJI-MIRIM	4250	8,5%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				45785	91,5%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
7	31	3548005	SANTO ANTONIO DE POSSE	2648	17,1%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	5	VH	5	VH	5	VH
				12845	82,9%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	3	M	5	VH	5	VH	5	VH
7	32	3501608	AMERICANA	1236	9,2%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	5	VH	5	VH	4	H	5	VH
				12175	90,8%	4	H	3,0	M	2,0	L	2,0	L	1	VL	4	H	5	VH	5	VH	4	H	5	VH
7	32	3509502	CAMPINAS	16746	21,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH
				60308	78,3%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	4	H	5	VH
7	32	3512803	COSMOPOLIS	1426	9,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	4	H
				14032	90,8%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	5	VH	4	H
7	32	3514908	ELIAS FAUSTO	2380	11,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	3	M
				17822	88,2%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	3	M
7	32	3519055	HOLAMBRA	373	5,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				6187	94,3%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
7	32	3519071	HORTOLANDIA	565	9,0%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				5697	91,0%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
7	32	3520509	INDAIATUBA	3242	10,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				27818	89,6%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
7	32	3524709	JAGUARIUNA	1840	13,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				12138	86,8%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
7	32	3531803	MONTE MOR	2775	11,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				21299	88,5%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
7	32	3533403	NOVA ODESSA	513	6,9%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				6877	93,1%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
7	32	3536505	PAULINIA	669	4,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	4	H
				13311	95,2%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	3	M	4	H	5	VH	4	H
7	32	3537107	PEDREIRA	4557	60,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				2960	39,4%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
7	32	3545803	SANTA BARBARA D'OESTE	1928	7,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	3	M	5	VH	5	VH
				25389	92,9%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	3	M	5	VH	5	VH
7	32	3552403	SUMARE	831	5,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				14648	94,6%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
7	32	3556206	VALINHOS	5209	39,0%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				8139	61,0%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
7	32	3556701	VINHEDO	3201	42,3%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	3	M	1	VL	5	VH	5	VH
				4365	57,7%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	3	M	1	VL	5	VH	5	VH
7	33	3501905	AMPARO	16439	53,3%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				14408	46,7%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
7	33	3527009	LINDOIA	1270	68,5%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	1	VL
				584	31,5%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	1	VL
7	33	3531209	MONTE ALEGRE DO SUL	519	79,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				137	20,9%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	3	M	5	VH	1	VL
7	33	3551603	SERRA NEGRA	4680	66,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	5	VH	5	VH
				2344	33,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	5	VH	5	VH
7	33	3552106	SOCORRO	480	60,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				320	40,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
8	34	3514403	DRACENA	341	0,7%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	1	VL	5	VH	5	VH
				47904	99,3%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	1	VL	5	VH	5	VH
8	34	3526001	JUNQUEIROPOLIS	827	1,5%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	1	VL	1	VL
				55228	98,5%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	1	VL	1	VL
8	34	3531605	MONTE CASTELO	25	0,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				20832	99,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
8	34	3533106	NOVA GUATAPORANGA	8	0,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	3	M	4	H	5	VH	1	VL
				3540	99,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	3	M	4	H	5	VH	1	VL
8	34	3534807	OURO VERDE	83	0,3%	1	VL	1,5	VH	2,0	L	1,0	VL	4	H	3	M	1	VL	4	H	1	VL	1	VL
				25921	99,7%	3	M	1,5	VH	2,0	L	3,0	M	4	H	3	M	1	VL	4	H	1	VL	1	VL
8	34	3535408	PANORAMA	106	0,3%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	1	VL	1	VL	3	M	5	VH	4	H
				32775	99,7%	4	H	2,5	VH	2,0	L	3,0	M	4	H	1	VL	1	VL	3	M	5	VH	4	H
8	34	3536406	PAULICEIA	43	0,1%	1	VL	2,0	L	2,0	L	1,0	VL	4	H	1	VL	1	VL	4	H	1	VL	4	H
				34464	99,9%	3	M	2,0	L	2,0	L	3,0	M	4	H	1	VL	1	VL	4	H	1	VL	4	H
8	34	3547106	SANTA MERCEDES	31	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	4	H	4	H	1	VL	1	VL
				16708	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	4	H	4	H	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
8	34	3549300	SAO JOAO DO PAU D'ALHO	8	0,1%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				11286	99,9%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
8	34	3555109	TUPI PAULISTA	313	1,3%	1	VL	1,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
				23669	98,7%	2	L	1,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	1	VL
8	35	3500105	ADAMANTINA	2637	6,4%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	5	VH	4	H	5	VH
				38878	93,6%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	5	VH	4	H	5	VH
8	35	3515806	FLORA RICA	1058	4,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				21256	95,3%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
8	35	3516002	FLORIDA PAULISTA	3425	6,6%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	3	M
				48681	93,4%	3	M	2,0	L	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	3	M
8	35	3520806	INUBIA PAULISTA	544	6,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				8093	93,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
8	35	3521606	IRAPURU	994	4,7%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
				20093	95,3%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
8	35	3527405	LUCELIA	2662	8,4%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	4	H	1	VL	4	H	5	VH	4	H
				28867	91,6%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	4	H	1	VL	4	H	5	VH	4	H
8	35	3528908	MARIAPOLIS	1861	10,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				16670	90,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
8	35	3534609	OSVALDO CRUZ	1466	6,0%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	5	VH
				22883	94,0%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	5	VH	5	VH
8	35	3534906	PACAEMBU	1789	5,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	3	M	5	VH	1	VL	1	VL
				31685	94,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	3	M	5	VH	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
8	35	3536000	PARAPUA	1494	4,1%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	4	H	5	VH	5	VH	1	VL
				35073	95,9%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	4	H	5	VH	5	VH	1	VL
8	35	3540853	PRACINHA	651	10,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				5699	89,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
8	35	3543808	RINOPOLIS	1285	3,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				34024	96,4%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
8	35	3544707	SAGRES	998	6,7%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				13897	93,3%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
8	35	3545100	SALMOURAO	321	2,0%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
				15700	98,0%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
8	36	3500808	ALFREDO MARCONDES	2033	17,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				9862	82,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
8	36	3501301	ALVARES MACHADO	1958	5,7%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH
				32251	94,3%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
8	36	3502408	ANHUMAS	1542	4,8%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				30806	95,2%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
8	36	3508900	CAIABU	3683	14,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				21475	85,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
8	36	3509106	CAIUA	692	1,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	5	VH	1	VL	5	VH
				50768	98,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	5	VH	1	VL	5	VH
8	36	3515129	EMILIANOPOLIS	792	3,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				21278	96,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
8	36	3515301	ESTRELA DO NORTE	3020	11,4%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	4	H	5	VH	1	VL	3	M
				23443	88,6%	4	H	2,5	VH	2,5	VH	2,0	L	5	VH	3	M	4	H	5	VH	1	VL	3	M
8	36	3515350	EUCLIDES DA CUNHA PAULISTA	257	0,5%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
				55917	99,5%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
8	36	3520608	INDIANA	1451	11,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	1	VL
				11122	88,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	1	VL
8	36	3525607	JOAO RAMALHO	863	2,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	4	H
				40432	97,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	4	H
8	36	3528700	MARABA PAULISTA	5542	6,1%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	3	M	1	VL	1	VL
				85860	93,9%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	3	M	1	VL	1	VL
8	36	3529203	MARTINOPOLIS	7834	6,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
				117622	93,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
8	36	3530201	MIRANTE DO PARANAPANEMA	2689	2,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	4	H
				121219	97,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	4	H
8	36	3532207	NARANDIBA	847	2,5%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	3	M
				33301	97,5%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	3	M
8	36	3538303	PIQUEROBI	2183	4,6%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	1	VL	1	VL
				45716	95,4%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	1	VL	1	VL
8	36	3539202	PIRAPOZINHO	1940	4,1%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	2	L	4	H	5	VH	5	VH
				45188	95,9%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	2	L	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
8	36	3541208	PRESIDENTE BERNARDES	4034	5,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	1	VL	4	H	5	VH
				71443	94,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	1	VL	4	H	5	VH
8	36	3541307	PRESIDENTE EPITACIO	741	0,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				124531	99,4%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H
8	36	3541406	PRESIDENTE PRUDENTE	8140	14,4%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	5	VH	4	H	5	VH	5	VH
				48442	85,6%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	5	VH	4	H	5	VH	5	VH
8	36	3541505	PRESIDENTE VENCESLAU	2722	3,7%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	4	H	1	VL	5	VH	4	H	5	VH
				71579	96,3%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	4	H	1	VL	5	VH	4	H	5	VH
8	36	3542206	RANCHARIA	3489	2,2%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	5	VH
				154836	97,8%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	5	VH
8	36	3542404	REGENTE FEIJO	2843	10,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				23782	89,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
8	36	3543238	RIBEIRAO DOS INDIOS	958	5,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	1	VL	1	VL
				18031	95,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	1	VL	1	VL
8	36	3544251	ROSANA	804	1,1%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				70738	98,9%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
8	36	3545506	SANDOVALINA	638	1,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				44158	98,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
8	36	3547700	SANTO ANASTACIO	3054	5,5%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH
				52407	94,5%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
8	36	3548302	SANTO EXPEDITO	967	10,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				8666	90,0%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H
8	36	3552908	TACIBA	2374	3,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				58133	96,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
8	36	3553906	TARABAI	414	2,1%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
				19505	97,9%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
8	36	3554300	TEODORO SAMPAIO	809	0,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	4	H
				117906	99,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	4	H
9	37	3503356	ARCO-IRIS	1564	6,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	4	H	4	H	1	VL	1	VL
				24632	94,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	4	H	4	H	1	VL	1	VL
9	37	3505807	BASTOS	487	2,8%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	4	H
				16621	97,2%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	4	H
9	37	3519006	HERCULANDIA	1439	3,9%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	2	L	4	H	5	VH	1	VL
				35079	96,1%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	2	L	4	H	5	VH	1	VL
9	37	3519204	IACRI	820	2,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	5	VH	5	VH	1	VL	1	VL
				31289	97,4%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	5	VH	5	VH	1	VL	1	VL
9	37	3541802	QUEIROZ	988	4,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				22707	95,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	37	3542008	QUINTANA	4215	13,6%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				26685	86,4%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	37	3555000	TUPA	2720	4,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				60361	95,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
9	38	3501400	ALVARO DE CARVALHO	4459	33,6%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	3	M	5	VH	1	VL
				8813	66,4%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	3	M	5	VH	1	VL
9	38	3501509	ALVINLANDIA	2205	29,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				5223	70,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	38	3514700	ECHAPORA	7082	14,9%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
				40502	85,1%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
9	38	3515657	FERNAO	1806	18,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				8223	82,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	38	3516606	GALIA	7366	23,1%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				24476	76,9%	3	M	2,0	L	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
9	38	3516705	GARCA	12142	25,5%	1	VL	3,0	M	2,5	VH	1,0	VL	5	VH	3	M	5	VH	5	VH	5	VH	5	VH
				35554	74,5%	5	VH	3,0	M	2,5	VH	3,0	M	5	VH	3	M	5	VH	5	VH	5	VH	5	VH
9	38	3527801	LUPERCIO	3658	28,5%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				9189	71,5%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	38	3529005	MARILIA	20519	19,8%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	5	VH	5	VH	5	VH
				82971	80,2%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	5	VH	5	VH	5	VH
9	38	3533700	OCAUCU	5162	19,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	4	H
				21551	80,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	4	H
9	38	3534104	ORIENTE	4690	23,9%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				14926	76,1%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
9	38	3534500	OSCAR BRESSANE	4424	20,9%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				16739	79,1%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
9	38	3540002	POMPEIA	9689	12,9%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	3	M
				65601	87,1%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	3	M
9	38	3556602	VERA CRUZ	6020	28,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				14937	71,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
10	39	3504008	ASSIS	885	2,0%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	5	VH	5	VH	5	VH
				44374	98,0%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	5	VH	5	VH	5	VH
10	39	3507209	BORA	2285	20,0%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				9134	80,0%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
10	39	3509809	CAMPOS NOVOS PAULISTA	2580	5,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	4	H
				43481	94,4%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	4	H
10	39	3510005	CANDIDO MOTA	588	1,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	4	H	3	M	1	VL	4	H	5	VH	5	VH
				58512	99,0%	4	H	2,5	VH	2,5	VH	3,0	M	4	H	3	M	1	VL	4	H	5	VH	5	VH
10	39	3513306	CRUZALIA	27	0,2%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				14867	99,8%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
10	39	3516101	FLORINIA	207	0,9%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
				21589	99,1%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	1	VL	1	VL
10	39	3519501	IBIRAREMA	182	0,8%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	4	H	4	H	1	VL	1	VL
				22149	99,2%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	4	H	4	H	1	VL	1	VL
10	39	3519907	IEPE	897	1,5%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	1	VL
				58488	98,5%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	1	VL
10	39	3527900	LUTECIA	4254	9,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	1	VL	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				43273	91,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	1	VL	3	M
10	39	3528809	MARACAI	746	1,4%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
				52188	98,6%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	5	VH
10	39	3532157	NANTES	524	1,9%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	1	VL	1	VL
				27719	98,1%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	1	VL	1	VL
10	39	3535309	PALMITAL	862	1,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				53526	98,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
10	39	3535507	PARAGUACU PAULISTA	4091	4,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	1	VL	5	VH
				96166	95,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	1	VL	5	VH
10	39	3537156	PEDRINHAS PAULISTA	38	0,3%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	1	VL
				15085	99,7%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	1	VL
10	39	3539707	PLATINA	790	2,4%	1	VL	1,0	VL	2,0	L	1,0	VL	5	VH	2	L	1	VL	1	VL	1	VL	1	VL
				32197	97,6%	2	L	1,0	VL	2,0	L	3,0	M	5	VH	2	L	1	VL	1	VL	1	VL	1	VL
10	39	3541703	QUATA	5543	8,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				60348	91,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
10	39	3553955	TARUMA	202	0,7%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				30336	99,3%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
10	40	3506300	BERNARDINO DE CAMPOS	3530	14,8%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	1	VL
				20280	85,2%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	1	VL
10	40	3510153	CANITAR	366	6,4%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	4	H	5	VH	1	VL	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				5326	93,6%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	4	H	5	VH	1	VL	4	H
10	40	3557204	CHAVANTES	1538	8,4%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				16765	91,6%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
10	40	3515194	ESPIRITO SANTO DO TURVO	1385	7,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				17859	92,8%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
10	40	3515400	FARTURA	10514	27,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				27204	72,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
10	40	3520905	IPAUCU	3014	15,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
				17100	85,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	5	VH	5	VH	1	VL
10	40	3528601	MANDURI	1993	8,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	3	M
				20981	91,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	3	M
10	40	3533809	OLEO	2189	11,1%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				17598	88,9%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
10	40	3534708	OURINHOS	1442	4,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				27888	95,1%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
10	40	3538808	PIRAJU	11859	24,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				36262	75,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
10	40	3543204	RIBEIRAO DO SUL	683	5,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				12899	95,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
10	40	3545407	SALTO GRANDE	806	3,8%	1	VL	1,5	VH	2,0	L	1,0	VL	4	H	3	M	1	VL	1	VL	5	VH	1	VL
				20228	96,2%	3	M	1,5	VH	2,0	L	3,0	M	4	H	3	M	1	VL	1	VL	5	VH	1	VL

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
10	40	3546405	SANTA CRUZ DO RIO PARDO	10442	9,6%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	4	H	5	VH
				98628	90,4%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	4	H	5	VH
10	40	3550506	SAO PEDRO DO TURVO	10296	13,7%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	1	VL	1	VL
				64990	86,3%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	1	VL	1	VL
10	40	3551207	SARUTAIA	5098	40,0%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
				7651	60,0%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
10	40	3553005	TAGUAI	4840	34,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	1	VL
				9076	65,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	3	M	4	H	5	VH	1	VL
10	40	3554201	TEJUPA	9558	33,0%	1	VL	3,0	M	2,5	VH	1,0	VL	4	H	3	M	4	H	4	H	5	VH	4	H
				19399	67,0%	5	VH	3,0	M	2,5	VH	3,0	M	4	H	3	M	4	H	4	H	5	VH	4	H
10	40	3554607	TIMBURI	6622	50,7%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	1	VL
				6447	49,3%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	1	VL
11	41	3505005	BARAO DE ANTONINA	4908	37,4%	1	VL	3,0	M	2,5	VH	1,0	VL	5	VH	3	M	2	L	5	VH	5	VH	5	VH
				8201	62,6%	5	VH	3,0	M	2,5	VH	3,0	M	5	VH	3	M	2	L	5	VH	5	VH	5	VH
11	41	3508009	BURI	21842	18,5%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
				95918	81,5%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
11	41	3512605	CORONEL MACEDO	8255	27,2%	1	VL	1,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
				22104	72,8%	3	M	1,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	1	VL
11	41	3521705	ITABERA	22646	33,0%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				45883	67,0%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
11	41	3522406	ITAPEVA	23375	21,4%	1	VL	3,0	M	2,5	VH	1,0	VL	5	VH	3	M	3	M	5	VH	5	VH	5	VH
				85601	78,6%	5	VH	3,0	M	2,5	VH	3,0	M	5	VH	3	M	3	M	5	VH	5	VH	5	VH
11	41	3522802	ITAPORANGA	15738	31,7%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	2	L	1	VL	3	M	5	VH	5	VH
				33869	68,3%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	2	L	1	VL	3	M	5	VH	5	VH
11	41	3523206	ITARARE	22149	43,8%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	5	VH
				28471	56,2%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	5	VH
11	41	3543501	RIVERSUL	16310	43,2%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	1	VL	1	VL	4	H	5	VH	4	H
				21451	56,8%	4	H	2,5	VH	2,0	L	3,0	M	4	H	1	VL	1	VL	4	H	5	VH	4	H
11	41	3553807	TAQUARITUBA	6078	14,1%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	1	VL	5	VH	4	H
				37118	85,9%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	1	VL	5	VH	4	H
11	41	3553856	TAQUARIVAI	3187	17,1%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
				15446	82,9%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
11	42	3500758	ALAMBARI	3019	19,0%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	4	H	1	VL
				12832	81,0%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	4	H	1	VL
11	42	3502200	ANGATUBA	16244	16,3%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	5	VH
				83430	83,7%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	5	VH
11	42	3509452	CAMPINA DO MONTE ALEGRE	1766	9,7%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
				16437	90,3%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
11	42	3518503	GUAREI	13261	24,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	4	H
				40254	75,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	4	H
11	42	3522307	ITAPETININGA	25090	19,7%	1	VL	2,0	L	2,0	L	1,0	VL	1	VL	4	H	1	VL	1	VL	5	VH	5	VH
				102387	80,3%	3	M	2,0	L	2,0	L	3,0	M	1	VL	4	H	1	VL	1	VL	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
11	43	3507001	BOITUVA	2856	11,5%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				22011	88,5%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
11	43	3511508	CERQUILHO	1198	9,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				11578	90,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
11	43	3511607	CESARIO LANGE	1011	5,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				18049	94,7%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
11	43	3526407	LARANJAL PAULISTA	5078	13,0%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
				34074	87,0%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	5	VH	5	VH
11	43	3537503	PEREIRAS	2384	10,8%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	5	VH	5	VH	5	VH
				19597	89,2%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	3	M	5	VH	5	VH	5	VH
11	43	3540507	PORANGABA	3245	12,2%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	1	VL
				23315	87,8%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	1	VL
11	43	3541653	QUADRA	1188	5,7%	1	VL	2,0	L	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	1	VL	3	M
				19638	94,3%	2	L	2,0	L	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	1	VL	3	M
11	43	3554003	TATUI	4579	8,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				47885	91,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
11	43	3554656	TORRE DE PEDRA	2605	51,0%	1	VL	2,0	L	2,5	VH	1,0	VL	5	VH	3	M	1	VL	3	M	5	VH	1	VL
				2498	49,0%	4	H	2,0	L	2,5	VH	3,0	M	5	VH	3	M	1	VL	3	M	5	VH	1	VL
11	44	3510203	CAPAO BONITO	9309	17,5%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	3	M	1	VL	4	H	5	VH	4	H
				43886	82,5%	4	H	2,5	VH	2,0	L	3,0	M	4	H	3	M	1	VL	4	H	5	VH	4	H
12	45	3537909	PILAR DO SUL	629	39,6%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	4	H
				960	60,4%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
12	45	3550209	SAO MIGUEL ARCANJO	660	22,1%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	5	VH
				2325	77,9%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	5	VH
12	46	3501152	ALUMINIO	432	54,4%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	3	M
				362	45,6%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	3	M
12	46	3502754	ARACARIGUAMA	2487	58,3%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	4	H	4	H
				1781	41,7%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	3	M	4	H	4	H
12	46	3502903	ARACOIABA DA SERRA	5803	23,7%	1	VL	3,0	M	2,0	L	1,0	VL	1	VL	4	H	4	H	5	VH	5	VH	5	VH
				18670	76,3%	4	H	3,0	M	2,0	L	3,0	M	1	VL	4	H	4	H	5	VH	5	VH	5	VH
12	46	3508405	CABREUVA	3596	48,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				3848	51,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
12	46	3510302	CAPELA DO ALTO	1880	11,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				14686	88,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
12	46	3521002	IPERO	1379	9,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH
				12951	90,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	4	H	5	VH
12	46	3523909	ITU	15029	26,3%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH
				42025	73,7%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	4	H	5	VH
12	46	3528403	MAIRINQUE	1047	44,6%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	1	VL	5	VH	4	H
				1300	55,4%	3	M	2,0	L	1,5	VH	3,0	M	1	VL	3	M	1	VL	1	VL	5	VH	4	H
12	46	3540606	PORTO FELIZ	6300	11,3%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	4	H	5	VH
				49569	88,7%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	5	VH	4	H	5	VH
12	46	3545209	SALTO	1050	7,9%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				12232	92,1%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	5	VH	5	VH
12	46	3545308	SALTO DE PIRAPORA	3861	22,6%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	5	VH
				13218	77,4%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	5	VH
12	46	3550605	SAO ROQUE	369	62,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	4	H	5	VH
				226	38,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	4	H	5	VH
12	46	3551108	SARAPUI	6966	24,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	5	VH	5	VH	3	M
				21381	75,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	5	VH	5	VH	3	M
12	46	3552205	SOROCABA	5875	14,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	3	M	4	H	5	VH
				34959	85,6%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	3	M	4	H	5	VH
12	46	3557006	VOTORANTIM	707	21,6%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				2574	78,4%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	5	VH
12	47	3524006	ITUPEVA	5537	29,9%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	5	VH	4	H
				12969	70,1%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	5	VH	4	H
12	47	3525904	JUNDIAI	6920	31,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	5	VH	4	H	5	VH
				15085	68,6%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	5	VH	4	H	5	VH
12	47	3527306	LOUVEIRA	2341	44,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	3	M
				2894	55,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	4	H	5	VH	3	M
12	47	3556503	VARZEA PAULISTA	295	46,9%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	4	H	5	VH	5	VH
				334	53,1%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	4	H	5	VH	5	VH
12	48	3504107	ATIBAIA	995	34,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				1926	65,9%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	4	H	5	VH
12	48	3507605	BRAGANCA PAULISTA	604	44,5%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	5	VH	5	VH	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				754	55,5%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	3	M	5	VH	5	VH	5	VH
12	48	3523404	ITATIBA	13099	52,7%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
				11764	47,3%	4	H	2,5	VH	2,0	L	2,0	L	1	VL	4	H	1	VL	4	H	4	H	5	VH
12	48	3525201	JARINU	3810	49,2%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	4	H	5	VH	5	VH
				3938	50,8%	4	H	3,0	M	1,5	VH	2,0	L	1	VL	3	M	3	M	4	H	5	VH	5	VH
12	48	3532009	MORUNGABA	4266	56,8%	1	VL	2,0	L	1,5	VH	1,0	VL	1	VL	3	M	1	VL	3	M	4	H	4	H
				3246	43,2%	3	M	2,0	L	1,5	VH	2,0	L	1	VL	3	M	1	VL	3	M	4	H	4	H
12	48	3554953	TUIUTI	294	k	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	2	L	4	H	5	VH	5	VH
				268	47,7%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	2	L	4	H	5	VH	5	VH
13	49	3531704	MONTEIRO LOBATO	let	98,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	3	M	4	H	5	VH	1	VL
				0	1,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	3	M	4	H	5	VH	1	VL
13	50	3508504	CACAPAVA	3098	15,7%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				16673	84,3%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
13	50	3520202	IGARATA	3711	57,8%	1	VL	2,5	VH	2,5	VH	1,0	VL	4	H	3	M	1	VL	5	VH	5	VH	5	VH
			jk ww	2715	42,2%	4	H	2,5	VH	2,5	VH	3,0	M	4	H	3	M	1	VL	5	VH	5	VH	5	VH
13	50	3524402	JACARscxáwql	11513	41,4%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH
			z Azzz zaa s,s,	16290	58,6%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	5	VH
13	50	3538006	PINDAMONHANGA BA	3692	10,0%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
				33386	90,0%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	3	M	1	VL	5	VH	5	VH	5	VH
13	50	3546009	SANTA BRANCA	1500	65,9%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	5	VH	3	M
				775	34,1%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	5	VH	3	M

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
13	50	3549904	SAO JOSE DOS CAMPOS	9261	25,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				27428	74,8%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
13	50	3554102	TAUBATE	4575	20,2%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	5	VH	5	VH
				18061	79,8%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	5	VH	5	VH
13	50	3554805	TREMEMBE	1925	14,1%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	4	H	4	H	5	VH
				11754	85,9%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	4	H	4	H	5	VH
13	51	3502507	APARECIDA	1277	41,3%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	4	H	4	H	5	VH	5	VH
				1814	58,7%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	4	H	4	H	5	VH	5	VH
13	51	3508603	CACHOEIRA PAULISTA	7999	45,3%	1	VL	2,5	VH	1,0	VL	1,0	VL	1	VL	1	VL	1	VL	3	M	5	VH	4	H
				9676	54,7%	3	M	2,5	VH	1,0	VL	3,0	M	1	VL	1	VL	1	VL	3	M	5	VH	4	H
13	51	3509957	CANAS	1060	24,6%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
				3241	75,4%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
13	51	3513405	CRUZEIRO	4175	45,6%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	5	VH
13	51	3518404	GUARATINGUETA	5703	22,7%	1	VL	3,0	M	1,5	VH	1,0	VL	1	VL	3	M	3	M	5	VH	4	H	5	VH
				19462	77,3%	4	H	3,0	M	1,5	VH	3,0	M	1	VL	3	M	3	M	5	VH	4	H	5	VH
13	51	3526605	LAVRINHAS	2219	59,6%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	2	L	4	H	5	VH	1	VL
				1507	40,4%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	2	L	4	H	5	VH	1	VL
13	51	3527207	LORENA	3937	25,7%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	5	VH
				11381	74,3%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	5	VH
13	51	3538501	PIQUETE	1168	57,2%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	2	L	1	VL	4	H	4	H	4	H
				874	42,8%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	2	L	1	VL	4	H	4	H	4	H

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
13	51	3540754	POTIM	4493	100,0 %	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	4	H	1	VL
13	51	3541901	QUELUZ	3908	68,0%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
				1837	32,0%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	4	H	5	VH	1	VL
13	51	3544301	ROSEIRA	1069	17,3%	1	VL	2,0	L	2,0	L	1,0	VL	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
				5101	82,7%	3	M	2,0	L	2,0	L	3,0	M	5	VH	1	VL	1	VL	5	VH	5	VH	1	VL
13	52	3503158	ARAPEI	3262	70,6%	1	VL	2,0	L	2,0	L	1,0	VL	4	H	2	L	1	VL	1	VL	5	VH	3	M
				1357	29,4%	3	M	2,0	L	2,0	L	3,0	M	4	H	2	L	1	VL	1	VL	5	VH	3	M
13	52	3503505	AREIAS	4628	74,7%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
				1568	25,3%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
13	52	3504909	BANANAL	7147	69,3%	1	VL	2,5	VH	2,5	VH	1,0	VL	5	VH	3	M	1	VL	4	H	5	VH	3	M
				3166	30,7%	4	H	2,5	VH	2,5	VH	3,0	M	5	VH	3	M	1	VL	4	H	5	VH	3	M
13	52	3549607	SAO JOSE DO BARREIRO	3186	80,6%	1	VL	1,5	VH	2,0	L	1,0	VL	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
				768	19,4%	3	M	1,5	VH	2,0	L	3,0	M	5	VH	1	VL	1	VL	1	VL	5	VH	1	VL
13	52	3552007	SILVEIRAS	6233	77,5%	1	VL	2,5	VH	2,0	L	1,0	VL	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
				1808	22,5%	4	H	2,5	VH	2,0	L	3,0	M	5	VH	1	VL	5	VH	4	H	5	VH	1	VL
15	57	3539103	PIRAPORA DO BOM JESUS	173	61,3%	1	VL	2,5	VH	2,0	L	1,0	VL	4	H	1	VL	1	VL	4	H	5	VH	4	H
				110	38,7%	4	H	2,5	VH	2,0	L	2,0	L	4	H	1	VL	1	VL	4	H	5	VH	4	H
15	59	3546801	SANTA ISABEL	7622	60,8%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	2	L	1	VL	4	H	5	VH	5	VH
				4912	39,2%	3	M	2,5	VH	1,5	VH	3,0	M	1	VL	2	L	1	VL	4	H	5	VH	5	VH
15	62	3518305	GUARAREMA	6454	53,1%	1	VL	2,5	VH	2,0	L	1,0	VL	1	VL	4	H	1	VL	4	H	4	H	5	VH

Ce	Ci	CU	Nmun	Area (Ha.)	Ap (%)	IS		DC		DB		DA-P1		P2		P3		P4		P6		P7		P8	
				5695	46,9%	4	H	2,5	VH	2,0	L	3,0	M	1	VL	4	H	1	VL	4	H	4	H	5	VH
15	62	3530607	MOJI DAS CRUZES	268	24,2%	1	VL	2,5	VH	1,5	VH	1,0	VL	1	VL	3	M	1	VL	5	VH	4	H	4	H
				840	75,8%	3	M	2,5	VH	1,5	VH	2,0	L	1	VL	3	M	1	VL	5	VH	4	H	4	H

Legend

Cme Meso-region code

Cmi Micro- region code

Cmu Municipality code

Nmu Municipality name

Area Total area with same classification

Ap Percentage of total area where sugarcane is allowed

IS Sustainability index

DC Municipal policy domain

DB Socioeconomic domain

DA Environmental domain

P2 Principle 2:

P3 Principle 3:

P4 Principle 4:

P6 Principle 6:

P7 Principle 7:

P8 Principle 8:

VL Very low

L Low

M Moderate

H High

VH Very high

III. ATLAS MAPS

A. Principle / Domain A

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus
 Domain A / Principle 1
 If A1=1 or A2=1; then Domain A / Principle 1 = 1
 If not; Domain A / Principle 1 = A3
 Classification:
 If Domain A / Principle 1 = 1; then classification is 1 (Low)
 If Domain A / Principle 1 = 2; then classification is 2 (Moderate)
 If Domain A / Principle 1 = 3; then classification is 3 (High)

Categories

- Low
- Moderate
- High
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

Localization

A. DOMAIN A
Environmental aspects
PRINCIPLE 1
The integrity of the
socio-ecological system

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 Process No. 2013/12981-1

Elaborated by
 Alejandra Daniela. Mendizábal Cortés

Elaboration date: October 22, 2017

B. Principle 2

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus
Principle 2
If $S2=1$, then Principle 2 = 1
If not; Principle 2 = Mean (S2, S5, S6)

Classification:
If Principle 2 = 1; then Classification is 1 (Very low)
If Principle 2 > 1 and Principle 2 ≤ 1.5; then Classification is 2 (Low)
If Principle 2 > 1.5 and Principle 2 ≤ 2; then Classification is 3 (Moderate)
If Principle 2 > 2 and Principle 2 ≤ 2.5; then Classification is 4 (High)
If Principle 2 > 2.5; then Classification is 5 (Very high)

Categories

- Very low
- low
- Moderate
- High
- Very high
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

B. PRINCIPLE 2

Sufficient resources for subsistence
and access to opportunities

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Alejandra Daniela. Mendizábal Cortés

Elaboration date: October 22, 2017

C. Principle 3

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus
Principle 3
If $S1=1$, then Principle 3 = 1
If not; Principle 3 = Mean (S1, S3, E1)

Classification:
If Principle 3 = 1; then Classification is 1 (Very low)
If Principle 3 > 1 and Principle 3 ≤ 1.5; then Classification is 2 (Low)
If Principle 3 > 1.5 and Principle 3 ≤ 2; then Classification is 3 (Moderate)
If Principle 3 > 2 and Principle 3 ≤ 2.5; then Classification is 4 (High)
If Principle 3 > 2.5; then Classification is 5 (Very high)

Categories

- Very low
- low
- Moderate
- High
- Very high
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

C. PRINCIPLE 3 Intra-generational equity

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Process No. 2013/12981-1

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Alejandra Daniela. Mendizábal Cortés

Elaboration date: October 22, 2017

D. Domain B

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

1 centimeter = 11.000 meters

Calculation method

Calculus
Domain B
Domain B = Mean (P2, P3)

Classification:
If Domain B = 1; then classification is 1 (Very low)
If Domain B > 1 and Domain B <= 1,5;
then Classification is 2 (Low)
If Domain B > 1,5 and Domain B <= 2;
then Classification 3 (Moderate)
If Domain B > 2 and Domain B <= 2,5;
then Classification is 4 (High)
If Domain B > 2,5; then Classification is 5 (Very high)

Categories

- Very low
- low
- Moderate
- High
- Very high
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

Localization

H. DOMAIN B Socioeconomic aspects

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Elaboration date: October 22, 2017

E. Principle 4

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus

Principle 4

If $16=1$; then Principle 4 = 1

If not; Principle 4 = Mean (16, 12)

Classification:

If Principle 4 = 1; then Classification is 1 (Very low)

If Principle 4 > 1 and Principle 4 <= 1.5; then Classification is 2 (Low)

If Principle 4 > 1.5 and Principle 4 <= 2; then Classification is 3 (Moderate)

If Principle 4 > 2 and Principle 4 <= 2.5; then Classification is 4 (High)

If Principle 4 > 2.5; then Classification is 5 (Very high)

Categories

Very low

low

Moderate

High

Very high

Sugarcane cultivation not allowed

São Paulo municipalities' division

D. PRINCIPLE 4 Intergenerational equity

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Elaboration date: October 22, 2017

F. Principle 6

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus

Principle 6

If $S4 = 1$; then Principle 6 = 1

If not; Principle 6 = Mean (13, 14)

Classification:

If Principle 6 = 1; then Classification is 1 (Very low)

If Principle 6 > 1 and Principle 6 <= 1.5; then Classification is 2 (Low)

If Principle 6 > 1.5 and Principle 6 <= 2; then Classification is 3 (Moderate)

If Principle 6 > 2 and Principle 6 <= 2.5; then Classification is 4 (High)

If Principle 6 > 2.5; then Classification is 5 (Very high)

Categories

Very low

low

Moderate

High

Very high

Sugarcane cultivation not allowed

São Paulo municipalities' division

E. PRINCIPLE 6 Socioenvironmental civility and democratic governance

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G. Principle 7

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus

Principle 7

If $E2=1$; then Principle 7 = 1

If not; Principle 7 = Mean (E2, I5)

Classification:

If Principle 7 = 1; then Classification is 1 (Very low)

If Principle 7 > 1 and Principle 7 <= 1.5; then Classification is 2 (Low)

If Principle 7 > 1.5 and Principle 7 <= 2; then Classification is 3 (Moderate)

If Principle 7 > 2 and Principle 7 <= 2.5; then Classification is 4 (High)

If Principle 7 > 2.5; then Classification is 5 (Very high)

Categories

Very low

low

Moderate

High

Very high

Sugarcane cultivation not allowed

São Paulo municipalities' division

F. PRINCIPLE 7 Precaution and adaptation

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Elaboration date: October 22, 2017

H. Principle 8

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus

Principle 8

If $I7=1$; then Principle 8 = 1

If not; Principle 8 = Mean (I7, I1)

Classification:

If Principle 8 = 1; then Classification is 1 (Very low)

If Principle 8 > 1 and Principle 7 <= 1.5; then Classification is 2 (Low)

If Principle 8 > 1.5 and Principle 7 <= 2; then Classification is 3 (Moderate)

If Principle 8 > 2 and Principle 7 <= 2.5; then Classification is 4 (High)

If Principle 8 > 2.5; then Classification is 5 (Very high)

Categories

Very low

low

Moderate

High

Very high

Sugarcane cultivation not allowed

São Paulo municipalities' division

G. PRINCIPLE 8 Integration between current and long-term situation

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Elaboration date: October 22, 2017

I. Domain C

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus
Domain C = Mean (P4, P6, P7, P8)

Classification:
If Domain C = 1; then classification is 1 (Very low)
If Domain C > 1 and Domain C ≤ 1,5;
then Classification is 2 (Low)
If Domain C > 1,5 and Domain C ≤ 2;
then Classification 3 (Moderate)
If Domain C > 2 and Domain C ≤ 2,5;
then Classification is 4 (High)
If Domain C > 2,5; then Classification is 5 (Very high)

Categories

- Very low
- low
- Moderate
- High
- Very high
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

Localization

I. DOMAIN C Municipal policies

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Alejandra Daniela. Mendizábal Cortés

Elaboration date: October 22, 2017

J. Sustainability index

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus
Sustainability Index
If Domain (A) = 1; then Sustainability Index = 1
If not; then Sustainability Index = Mean (Domains B, and C)

Classification:
If Sustainability Index = 1; then Classification is 1 (Very low)
If Sustainability Index > 1 and Sustainability Index <= 1,5;
then Classification is 2 (Low)
If Sustainability Index > 1.5 and Sustainability Index <= 2;
then Classification 3 (Moderate)
If Sustainability Index > 2 and Sustainability Index <= 2,5;
then Classification is 4 (High)
If Sustainability Index > 2,5; then Classification is 5 (Very high)

Categories

- Very low
- low
- Moderate
- High
- Very high
- Sugarcane cultivation not allowed
- São Paulo municipalities' division

Localization

J. INDEX OF SUSTAINABILITY for sugarcane crop

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Process No. 2013/12981-1

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Elaboration date: October 22, 2017

K. Sustainability index by municipalities

Sistema de coordenadas: GCS_SIRGAS 2000

0 37,5 75 150 Km.

Calculation method

Calculus

Sustainability Index

If Domain (A) = 1; then Sustainability Index = 1

If not; then Sustainability Index = Mean (Domains B, and C)

Classification:

If Sustainability Index = 1; then Classification is 1 (Very low)

If Sustainability Index > 1 and Sustainability Index <= 1.5;

then Classification is 2 (Low)

If Sustainability Index > 1.5 and Sustainability Index <= 2;

then Classification 3 (Moderate)

If Sustainability Index > 2 and Sustainability Index <= 2.5;

then Classification is 4 (High)

If Sustainability Index > 2.5; then Classification is 5 (Very high)

Municipal level: predominant area in municipalities

Categories

Very low

low

Moderate

High

Very high

Sugarcane cultivation not allowed

São Paulo municipalities' division

Localization

K. INDEX OF SUSTAINABILITY

For sugarcane crop

Municipal level

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