NETLOG 2021
International Conference on Network Enterprises & Logistics Management

Impact of Piauí Soybean Production Growth on Municipalities HDI

Luz, J. A. A., Reis, J. G. M.

RESUP – PPGEP - Universidade Paulista - UNIP

Abstract

Brazil is a country whose agriculture represents 25% of the total GDP. In this context, agriculture is an important inducer of the country's economy. The North and Northeast Regions in the country are suggested as a new expanding agricultural frontier. This paper studies the relationship between GDP and the HDI between 2000 and 2010, considering the correlation analysis. The universe of the cities surveyed is divided into two groups: the cities that produce soybean and those that are considered savanna regions with potential for soybean production. The results show the economic impact associated or not with the social development of the region of the state of Piaui.

Keywords. Soybean, GDP, HDI, Savanna

Resumo

O Brasil é um país cujo PIB agrícola representa 25% do total. Nesse contexto, a agricultura é um importante indutor da economia do país. As regiões Norte e Nordeste do país são vistas como uma nova fronteira agrícola em expansão. Este artigo estuda a relação entre PIB e IDH entre 2000 e 2010, considerando a análise de correlação. O universo das cidades pesquisadas divide-se em dois grupos: as cidades que produzem soja e aquelas que são consideradas região de cerrado com potencial para a produção de soja. Os resultados da pesquisa discutem o impacto econômico associado ou não ao desenvolvimento social da região do estado do Piauí.

Keywords. Soja, PIB, IDH, Cerrado.

1. Introduction

Brazil is a major player in global agricultural trade, accounting for 7.3 percent of global agricultural exports. It is the world’s third-largest exporter of agricultural products, behind only the EU and the United States. (FAO, 2014). This economic activity has evolved considerably in the last 20 years in regions with low rates of economic and social development.

The share of agricultural GDP in Brazil consolidates the role of agribusiness in the national economy. Furtuoso (2019) states that the Brazilian agro-industrial complex represents approximately 32% of the national GDP. For this reason, the country's development dependence on grain production and other field activities directly influences macroeconomics.

North and Northeast regions of Brazil stand out with the growth of areas in agriculture, especially the savanna areas with soybean cultivation. The professionalization and implementation of productivity of soybean planted areas in the northern regions of the country have attracted interest in soybean cultivation, causing economic, social, and environmental impacts.

Brazil has historically been dependent on public policies to develop, this process directly involved state action in the economy and planning. Over time the concept of economic development has been associated with other social and environmental indicators to determine the evolutionary performance of a region. This more modern approach analyzes the general context from education, the Human Development Index - HDI, demographics linked to economic outcomes, and the impacts that development can bring.

It has been observed in specific literature that, although the evolution and competitiveness of agricultural production have positive effects on economic growth, such as per capita GDP, such factors are still not sufficient to improve the indexes related to the social development of a region, such as This is the case with income and poverty distribution (Zambra et al., 2015).

De Castro (2016) studied if there really is any relationship between soybean planting and socioeconomic development in the municipalities of Mato Grosso. For this, the General Index of Socioeconomic Development (IGDSE) was created, based on the Exploratory Factor Analysis, aiming to differentiate the development process of the municipalities of Mato Grosso, from the planting of soybean, in the years 2000 and 2010. The results showed that, in both 2000 and 2010, the municipalities that planted soybean developed more on average, indicating a positive relationship between soy planting and socioeconomic development.

In Piaui, a state located in the northeastern region of the country that has a low economic development index, the role of agriculture ensures primary activity with the most important of the segments, given that trade and services are incipient. However, there are no studies investigating the role of soybean in the development index. Piaui has 224 municipalities, of which 26 produce soybeans, with a total GDP of USD 10.3 billion, with the 21st position in the country besides being the 11th largest soybean producer in the country. As for the HDI, occupies the 25th position, according to IBGE (2019).

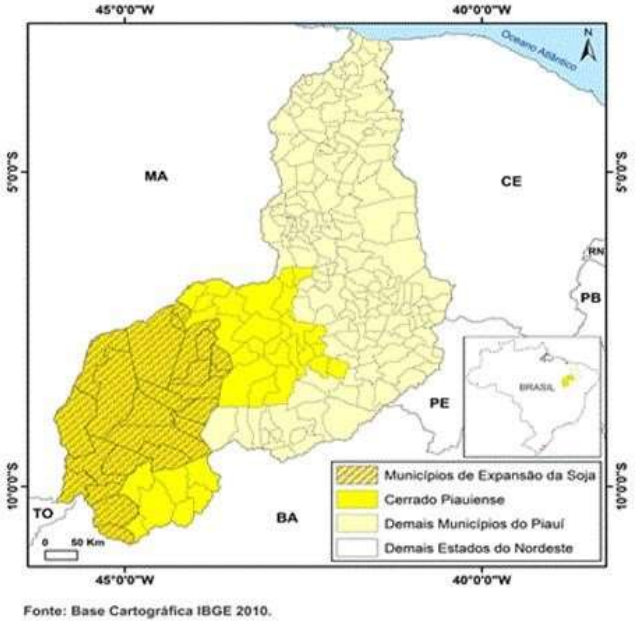
Therefore, this article intends to investigate whether there is a relationship between the variables GDP, HDI, and soybean production in the State of Piaui. The sample considers the municipalities classified as savanna area according to the Complementary Law No. 87/2007 of the Piaui State Government recognizing the municipalities that make up the Savanna microregion, Figure 1. Notice the area in the Southeast region of the map highlighted with yellow color, which represents the savanna region of Piaui. The research classifies the municipalities of this region that exploit soy in their territory and do not plant soybean.

2. Methods

To carry out this work was defined as research sample the universe of 54 municipalities that corresponds to the Savanna microregion. The cities were classified into municipalities that plant soybeans and those that do not plant soybeans in the period. Approximately 800,000 inhabitants live in these cities, according to the 2010 IBGE census. GDP has been calculated from 2000 to 2010, as well as the HDI of 2000 and 2010.

The study was performed using a linear regression solved with the aid of the IBM SPSS Statistics v.22 © programs. The analysis evaluates four hypotheses:

Figure 1. Savanna microregion. Fonte: IBGE



Formulas:

$$H1 = \alpha o + Dps2010 + \varepsilon i \quad (1)$$

$$H2 = \beta o + Dps2010 + \varepsilon i \quad (2)$$

$$H3 = \mu o + Ps2010 + \varepsilon i \quad (3)$$

$$H4 = ¥o + Ps2010 + \varepsilon i \quad (4)$$

Subtitle:

DPs = Municipalities without soybean plantation

Ps = Municipalities with soybean plantation

Initially through the Brazilian Institute of Geography and Statistics - IBGE evidence, the municipalities were divided into two groups, those that plant soybeans, Table 1, and those that do not plant soybeans.

In order to clarify the proposal of the study, we classify as univariate variables the universe of municipalities that fall or not soy. As an independent variable, GDP and HDI. A simple linear regression was developed between the evolution of the GDPs of the soybean and non-soybean municipalities, extracting the logarithmic in base 10, and the absolute number HDI, as for the savanna municipalities with and without soybean plantation in the 2000 and 2010 periods.

Table 1. Piaui's Municipalities with Soybean Plantation

Municipalities	**GDP – 2000 (BRL)**	**GDP – 2010 (BRL)**	**HDI 2000**	**HDI 2010**
Alvorada do Gurguéia	6.115.000.00	23.227.000.00	0.403	0.578
Antônio Almeida	5.553.000.00	80.206.000.00	0.478	0.620
Baixa grande do Ribeiro	25.006.000.00	148.451.000.00	0.349	0.564
Bom Jesus	39.249.000.00	204.103.000.00	0.486	0.668
Colônia do Gurguéia	5.362.000.00	42.732.000.00	0.445	0.628
Corrente	39.329.000.00	161.700.000.00	0.474	0.642
Currais	6.556.000.00	34.897.000.00	0.339	0.542
Gilbués	13.876.000.00	73.093.000.00	0.411	0.548
Guadalupe	51.255.000.00	198.106.000.00	0.495	0.65
Landri Sales	6.886.000.00	32.097.000.00	0.451	0.584
Monte Alegre do Piauí	10.433.000.00	57.913.000.00	0.387	0.578
Paes Landim	5.530.000.00	16.807.000.00	0.45	0.575
Pajeú do Piauí	3.263.000.00	12.573.000.00	0.383	0.559
Palmeira do Piauí	8.216.000.00	29.763.000.00	0.428	0.557
Porto alegre do Piauí	3.633.000.00	19.962.000.00	0.374	0.563
Redenção do Gurguéia	8.644.000.00	31.793.000.00	0.402	0.589
Ribeiro Gonçalves	9.959.000.00	81.673.000.00	0.439	0.601
Santa Filomena	9.748.000.00	71.648.000.00	0.393	0.544
São Gonçalo do Gurguéia	3.232.000.00	12.398.000.00	0.384	0.560
Sebastião Leal	6.697.000.00	69.007.000.00	0.369	0.562
Uruçuí	46.906.000.00	427.632.000.00	0.432	0.631

Table 2. Piaui's Municipalities without Soybean Plantation

Municipalities	GDP - 2000	GDP - 2010	HDI 2000	HDI 2010
Arraial	4.609.000.00	16.801.000.00	0.412	0.560
Avelino Lopes	9.080.000.00	36.300.000.00	0.367	0.554
Barreiras do Piauí	5.443.000.00	10.143.000.00	0.413	0.557
Bertolínia	7.658.000.00	27.055.000.00	0.441	0.612
Brejo do Piauí	3.647.000.00	14.522.000.00	0.278	0.515
Canavieira	5.187.000.00	15.324.000.00	0.388	0.583
Canto do Buriti	25.329.000.00	98.146.000.00	0.426	0.576
Cristalândia do Piauí	8.186.000.00	26.881.000.00	0.416	0.573
Cristino Castro	12.222.000.00	46.256.000.00	0.460	0.566
Curimatá	11.895.000.00	43.615.000.00	0.489	0.607
Eliseu Martins	5.956.000.00	20.643.000.00	0.449	0.595
Flores do Piauí	4.994.000.00	17.176.000.00	0.353	0.547
Floriano	144.459.000.00	550.100.000.00	0.558	0.700
Francisco Ayres	5.122.000.00	16.077.000.00	0.391	0.577
Itaueira	12.595.000.00	51.693.000.00	0.444	0.583
Jerumenha	5.456.000.00	19.841.000.00	0.448	0.591
Júlio Borges	4.904.000.00	19.226.000.00	0.382	0.582
Manoel Emídio	6.008.000.00	23.779.000.00	0.442	0.573
Marcos Parente	4.927.000.00	16.919.000.00	0.466	0.59
Morro Cabeça do Tempo	4.709.000.00	16.107.000.00	0.317	0.542
Nazaré do Piauí	9.365.000.00	24.063.000.00	0.380	0.576
Pajeú do Piauí	3.263.000.00	12.573.000.00	0.383	0.559
Parnaguá	11.839.000.00	41.433.000.00	0.362	0.575
Pavussu	4.622.000.00	13.463.000.00	0.333	0.526
Pedro Laurentino	4.281.000.00	10.328.000.00	0.325	0.562
Porto alegre do Pauí	3.633.000.00	12.153.000.00	0.374	0.563
Riacho Frio	6.425.000.00	16.618.000.00	0.395	0.541
Ribeira do Piauí	4.736.000.00	13.333.000.00	0.285	0.52
Rio Grande do Piauí	6.361.000.00	23.613.000.00	0.414	0.572
Santa Luz	5.047.000.00	19.643.000.00	0.414	0.588
São José do Peixe	5.406.000.00	28.237.000.00	0.508	0.573
São Miguel do Fidalgo	4.197.000.00	11.144.000.00	0.348	0.535
Sebastião Barros	5.517.000.00	18.664.000.00	0.338	0.536
Socorro do Piauí	4.818.000.00	26.446.000.00	0.344	0.561
Tamboril do Piauí	3.112.000.00	10.586.000.00	0.316	0.501

The variables used were GDP, HDI, and Soy Production, Table 3.

Table 3. Data source and description of the variables used.

Variable	Indicator	Description	Source	Periods
X1	Economic	GDP -Gross domestic product	IBGE	2000 a 2010
X2	Social	HDI- Urban development index	PNUB	2000 a 2010
X3	Agricultual	PS- Soybean production	IBGE	2000 a 2010

The Human Development Index (HDI) is a summary measure of long-term progress in three basic dimensions of human development: income, education, and health. The purpose of the HDI was to offer a counterpoint to another widely used indicator. Gross Domestic Product (GDP), which considers the sum of all goods and services produced in an economy over a given period of time. It is believed that the GDP variable is directly associated with the soybean produced volume, therefore, in the correction, only GDP and HDI were calculated.

In Brazil, there are several aspects that favor the cultivation of soybeans, ranging from climatic conditions, technological development, public policies to entrepreneurship. Johnston and Mellor (1961) stated that the functions performed by agriculture are associated with the primary stages of economic development, especially in developed countries. However, this factor has changed over the years and may represent the reality of Brazil or the state of Piaui, where agricultural activity also contributes in the most advanced stages, generating many resources and jobs.

The choice of indicators was based on aspects that set questions of economic development in the municipalities of the savanna of Piaui. The literature has already recorded similar perspectives, as in the works of Hoffmann and Kageyama (1985), which analyzed aspects of agricultural modernization and income distribution in Brazil; Melo and Parré (2007) whose focus was to investigate the general relationship of rural development to the municipalities of Paraná; and Shikida (2010) who sought to show what was the development framework in a municipality that houses the sugarcane agro-industrial activity in Paraná.

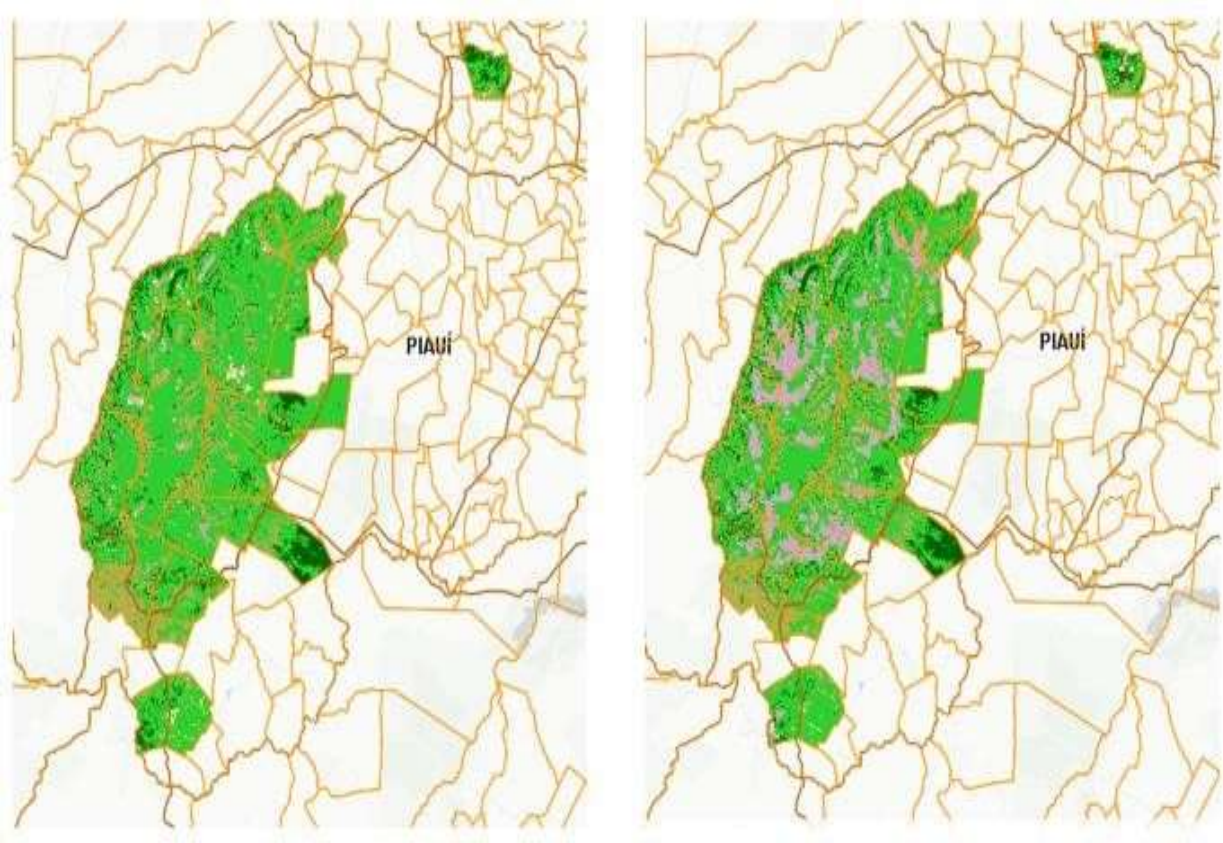
Similar to what was done by Carvalho et al. (2012) for the states of Tocantins and Bahia, the present work sought to investigate socioeconomic development by differentiating municipalities that planted and did not plant soybeans, for the reality of Piaui.

An exploratory data analysis was also adopted, which according to Silva (2012) allows to describe the spatial distribution, to understand the patterns of spatial association, and to verify the existence and forms of spatial instability. According to Almeida (2004), an exploratory analysis of spatial data seems appropriate for sectoral studies, since the variables that determine the Gross Domestic Product (GDP) of the sector may present multidirectional spatial interactions that benefit the sector dynamics itself. The spatial analysis deals directly with the effects of spatial dependence and spatial heterogeneity. The images extracted from the Agrosatellite Geotechnology program show different periods of land occupation with soybean plantation.

3. Results and Discussion

Every grain production process that covers the agribusiness segment causes environmental impacts. Environmental complexity encompasses the environment, society, and politics. The reduction in local fauna and flora replaced by soybean cultivation, as well as the effects on the soil and the use of chemicals to improve productivity are components to be evaluated and contained to avoid a loss of the natural quality of the grain production environment. However, it is known about the scope that agribusiness provides in terms of its production chain, such as dealers of pesticides and machines, gas stations, consultancies, as well as other activities such as schools, doctors' offices, gyms, clinics, among others, which resulted in a greater dynamization of the economy, in addition to the inputs used in agribusiness, companies that settle in the region, a tax collection is generated for the municipality and state. In this scenario, there is a need for infrastructure to promote business flow fluency.

Figure 2. Soybean planting Evolution. Source: Agrosatellite Biomes (2014)



It can be seen in Figure 2 that in the 21 municipalities that cultivate soybeans in Piaui there was a growth of the planted area, in the “pink” color of the map, the evolution in 14 years, still presenting a growth potential. The area dedicated to agribusiness, with reference to 2014 is 15% of the total area of 21 municipalities. We highlight the municipalities of Ribeiro Gonçalves and Bom Jesus with a proportion of 20 times the amount of soybean.

However, the scope of the discussion of this article focuses on the nuances of territorial expansion of planting, economy, and social variables. It is known that there is a bias in the Brazilian development model, much depends on the government's dialogue, the definition of public policies that permeate investments in infrastructure, credit lines policies, tax incentives, and training schools.

Table 4 presents the results of the calculated linear regressions.

Table 4. Regressão linear

Regression Statistics	Correlation Analysis with Soybean Planting 2000	Correlation Analysis without Soybean Planting 2000	Correlation Analysis with Soybean Planting 2010	Correlation Analysis without Soybean Planting 2010
R-Multiple	0.6112	0.6290	0.7388	0.6268
R-Square	0.3736	0.3957	0.5459	0.3929
R- Adjust Square	0.3546	0.3639	0.5321	0.3610
Standard Error	0.0500	0.0300	0.0200	0.0300
Number of Observations	35	21	35	21

There is a relationship between the analyzed variables involving the municipalities, but it is found differently for each surveyed period. It is shown in Table 4 that there is a greater correlation between the variables in the municipalities that do not plant soybeans with a ratio of 0.7388 in 0.5459 of the cases the municipalities that plant soybeans a ratio of 0.6268 in 0.3929 cases. Contrary to other literature linking the proportionality relationship between the evolution of GDP and HDI in soybean-producing municipalities in Brazilian states.

4. Conclusion

Despite the growth observed in the production area of the State of Piauí from 2000, it was between 2007 and 2014 that the expansion of planted area presented the largest volume. According to Rudorff (2015), the expansion of the Piaui cerrado was consolidated over native vegetation. IBGE (2015) states that the Piauiense cerrado has an area of 9 million hectares, corresponding to 11% of the Brazilian savanna.

Table 5. Evolution of soybean acreage in Piauí

Year	2000	2014	Growth %
Soybean acreage per hectare	153.997	811.419	427,00%

Soybean production in cities that grew between 2000 and 2010 grew in proportion according to Table 6. The variations are quite relevant in all municipalities that planted soybeans, well above the national growth of 110% between 2000 and 2010 (Gazola, 2012), in addition to the consolidation of decentralization of soybean cultivation in all regions of the Brazilian savanna.

Table 6. Evolution of soybean planting in municipalities that plant between 2000 and 2010

Coutries	2000 Soybean crops	2010 Soybean crops	Variations %
Baixa Grande do Ribeiro	629,133	3,256,417	433.50%
Uruçuí	539,767	3,966,283	634.81%
Ribeiro Gonçalves	71,267	1,693,650	2,276.50%
Bom Jesus	57,567	1,156,500	1,908.98%
Santa Filomena	109,767	1,067,567	872.58%
Currais	0	705,467	0.00%
Gilbués	32,000	549,600	1.617.50%
Sebastião Leal	78,483	402,800	413.23%
Monte Alegre do Piauí	37,200	462,583	1.143.50%
Corrente	4,167	56,833	1.264.00%
Palmeira do Piauí	38,000	413,633	988.51%
Regeneração	0	28,000	0.00%
Landri Sales	0	258,333	0.00%
Alvorada do Gurguéia	25,000	108.800	335.20%
Antônio Almeida	36,867	142,667	286.98%

It is suggested that future works investigate the causes of the outflow of financial resources that are not fixed in the region. in addition to government policy positions that may encourage the permanence of resources generated in the production of the soy chain.

References

Agrosatellite Applied Geotechnology Ltda (2015). Geospatial Analysis of Annual Crop Dynamics in the Cerrado: 2000-2014 / Rudorff, B .; Risso, J. et al., 2015 Florianópolis, Santa Catarina, Brazil, http:

//biomas.agrosatelite.com.br/img/Analise_geoespacial_da_dinamica_das_culturas_anual_no_bioma_Cerrado_2000a2014.pdf

Almeida, E. S. (2004) from. Applied Space Econometrics Course (Handout). University of São Paulo (USP) - "Luiz de Queiroz" Higher School of Agriculture (ESALQ). Piracicaba.

Oak, A. C. S (2012).; et al. Soy and Development: a comparative analysis between the states of Bahia and Tocantins. In: Annals of the VI Meeting National Association of Graduate and Research in Environment and Society, National Association of Graduate and Research in Environment and Society ANPPAS - Belém, PA.

CONAB (2019). Grain Harvest Report historical series 2015/2018. Conab Brasilia. URL: https://portaldeinformacoes.conab.gov.br/index.php/safra-serie-historica-dashboard.

De Castro, Lucas Siqueira; De Lima, João Eustáquio (2016). Soybeans and the state of Mato Grosso: is there any relationship between crop cultivation and municipal development?. Brazilian Journal of Regional and Urban Studies, v. 10, no. 2, p. 177-198.

FAO (2014) Country fact sheet on food and agriculture policy trends.Fadpa – Food and agriculture policy decision analysis. researched in 22/10/2020 http://www.fao.org/3/i3759e/i3759e.pdf.

Freitas, Rogério Edivaldo; mendonça (2016), Marco Aurélio Alves de. Agricultural Expansion in Brazil and Soy Participation: 20 years. Journal of Rural Economics and Sociology, v. 54, no. 3, p. 497-516.

Furtuoso, Maria Cristina Ortiz; De Camargo Barros, Geraldo Santy Ana; GUILHOTO, Joaquim José Martins. The gross domestic product of the Brazilian agroindustrial complex. Journal of Rural Economics and Sociology, v. 36, n. 3, p. 9-32, 2019.

Gazola, Keite Soares et al (2012). Evolution of soybean concentration and production level in Brazil and Mato Grosso from 2000 to 2010. UNEMAT journal of accounting, v. 1, no. 2.

Hoffmann, R ; Kageyama, A. A (1985). Modernization of agriculture and income distribution in Brazil. Journal of Economic Research and Planning, v. 15, no. 1, p. 171-208.

IBGE (2019). Cider - database of statistical tables. Brazilian Institute of Geography and

Johnston, B. F.; Mellor, J. W. (1961) The role of agriculture in economic development. American Economic Review, v. 51, no. 4, p. 566-93.

Melo, C. O.; parré, J. L. (2007) Index of rural development of the municipalities of Paraná: determinants and hierarchy. Journal of Rural Economics and Sociology, v. 45, no. 2, p. 329-365.

Shikida, P. F. A. (2012) Socioeconomic development and sugarcane agribusiness in Paraná. Agricultural Policy Journal, Brasilia, n. 3, pp. 67-82.

Savoia, José Roberto Ferreira (coord) (2009). Agribusiness in Brazil: a financial perspective. Sao Paulo: Saint Paul Publisher.

Silva, Guilherme Jonas Costa da; Souza, Ezra Cardoso; Martins, Humberto Eduardo de Paula (2012). Agricultural production in municipalities of Minas Gerais (1996-2006): patterns of distribution, specialization and spatial association. Journal of Rural Economics and Sociology, v. 50, no. 2, p. 333-349.

STATISTICS (2017).. Table 1612 planted area soybean harvested area by municipality series 2000 to 2017. URL: http://www.ibge.gov.br/apps/atlas_nacional/.

Zambra, Elisandra Marisa; Souza, Paulo Augusto Ramalho; Da Silva Pereira, Rachel (2015). Impacts of soybean production and development dynamics in Sorriso-MT. Pretext Magazine, v. 16, no. 3, p. 92-105.