Sizing Of The Agribusiness Of The State Of Mato Grosso And The Rest Of Brazil

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Abstract:
Agribusiness refers to the sum of all operations involved in the production and distribution of food and fiber, made up of four sectors: Inputs, Agriculture, Agroindustry and Services. It is a complex of systems characterized by a decrease in production control by the farmer, in which there are activities related to production that depend on third parties to have access to inputs, machines and equipment and the transformation and marketing of products. The objective of this study was to measure agribusiness in the state of Mato Grosso and the rest of Brazil, its indicators and economic impacts. The source of the data was the Amazon Development Superintendency (SUDAM). The production chain was divided into Agriculture, Livestock and Forestry production, fishing and aquaculture. The economy of the state of Mato Grosso is dependent on agribusiness, as more than 50% of income, taxes and jobs are generated by activities related to this production chain, for Brazil the share of agribusiness in the economy is 19% of income and 28% of jobs. The values of labor productivity in the field of Agriculture and Forestry Production in Mato Grosso are higher than for the rest of the national economy, which indicates high technology and productive efficiency. In the case of Livestock, there is the potential to increase labor productivity using inputs and new technologies. The state economy presents an agroindustry with great growth potential in absolute and relative values, however, the share of taxes in income is greater for the Agriculture and Livestock agro-industries in the state, a fact that can hinder their performance.
Key Word: *agricultural products; input-output; production chain.*

I. Introduction

The agribusiness chain represents the sum of all operations in the field, in addition to the production and distribution of all agricultural supplies plus operations carried out in connection with the handling, storage, processing and distribution of agricultural products. Brazil has approximately a quarter of the world's arable land, and the high technology used in the field makes Brazilian agribusiness a modern, efficient and competitive sector on the international stage (SESSO FILHO et al., 2019). There are several factors that contribute to the country increasing its agricultural production in the long term, one can highlight the existence of unexplored or inefficiently exploited areas that, with investment in technology and means of transport to crops, could be unified with the Agricultural production.

Davis and Goldberg (1957) proposed a new concept of agribusiness to understand the production chain from farmers to consumers. The conclusion is that the agribusiness chain represents the sum of all operations in the field, in addition to the production and distribution of all agricultural supplies plus operations carried out in connection with the handling, storage, processing and distribution of agricultural products. Therefore, agribusiness refers to the sum of all operations involved in the production and distribution of food and fiber, made up of four sectors: Inputs, Agriculture, Agroindustry and Services. Still according to the authors, agribusiness is a complex of systems whose characteristic is the reduction of production control by the farmer, where the activities that are his responsibility are resumed at the time of production, depending on third parties to have access to inputs, machinery and equipment and for the commercialization and transformation of production.

Economic experts have predicted growth in the world economy that will benefit Brazilian agribusiness. Projections indicate that world GDP will grow at a rate of 3.5% per year until 2030, the world market will increase by 229.36%, generating excellent opportunities (IEO, 2020; MONTOYA et al., 2016).

Due to the availability of natural resources, technological innovation and investments in agriculture with productivity gains above the international average, Brazilian agribusiness has become a global reference in food supply.The interconnection of agribusiness sectors provides a relative participation in the national GDP, with technological innovation in rural production, the energization in the industrialization of agricultural products and an increase in the strength of services, will induce the generation income and, finally, the size of agribusiness (MONTOYA et al., 2016).

The objective of this study was to size agribusiness in the state of Mato Grosso in terms of Gross Domestic Product, jobs and taxes to measure the economic importance of agribusiness for the state and regional impacts. Specifically, the results allow us to analyze the contribution of aggregates (inputs, agriculture, industry and services) to the generation of income and employment, labor productivity and taxes in the state economy.

II. Material And Methods

The sizing of the Agribusiness Gross Domestic Product will be based on the methodology described in Sesso Filho et al. (2019). The input-output matrix was obtained from the Amazon Development Superintendency (SUDAM, 2015). The sizing of agribusiness estimates the generation of income, employment and taxes within the scope of agribusiness divided into four sectors: inputs, agricultural production, industry and services. The methodology uses the most recent input-output matrix from the state of Mato Grosso.

The methodology for calculating Agribusiness GDP is based on studies by Furtuoso and Guilhoto (2003) and Furtuoso (1998), which take into account the interdependence between activities related to rural production. The calculation is made based on the sum of four aggregates: inputs, agriculture, industry and distribution. The method considers not only agricultural production itself, but also related activities that contribute to feeding and being fed by rural production. To calculate the GDP of Aggregate I (Inputs for Agriculture and Livestock), information is used on the values of inputs acquired by Agriculture and Livestock available in the input-output tables. The input values are multiplied by the corresponding added value coefficients (AVC_i), where we have i = 68 sectors (AV_{PMi}) by Sector Production (X_i), that is,

$$AVC_i = \frac{VA_{PMi}}{X_i} \tag{1}$$

Value Added at market prices is obtained by adding the value added at basic prices to indirect taxes net of subsidies on products, resulting in the following expression: $VA_{PM} = VA_{PB} + NIT$, VA_{PM} = Value Added at Market Prices, VA_{PB} = Value Added to Basic Prices, NIT = Net Indirect Taxes. Therefore, the common problem of double counting in agribusiness GDP estimates was resolved, which occurs when input values are considered without considering the added value generated in production. Then we have:

$$GDP_{I_k} = \sum_{i=1}^{n} z_{ik} * AVC_i \tag{2}$$

k= 1, 2, 3 agriculture, livestock and forestry production sector
i= 1, 2, ..., n sectors remaining

GDP_{Ik} = GDP of aggregate I (inputs) for agriculture (k=1), livestock (k = 2) and forestry production (k = 3)
z_{ik} = total value of input from sector i for agriculture, livestock or forestry production
AVC_i = value added coefficient of sector i

For total Aggregate I we have:

$$GDP_I = GDP_{I_1} + GDP_{I_2} + GDP_{I_3} \tag{3}$$

GDP_I = GDP of aggregate I and the other variables are as previously defined.

When calculating Aggregate II, which refers to the Agriculture and Livestock Sector, the added values generated by each sector are considered, and the values that were used as inputs are subtracted from these values. This eliminates the problem of double counting that occurred in previous estimates of agribusiness GDP. Then:

$$GDP_{II_k} = AV_{PM_k} - \sum_{i=1}^{n} z_{ik} * AVC_i \tag{4}$$

GDP_{IIk} = GDP of aggregate II for agriculture k = 1, livestock k = 2 and forestry production k = 3 and the other variables are as previously defined. For total Aggregate II we have:

$$GDP_{II} = GDP_{II_1} + GDP_{II_2} + GDP_{II_3} \qquad (5)$$

GDP_{II} = GDP of aggregate II and the other variables are as previously defined.

To determine the composition of Aggregate III, which corresponds to Agricultural-Based Industries, several indicators were considered, such as the main sectors demanding agricultural products, the shares of agricultural inputs in the intermediate consumption of the agro-industrial sectors and the activities that transform raw materials agricultural products. Aggregates II and III represent the income or added value generated by these segments. To calculate Aggregate III, the added value of the agro-industrial sectors is added, and the added value used as an input in Aggregate II is subtracted. As already mentioned, this subtraction is necessary to avoid double counting that occurred in previous estimates of agribusiness GDP, that is:

$$GDP_{III_k} = \sum_{q \in k} \left(AV_{PM_q} - z_{qk} * AVC_q \right) \qquad (6)$$

GDP_{IIIk} = GDP of aggregate III for agriculture (k = 1), livestock (k = 2) and forestry production (k = 3) and the other variables are as previously defined. For the total Aggregate III we have:

$$GDP_{III} = GDP_{III_1} + GDP_{III_2} + GDP_{III_3} \qquad (7)$$

GDP_{III} = GDP of aggregate III and the other variables are as defined previously.

Agribusiness GDP Aggregate IV is calculated based on the added value of the transport, commerce and services sectors, with the participation of agricultural and agro-industrial products in the final demand for products being considered to determine the portion corresponding to Agribusiness. In summary, the value of the final distribution of industrial agribusiness is obtained using this system, represented by:

$$GFD - NIT_{FD} - PI_{FD} = DFD \qquad (8)$$

$$AVT_{MP} + AVTR_{MP} + AVS_{MP} = MM \qquad (9)$$

$$GDP_{IVk} = MM \times \frac{FD_k + \sum_{q \in k} FD_q}{DFD} \qquad (10)$$

GFD = global final demand
NIT_{FD} = net indirect taxes paid by final demand
PI_{FD} = products imported by final demand
DFD = domestic final demand
AVT_{MP} = added value of the transport sector at market prices
$AVTR_{MP}$ = added value of the trade sector at market prices
AVS_{MP} = added value of the services sector at market prices
MM = marketing margin
FD_k = final demand from agriculture (k=1) and livestock (k=2) and forestry production (k=3)
FD_q = final demand from agro-industrial sectors

GDP_{IVk} = GDP of aggregate IV for agriculture (k=1), livestock (k=2) and forestry production (k=3)
For the total Aggregate IV we have:

$$GDP_{IV} = GDP_{IV_1} + GDP_{IV_2} + GDP_{IV_3} \qquad (11)$$

GDP_{IV} = GDP of aggregate IV

The total GDP of Agribusiness is given by the sum of its aggregates, that is:

$$GDP_{Agr_k} = GDP_{I_k} + GDP_{II_k} + GDP_{III_k} + GDP_{IV_k} \qquad k = 1,2,3 \qquad (12)$$

GDP_{Agr_k}= Agribusiness GDP for agriculture (k=1), livestock (k=2) and forestry production (k=3)
For total Agribusiness we have:

$$GDP_{Agr} = GDP_{Agr_1} + GDP_{Agr_2} + GDP_{Agr_3} \qquad (13)$$

GDP_{Agr}= agribusiness GDP

For the present study, state data from Mato Grosso and the rest of Brazil on livestock production and productivity by area were used, which were obtained from the Amazon Development Superintendency (SUDAM). At this moment, the results presented below refer to the size of agribusiness in the state of Mato Grosso compared to the rest of Brazil.

III. Result

Table 1 contains the results of the agribusiness sizing in the state of Mato Grosso, Rest of Brazil and Brazil. It is noted that in the state of Mato Grosso, agribusiness is responsible for approximately 51 billion reais in 2015, generating around 890 thousand jobs and 5.2 billion in taxes. The amounts represent more than 50% of the state economy. In Brazil, the agribusiness GDP of 987 billion reais in 2015 represented around 19% of the national economy and generated 28 million jobs (28% of the total) and 71 million reais in taxes (20% of the total).

The results indicate the great importance of agribusiness in the state of Mato Grosso, mainly in the generation of taxes throughout the production chain, notably in agriculture (aggregate II) with 2.8 billion in taxes. In the generation of income and jobs, Commerce and services (aggregate IV) stands out with 23 billion reais of Gross Domestic Product and 402 thousand jobs, followed by aggregate II (Agriculture) with 19 billion reais of income and 307 thousand jobs in the field.

For the country, the highlight is Agroindustry (Aggregate III) in the generation of taxes (26 billion reais), jobs in Agriculture (Aggregate II) with 12.6 million jobs in the field and the generation of income from Services (Aggregate IV) with 478 billion reais in income. The comparative analysis between the results obtained from the agribusiness dimensioning for Mato Grosso and Brazil shows that agroindustry (Aggregate III) assumes relatively greater economic importance in Brazil than in Mato Grosso.

Comparing the results of the present study with previous research developed by Sesso Filho et al. (2019) who measured Mato Grosso's agribusiness for the year 2008, the authors found that Mato Grosso's agribusiness represented 60% of the state's GDP, 70% of jobs and 66% of taxes. The values were higher than those obtained for 2015, which shows that agribusiness in Mato Grosso reduced its participation in the state economy. This is in line with Sesso Filho et al. (2022) who concluded that economic development is accompanied by a decrease in the importance (participation) of agribusiness in the economy, as well as greater value addition through industrialization and services.

Table 1: Gross Domestic Product, jobs and taxes in the Agribusiness production chain in Mato Grosso, the rest of Brazil and Brazil in 2015. Monetary values in billions of nominal reais and jobs in thousands of jobs. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Region	Variable	Aggregates				Total Agribusiness	Total for the region	Participation (%)
		I	*II*	*III*	*IV*			
Mato Grosso	Gross Domestic Product	4.8	18.7	4.6	22.9	51.1	97.6	52%
	Jobs	81.5	307.0	99.3	401.8	889.6	1,708.8	52%
	Taxes	0.5	2.8	0.8	1.1	5.2	8.6	61%
Rest of Brazil	Gross Domestic Product	50.7	230.0	200.4	455.2	936.3	5,058.0	19%
	Jobs	1,184.1	12,316.7	5,575.9	8,194.1	27,270.7	100,236.3	27%
	Taxes	5.4	14.7	25.6	20.4	66.0	355.7	19%
Brazil	Gross Domestic Product	55.5	248.8	205.0	478.2	987.4	5,155.6	19%
	Jobs	1,265.6	12,623.6	5,675.2	8,595.9	28,160.3	101,945.1	28%
	Taxes	5.9	17.4	26.4	21.5	71.2	364.3	20%

Source: Original survey results

Table 2 presents the disaggregated results for the three production chains (Agriculture, Livestock and Forestry Production, Fishing and Aquaculture) of the sizing of agribusiness in the state of Mato Grosso, Rest of

Brazil and Brazil for the year 2015 considering the variable Gross Domestic Product , values are in millions of nominal reais. Based on the results in Table 2, Figure 1 was created, which illustrates the participation of households in the production chains of Mato Grosso and the rest of Brazil.

The state of Mato Grosso presented 35 billion reais in income generated by Agriculture, the main state production chain, while Livestock obtained 14 billion reais and Forestry production around 1.6 billion reais in the same year of 2015. It is noted the high participation (above 45%) of the income generation of Aggregates II (Agriculture) and IV (Services) for Agriculture and of Aggregate IV of Services (more than 50%) for Livestock, while Aggregates II (Forestry production) and III (Industry) are more important for the Forest Production production chain.
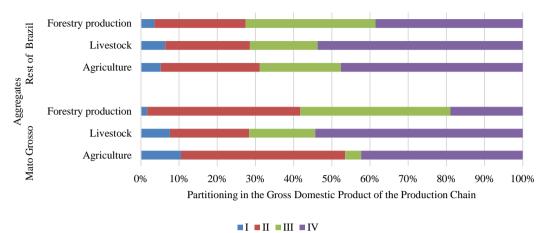
Income generation in Brazilian agribusiness showed a different structure from that in the state of Mato Grosso, which had in Aggregate IV the link of greatest relative importance in generating income for the three production chains under analysis. The added value of rural products by the industrial and service sectors is a characteristic of countries whose agribusiness follows trends developed by the increase in per capita income, which influences the growth in demand for products with greater processing, convenience and ease of consumption. Therefore, the results indicate that the productive structure of agribusiness in Mato Grosso is aimed at meeting the demand for basic agricultural commodities without adding value through industrialization and services.

Table 2: Agribusiness Gross Domestic Product and aggregates in the state of Mato Grosso and the rest of Brazil. Values in millions of reais in 2015. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Aggregates		Production chains			Aggregate totals
		Agriculture	Livestock	Forestry production; fishing and aquaculture	
Mato Grosso	I	3,686	1,081	27	4,794
	II	15,131	2,956	652	18,739
	III	1,479	2,468	639	4,586
	IV	14,893	7,743	309	22,945
	Chain totals	35,190	14,248	1,627	51,065
Rest of Brazil	I	28,988	18,408	3,287	50,683
	II	144,043	63,755	22,213	230.011
	III	117,620	51,140	31,640	200,400
	IV	264,723	154,658	35,840	455,220
	Chain totals	555,374	287,960	92,980	936,314
Brazil	I	32,675	19,489	3,313	55,477
	II	159,174	66,710	22,866	248,750
	III	119,099	53,608	32,279	204,986
	IV	279,616	162,401	36,149	478,165
	Chain totals	590,564	302,208	94,607	987,378

Source: Original survey results

Figure 1: Participation of households in the Gross Domestic Product of the Agribusiness Production Chains in Mato Grosso and the Rest of Brazil, 2015. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Source: Original survey results

The generation of agribusiness jobs detailed in aggregates and production chains is presented in Table 3 for the state of Mato Grosso, Rest of Brazil and Brazil. As already noted, jobs generated in agribusiness in Mato Grosso represent around 52% of all jobs in the state. The highlight is Aggregate IV of Agriculture (260 thousand jobs) and Aggregate II of Livestock (220 thousand jobs), which together represent more than 50% of the total jobs in state agribusiness. For Brazil, the highlights are Aggregate II (field) of Agriculture and Livestock, which together account for 11.7 million jobs, followed by Aggregate IV of Agriculture with 5 million jobs.

Figure 2 shows the labor productivity of aggregates in the agribusiness production chains in Mato Grosso and the rest of Brazil. The values for Aggregate I in Mato Grosso are higher than for the Rest of Brazil for all production chains, this indicates an advantage in the production of these agricultural inputs. Note the high productivity of work in Aggregate II (field) of Agriculture, generating income above R$ 180 thousand per worker per year, and in Forestry Production it was around R$ 100 thousand. The results indicate that production in the field of these production chains is high technology, based on monoculture and low intensity of labor use, leading to high values of labor productivity.
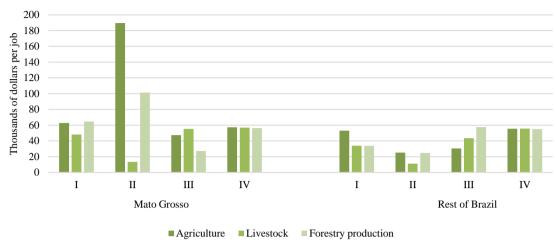
The results for Livestock in Aggregate II are close for the two regions, while for Aggregate III the values obtained were higher for Agriculture and Livestock in Mato Grosso and higher for Forestry production in the Rest of Brazil. Aggregate IV presented similar values for the two regions. Differences occur due to regional labor market conditions, technology, tax incentives and other economic factors that generate differences in labor productivity.

Table 3: Jobs generated in Agribusiness aggregates in the state of Mato Grosso and the rest of Brazil. Values in millions of reais in 2015. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Aggregates		Production chains			Aggregate totals
		Agriculture	Livestock	Forestry production; fishing and aquaculture	
Mato Grosso	I	58,620	22,466	412	81,498
	II	79,798	220,737	6,431	306,966
	III	31,251	44,658	23,413	99,322
	IV	260,165	136,162	5,490	401,817
	Chain totals	429,834	424,023	35,746	889,603
Rest of Brazil	I	545,519	541,320	97,224	1,184,062
	II	5,730,299	5,693,142	893,217	12,316,658
	III	3,850,173	1,175,337	550,402	5,575,912
	IV	4,767,262	2,776,496	650,317	8,194,075
	Chain totals	14,893,252	10,186,295	2,191,161	27,270,707
Brazil	I	604,138	563,786	97,636	1,265,560
	II	5,810,097	5,913,880	899,647	12,623,624
	III	3,881,424	1,219,994	573,815	5,675,234
	IV	5,027,427	2,912,658	655,808	8,595,892
	Chain totals	15,323,086	10,610,318	2,226,907	28,160,310

Source: Original survey results

Figure 2: Labor productivity (income per worker) of Agribusiness households in Mato Grosso and the rest of Brazil, 2015. Values in thousands of reais per job. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Source: Original survey results

Table 4 presents the results of tax generation in millions of nominal reais in 2015 from agribusiness aggregates, production chains and regions of Mato Grosso, Rest of Brazil and Brazil. In the state of Mato Grosso, around 40% of the 5.2 billion reais in taxes were obtained from Aggregate II (field) of Agriculture, which totaled 2.2 billion reais in 2015 values. The same occurred in Livestock, its Aggregate II paid around half a billion reais. A different situation from the Rest of Brazil, as the main Aggregate that pays taxes, considering absolute values, is industry (Aggregate III), which in this region paid 25 billion reais in taxes.

Table 4: Taxes in sectors of the production chain generated in Agribusiness aggregates in the state of Mato Grosso and the rest of Brazil. Values in millions of reais in 2015. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

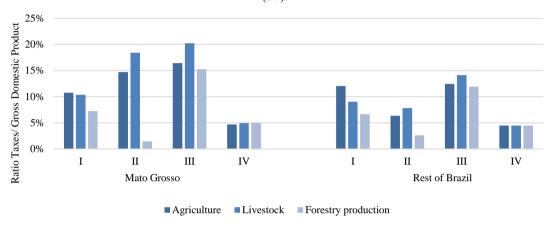| Aggregates		Production chains			Aggregate totals
		Agriculture	Livestock	Forestry production; fishing and aquaculture	
Mato Grosso	I	396	112	two	510
	II	2,222	544	9	2,776
	III	243	499	97	839
	IV	695	380	15	1,091
	Chain totals	3,556	1,535	124	5,215
Rest of Brazil	I	3,485	1,664	218	5,367
	II	9,118	4,972	579	14,670
	III	14,624	7,221	3,765	25,610
	IV	11,850	6,930	1,605	20,385
	Chain totals	39,077	20,788	6,167	66,031
Brazil	I	3,881	1,776	220	5,877
	II	11,340	5,516	589	17,445
	III	14,866	7,720	3,862	26,449
	IV	12,545	7,311	1,620	21,476
	Chain totals	42,632	22,322	6,291	71,246

Source: Original survey results

The analysis of the absolute values of taxes paid in agribusiness aggregates indicates the main taxpayers, however, it is important to evaluate the percentage of income that the amounts represent, which is a proxy (substitute variable) of the tax burden for each link in the production chain. Figure 3 shows the relationship between tax values and income (Gross Domestic Product) of production chains and their aggregates in the regions of Mato Grosso and the rest of Brazil. It is noted that Aggregate I of Mato Grosso presents percentage values close to those obtained for the Rest of Brazil. On the other hand, State Aggregate II of

Agriculture and Livestock shows higher values than the rest of the economy, being close to 15% for Agriculture and 18% for Livestock while for the Rest of Brazil it does not exceed 10%. For Forest Production Aggregate II, the values for the two regions are close and do not exceed 5%. Similarly, all agro-industrial sectors in Mato Grosso (Aggregate III) suffer higher income taxes than in the Rest of Brazil, values between 15% and 20%, and for the Rest of Brazil it does not exceed 15%. The values obtained for Aggregate IV (Services) are similar for both regions.

Despite the need for tax incidence on agribusiness, it is important to note that high percentage values of income taxation inhibit economic activity. It can be stated that Aggregates II and III of Mato Grosso suffer higher taxation than in the Rest of Brazil considering the analyzed indicator.

Figure 3: Relationship between taxes and Gross Domestic Product of Agribusiness aggregates in Mato Grosso and the rest of Brazil, 2015. In percentage values. Inputs (I), Agriculture (II), Agroindustry (III) and Services (IV).

Source: Original survey results

Despite the need for tax incidence on agribusiness, it is important to note that high percentage values of income taxation inhibit economic activity. It can be stated that Aggregates II and III of Agribusiness in Mato Grosso suffer higher taxation than in the Rest of Brazil considering the analyzed indicator.

IV. Conclusion

The research results showed that the state of Mato Grosso depends on agribusiness, mainly agriculture, to move its economy, as more than 50% of income, taxes and jobs depend on activities related to this production chain that encompasses agriculture, livestock and production forestry. For Brazil, participation in the economy (income, jobs and taxes) varies between 19% (income) and 28% (jobs).

This information shows the importance of the state for the development and installation of new companies and labor in this segment, in addition to the enormous potential for opportunities aimed at regional and national development. It is worth noting that even though the country's percentage is lower when compared to the state, the information shows the great importance of the segment at the national level, demonstrating an excellent opportunity for new frontiers.

The values of labor productivity in the field of Agriculture and Forestry Production in Mato Grosso are higher than for the rest of the national economy, which indicates high technology and productive efficiency. For Livestock, there is the potential to increase labor productivity through the use of inputs and new technologies to reach a level closer to the other two regional production chains.

Furthermore, when analyzing the need and potential of Livestock in increasing productivity together with Agriculture and Forestry Production that already have high levels through the improvement of practices, it is worth highlighting the great opportunity there is for integration practices between these three production chains.

The comparative analysis of agribusiness in Mato Grosso and the Rest of Brazil showed that the state economy presents an agroindustry with great potential for growth in absolute and relative values to increase its participation in generating income and jobs, in addition to the increase in new technologies in the region. However, the share of taxes in income is greater for the Agriculture and Livestock agro-industries in the state, a fact that can hinder their performance. The industrialization of rural products can add value and promoting regional development.

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