THE NEW RAILWAY ROAD: A PERSPECTIVE FOR THE DEVELOPMENT OF WESTERN PARANÁ-BRAZIL

O NOVO TRAÇADO DA FERROESTE: UMA PERSPECTIVA PARA O DESENVOLVIMENTO DO OESTE DO PARANÁ-BRASIL

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Abstract

The objective of this work was to analyze the economic impacts of the New Route of the Ferroeste and its associations between the municipalities of the West of the state of Paraná, through the analysis of spatial data of agricultural production and economic indicators from the years 2018 to 2020. The method used was Moran's global and local spatial autocorrelation index technique, Kernel density estimator with a distance of 150 km. For cluster analysis, the hierarchical full linkage method was used. There were similar regions of agricultural production. Significant spatial autocorrelation was observed for milk production, swine production, cattle production, corn and soybean productions. For the distance of 150 km, the result showed that its influence could benefit the municipalities of the West, favoring the generation of employment and income. By the cluster analysis, it was found that the central group presents the Cascavel-Paraná transshipment municipality that is in operation and the municipalities with similar characteristics to the same and mostly grouped municipalities with high potential of gross value of agricultural production and agricultural production.

Keywords: Spatial Association. Cluster. Kernel Density Estimator. Economic Indicators. Modes of transport.

Resumo

O objetivo deste trabalho foi analisar os impactos econômicos do Novo Traçado da Ferroeste e as suas associações entre os municípios do Oeste do Paraná, por meio da econometria espacial da

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produção agropecuária e indicadores econômicos dos anos de 2018 a 2020. O método utilizado foi à técnica de índice de autocorrelação espacial global e local de Moran, estimador de densidade de *Kernel* com distância de 150 km. Para análise de agrupamento foi utilizado o método hierárquico da ligação completa. Houve regiões similares da produção agropecuária. Observou-se autocorrelação espacial significativa para a produção de leite, produção de suínos, produção de bovinos, produções de milho e soja. Pela distância de 150 km o resultado mostrou que essa influencia poderá beneficiar os municípios do Oeste, favorecendo a geração de emprego e renda. Pela análise de agrupamento, verificou-se que o grupo central apresenta o município transbordo Cascavel-Paraná que se encontra em operação e os municípios com características parecidas ao mesmo e em sua maioria agrupou municípios com alto potencial de valor bruto da produção agropecuária e produção agropecuária.

Palavras-chave: Associação espacial, Agrupamento. Estimador de densidade de *Kernel*. Indicadores econômicos. Modais de transporte.

Introduction

The high logistical costs of transport for the distribution of agricultural crops through the road modal compromise the matrix of the transport system and the rail routes would be more efficient from sections between 500 to 1000 km because they pollute less per ton transported and have lower costs (CNT, 2015). Recent studies, as seen in Vieira and Oliveira (2020), show that Brazilian railroads were created in the early 20th century as a means of transporting agricultural crops, among other goods, thus initiating a transformation in the urban and economic scenario, which in some ways favored the evolution of the transport system in Brazil. Paraná stands out on the national scene as a major agricultural producer and constitutes an expressive articulator of wide agribusiness potential that intensively moves several economic sectors (GILIO and JANK, 2021).

The Nova Ferroeste is an expansion of the railway section linking the municipality of Maracaju in Mato Grosso do Sul to the Port of Paranaguá. There is also a forecast for the construction of a branch line between Cascavel-Paraná and Foz do Iguaçu, which will allow the capture of cargo from Paraguay and Argentina (PARANÁ, 2022a). In recent years, the modernization of agriculture in Paraná has become evident with investments in technology and port maintenance, but the link between these two scenarios that involve the distribution and transport of cargo lacks better structure, analysis and understanding (PARANÁ, 2017) .

Lima (2022) reports that the contiguity of territorial areas stimulates their relationships, which postpones the distance and its frictions that generate obstacles or result in exchanges. In this analysis look, the same author informs that in the analysis of geography the scale (cartography) is associated with agreement and representation. The scalar unit will show how much the territory occupies in the geographic space.

In economic development, considering its historical evolution, the dynamism of territorial areas happens in a divergent way, in a centralized (polarized) and heterogeneous way and can be influenced by endogenous factors (LIMA, 2022).

Petranski and Ternoski (2021) report that growth and economic development follow almost similar trajectories, and development is more complex because it is related to income distribution, among other factors. They also report that for development to take place, the presence of public policies is necessary. The same authors report that a public policy is related to a social demand and that it needs to be politically viable and needs to meet the purposes for which it was intended.

The works and infrastructure systems according to the literature are necessary and fundamental for the economic development of a region, their reflexes have direct impacts on different segments of the productive area, favoring the competitiveness of the domestic and foreign markets (CHILIATTO LEITE, 2019).

In this sense, the need to review and even expand the new rail route culminated in the elaboration of a project that covers the route starting in the municipality of Maracajú, in the state of Mato Grosso do Sul, and extending to the cities of Cascavel and Foz do Iguaçu. , located in Paraná. With the projection of a new rail route, a representative economic contribution is expected to favor local and regional economies as well as incentives for new investments in the agribusiness segment (PARANÁ, 2022b).

Silva et al. (2020) report that the economic development of a given location may occur from structural changes and socioeconomic indicators improvements. Therefore, the challenge of regional and economic development is related to different factors related to the productive dynamics of each region. The analysis of spatial econometrics, when used interactively with economic indicators, promotes a broad understanding of the spatial behavior of different investigation profiles that are associated with a given location (CIMA et al., 2021). For Dunmore et al. (2018) cluster analysis is used in data analysis, whose purpose is to identify scenarios (municipalities) that share similar characteristics among themselves within the same group, but that are different in relation to other groups and that present trends of possible behavior patterns (CIMA et al., 2018; CIMA et al., 2020).

This work aims to verify the spatial behavior of the Nova Ferroeste and its influence on the development of agricultural production in the municipalities of the western Paraná-Brazil region through spatial econometric analysis and seeks to verify the importance of the transshipment municipalities (Cascavel-Paraná and Foz do Iguaçu), in relation to agricultural production and economic indicators considering a count of all municipalities through a region of influence, weighting them by distance (Kernel estimator) and agglomerative hierarchical cluster analysis.

Metodology

The objective of this work is to demonstrate the extension of the enlargement of the Nova Ferroeste (Figure 1) and its possible impacts, in relation to the formation of clusters in a certain geographic location, of the production of swine (QTSUI) [Quantity/head], bovine (QTBOV) [Quantity/head], poultry (QTAVES) [Quantity/head], milk (PROLE), [Thousand/l] corn (Corn) [t], soybean (Soybean) [t], gross value of agricultural production (GVP) [R$], additional tax per capita value (VAPC) [R$] and gross domestic product (GDP) [R$].

Figure 1: Characterization of the New Planned Railroad Track that links the West in relation to the Port of Paranaguá, Paraná-Brazil
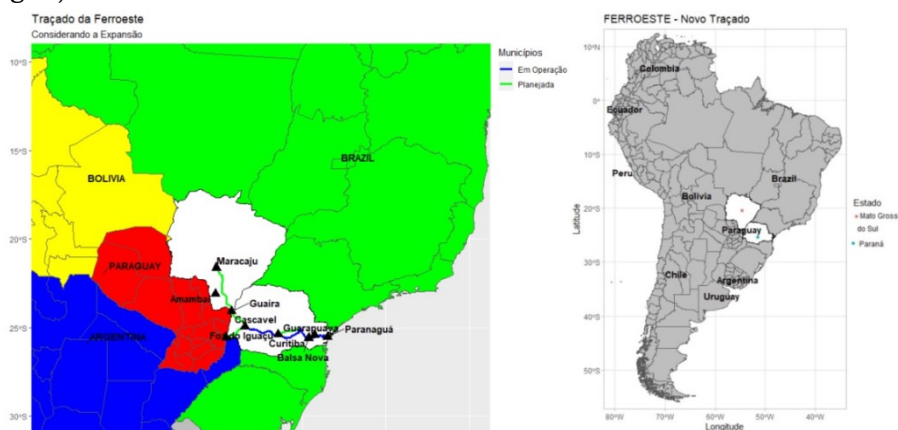
Source: Adapted from PARANÁ (2022b)

Data were collected on official websites, as seen in Seab (2020) and Ipardes (2022), from January to June 2022, referring to the years 2018 to 2020. The econometric analysis technique was used, being: Analysis of the Global Moran Spatial Autocorrelation (I) and univariate Local Spatial Autocorrelation (LISA) (MORAN, 1950). For the analysis of the density between the municipalities considering the transshipment municipalities (Cascavel and Foz do Iguaçu), the influence of the municipalities that are large producers of agricultural production in relation to the other municipalities was verified, considering the distance of 150 km (WAHBA, 1975; WAND, 1995; Worton, 1995).

The analysis was performed and implemented in Software R 4.5 through the adhabitatHR package. Clustering maps (Lisa-Map) of the municipalities of the West were elaborated, by variable and regional maps were constructed showing the municipalities and mesoregions by variables analyzed with a radius of 150 km, considering the large producer municipalities. To obtain the map, the influence of the presence of municipalities of interest in a given geographic area was calculated. The unsupervised Machine Learning Technique of cluster analysis was applied, whose method used was of the agglomerative hierarchical type. The use of this method allows all municipalities to start

separately and to be grouped according to their similarity between the groups until a single grouping is obtained. The result obtained was a dendrogram showing the Euclidean distances between the groups formed according to the complete linkage criterion. The fifty municipalities in the West were grouped in relation to their economic and agricultural variables, according to the methodology presented in Bilbas et al. (2017). Clustering in the Tree clustering style was adopted, using the complete linkage method, as it has the advantage of lower sensitivity to outliers during the clustering process.

Results and Discussions

By analyzing Table 1, it is possible to notice the presence of significant positive global spatial autocorrelation for the analyzed production of milk, swine, corn, soybean and cattle for the years 2019 and 2020 in the analyzed period.

Table 1: The Global Moran Index (*I*) and livestock production significance test (poultry, milk, swine, corn, soy and cattle)

| Variables	2018	2019	2020
Poultry production	0,089NS	0,103*	0,117*
Milk production	0,224*	0.218*	0,154*
Swine production	0,374*	0,385*	0,402*
Corn production	0,364*	0,327*	0,208*
Soy production	-0,063NS	0,128*	0,137*
Cattle production	0,271*	0,278*	0,272*

Source: Elaborated by the Authors (2022)
Notes: Ns: Non-significant values; *: statistically significant at the 5% probability level

In the 2017/2018 crop year, there was a decrease in soybean harvest due to less favorable weather conditions, resulting in the commitment and decline of this crop in the analyzed period (SEAB, 2018).

In the analysis of Figure 2, for the years 2019 and 2020, the predominant presence of only one category of clusters of type A-A (high-high) followed by category B-B (low-low) and A-B (high-low) can be seen. By groupings A-A, the municipalities with indicators of high spatial aggregation of poultry production are presented, surrounded by municipalities also with high poultry production. This cluster profile is located in the municipalities of Cafelândia, Nova Aurora, Maripá and Assis Chateaubriand (brown color). There is also a high-low profile in Guaraniaçu that is categorized in pink. These regions are considered major poultry producers, since agro-industries and cooperatives that operate in the poultry sector are in this location (OCEPAR, 2022). From another perspective of analysis, the municipalities close to the Guaraniaçu region are more conducive to cattle production (SEAB, 2022a), this profile is similar to that presented by the spatial dispersion seen in Figure 2.

**Figure 2:** LISA Cluster Maps: Poultry Production from 2019 to 2020
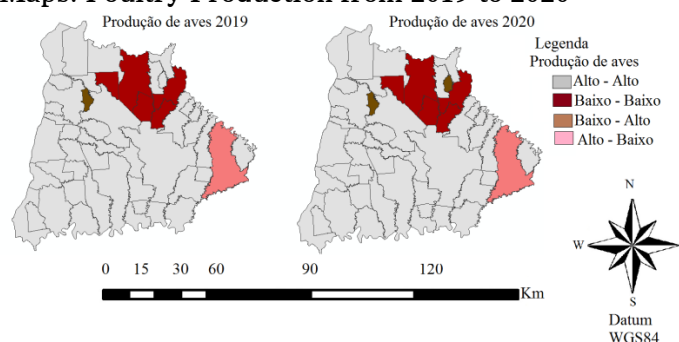
Source: Elaborated by the Authors (2022)

Also in Figure 2, it is relevant to inform that the production of poultry is directly related to the production of a product that adds value, such as animal protein. In this sense, the participation of cooperatives in the gross value of agricultural production has a great impact on the development of the regions where they are located, as seen in Neves et al. (2019). The spatial analysis of Figure 3 clearly shows the formation of a cluster in the municipalities belonging to the micro-region of Toledo

(brown color), whose location is characterized by high swine production, being considered the largest producer in Paraná (PARANÁ, 2021).

**Figure 3:** LISA Cluster Maps: Swinw Production from 2018 to 2020
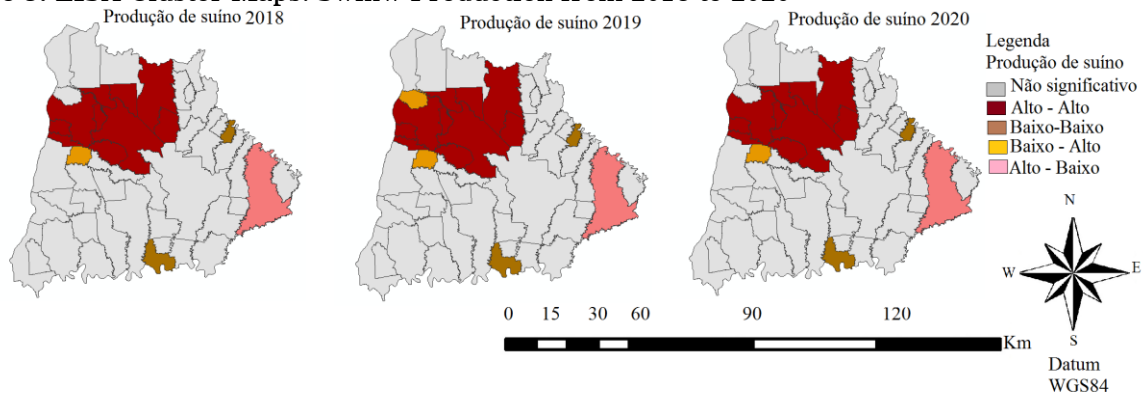
Source: Elaborated by the Authors (2022)

An A-B (high-low) cluster of swine herd was identified in Guaraniaçu, and another B-B (low-low) cluster in Capitão Leônidas Marques, showing that in these locations these municipalities are surrounded by neighbors with similar characteristics.

It is observed in Figure 4, that in the analyzed time space there was a similar profile with high cattle production identified in the brown category. The result points to places with high cattle production guided by municipalities with similar patterns, such as the municipalities of Diamante do Sul, Catanduvas, Diamante do Oeste, Três Barras and São Miguel do Iguaçu.

**Figure 4:** LISA Cluster Maps: Cattle Production from 2018 to 2020
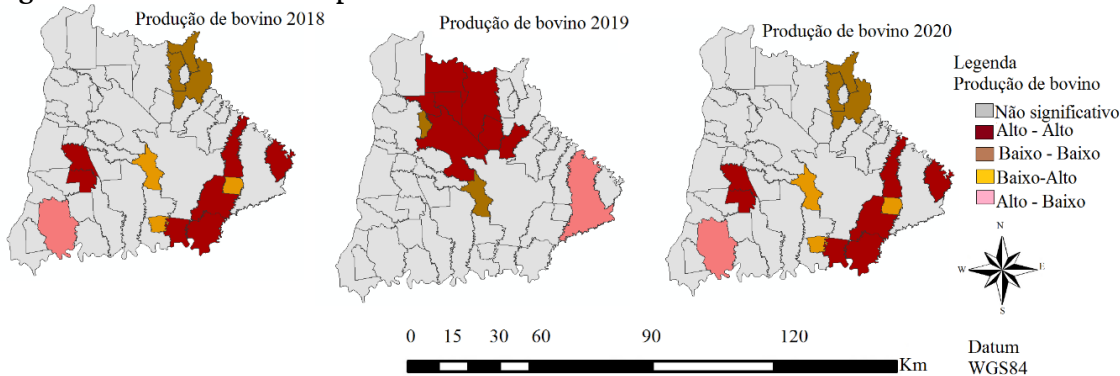
Source: Elaborated by the Authors (2022)

Figure 4 makes evident the significant emphasis on bovine production that are represented on the map by the brown category. These regions have a favorable terrain demographic for the culture of this type of herd (SEAB, 2019a).

Figure 5 shows significant clusters through spatial association, represented by the brown category: As the municipalities with high milk production: Serranópolis do Iguaçu, Toledo, Quatro Pontes, Nova Santa Rosa, Santa Tereza do Oeste and Maripá, these municipalities corroborate the large producing municipalities that make up Paraná (SEAB, 2019b).

**Figure 5**: LISA Cluster Maps: Milk Production from 2018 to 2020
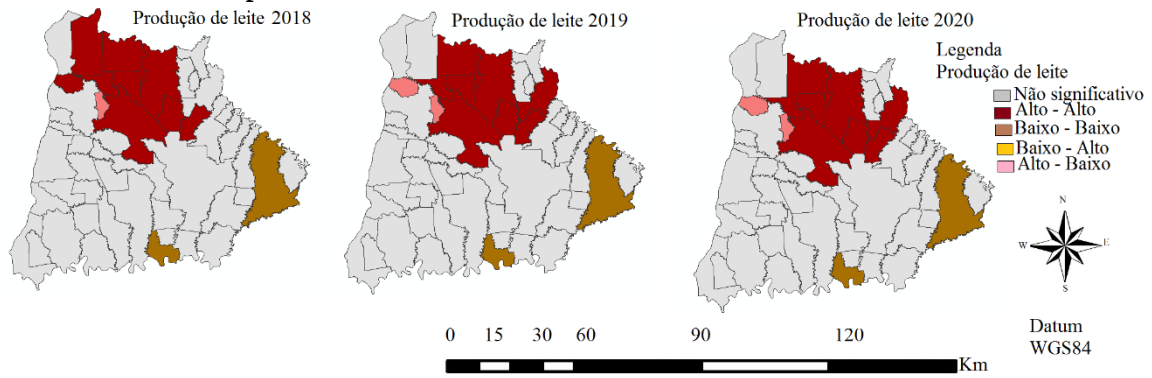
Source: Elaborated by the Authors (2022)

The results found for milk production are similar to those found in research that report that the West mesoregion has milk productivity highlighted in Paraná (ALVES et al., 2020).

From Figure 6, the results show a high presence of spatial clusters of type A-A, for corn production in the municipalities that are part of the micro-region of Toledo (brown color), it is notorious to inform that in these locations there are agro-industries and processing cooperatives, which drives the incentive for corn production (OCEPAR, 2022).

Figure 6: LISA Cluster Maps: Corn Production from 2018 to 2020
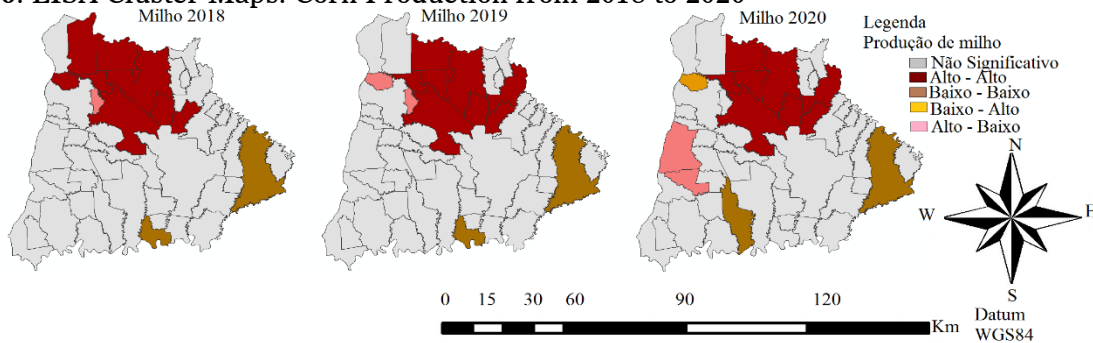
Source: Elaborated by the Authors (2022)

Furthermore, in the analyzed time frame, it is opportune to identify the presence of B-B clusters (light brown) in Guaraniaçu, informing that in these regions there is low corn production. In Figure 7, through the local analysis (LISA Cluster) it is observed in the analyzed years the significant presence of soybean cultivation on a larger scale of A-A (high-high) clusters, which are visible for the municipalities of Cascavel in the year 2019, Nova Aurora and its closest neighbors, the presence of A-B clusters is also observed in Santa Helena and its close neighbors.

Figure 7: LISA Cluster maps: Soybean cultivation in the years 2019 and 2020
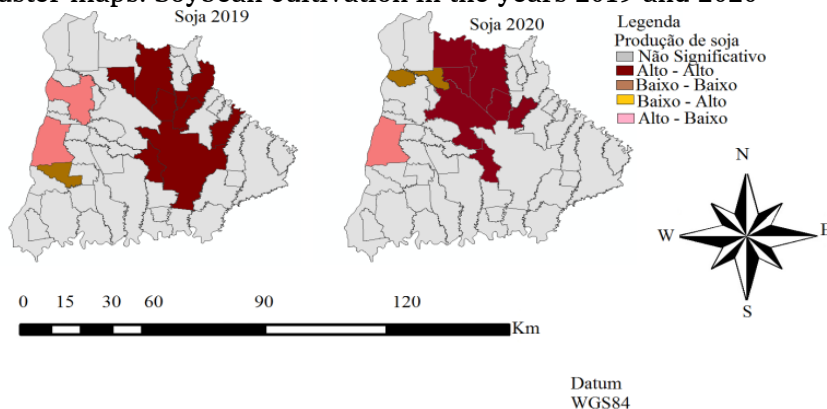
Source: Elaborated by the Authors (2022)

The results found agree with the findings in recent works, thus evidencing the vocation and motivation of the West region in soybean cultivation, which is influenced by the existence of processing agro-industries in this region (GABRIEL, et al., 2022). Taking into account the extension of the Nova Ferroeste that comprises the delineation of the municipalities of Cascavel Curitiba, Foz do Iguaçu, Guaíra and considering the coverage distance of 150 km that comprises the 133 municipalities in relation to the municipalities of interest (Cascavel and Foz do Iguaçu) , it can be seen in Figure 8 in the distance considered that these municipalities are dispersed in relation to municipalities that have high swine production, as shown in Figure 8 (represented in green, black, lilac, pink, brown, light brown, orange and red colors) .

Figure 8: Location map in relation to the distance of 150 km from the swine producing municipalities considering the municipalities (Cascavel and Foz do Iguaçu)
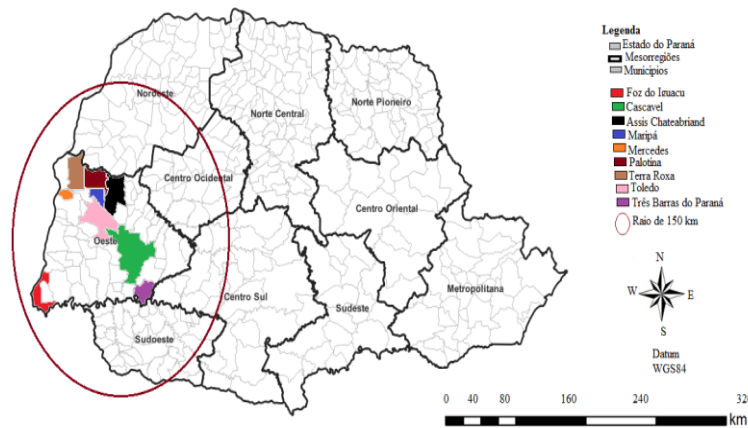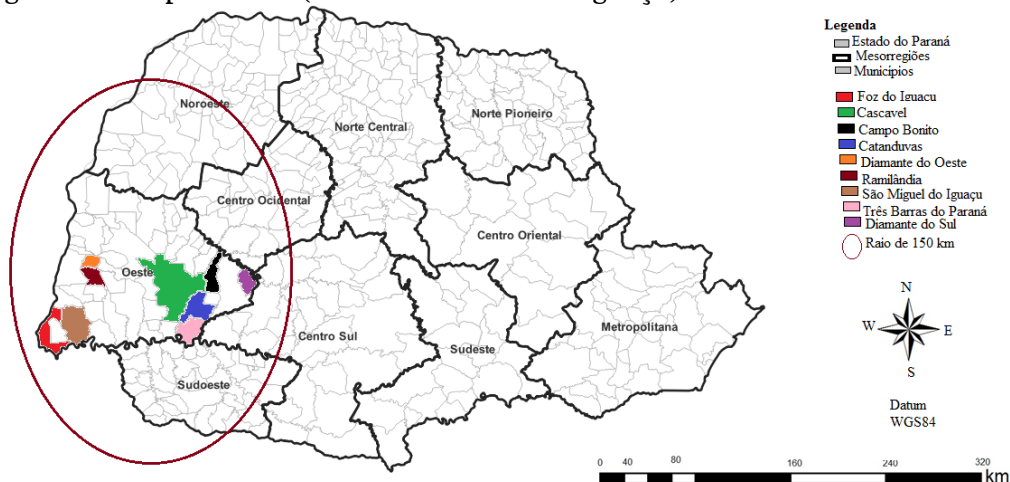

Source: Elaborated by the Authors (2022)

Furthermore, it is observed that the trajectory is far from the prominent municipalities in the production of swine because this radius goes beyond the West contour, encompassing part of the Northwest, Center West, Center South and Southwest regions, according to Figure 8.

In this sense, the high swine production that is contemplated in some of the municipalities that belong to the West, is far from the delimitation of 150 km. It is pertinent to inform that the Kernel influence estimator technique presents itself in a viable and interesting way because it identifies the profile of the municipalities in relation to swine production. Observing Figure 9 and considering the Ferroeste route in operation and the planned Nova Ferroeste route (Figure 1) it is visible through the map that the largest cattle producers are far from the distance of 150 km from the municipalities of Cascavel and Foz do Iguaçu, so it is suggested the non-influence of this production in relation to the distant municipalities of Cascavel and Foz do Iguaçu.

Figure 9: Location map in relation to the distance of 150 km from the cattle producing municipalities considering the municipalities of (Cascavel and Foz do Iguaçu)

In the analysis of Figure 10, the large milk producing municipalities that are part of the West are visualized, in relation to the distance of 150 km, covering municipalities that belong to other mesoregions (PARANÁ, 2021).

Figure 10: Location map in relation to the distance of 150 km from the milk producing municipalities considering the municipalities of interest (Cascavel and Foz do Iguaçu)

It is evident in Figure 10 that the large milk producing municipalities identified in the West are far from the 150 km range, suggesting that there is no influence on the distance considered.

From Figure 11 it is verified that the municipalities with high poultry production are close to the municipality of Cascavel (light blue color) which belongs to the West region. The result shows that within a radius of 150 km, poultry production is not very evident, suggesting that municipalities with productive potential are far from municipalities that are at 150 km.

Figure 11: Location map in relation to the distance of 150 km from the poultry producing municipalities considering the municipalities of interest (Cascavel and Foz do Iguaçu)
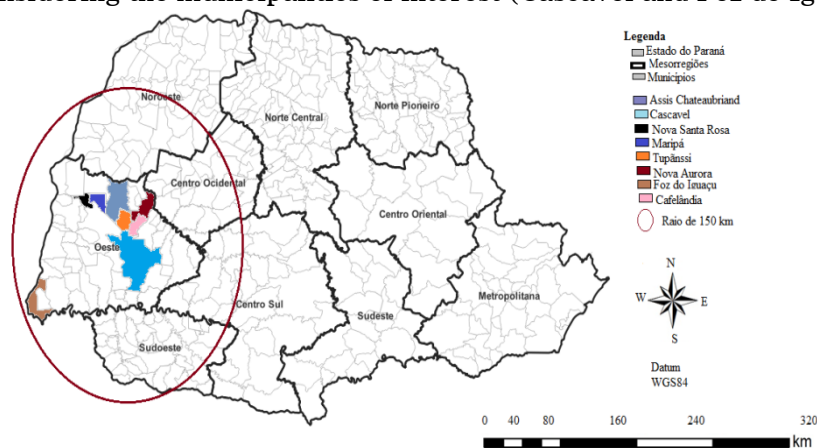
From Figure 12, the map shows the municipalities that are highly soybean producers, it is observed that the municipalities of Assis Chateaubriand (green), Tupãssi (orange) and Maripá (light green) are far from the municipalities that are 150 km from the municipalities of Foz do Iguaçu and Cascavel.

Figure 12: Location map in relation to the distance of 150 km from the soybean producing municipalities considering the municipalities of interest (Cascavel and Foz do Iguaçu)
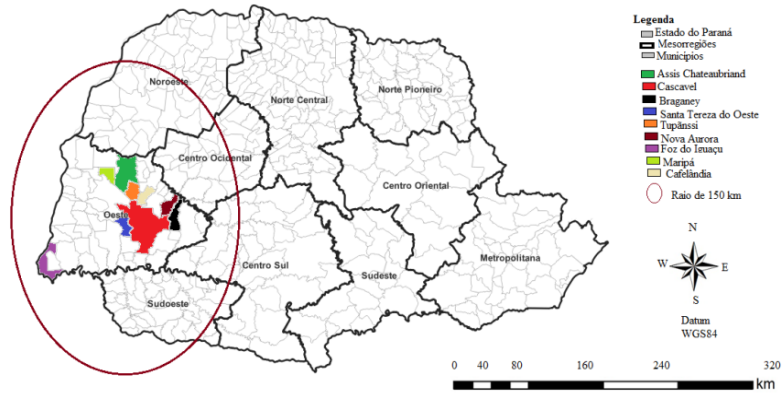
Source: Elaborated by the Authors (2022)

For corn production, the result showed that the largest productions located in the West are far from the 150 km coverage radius, in relation to Foz do Iguaçu and Cascavel, as seen in Figure 13, which may not directly influence production at this established distance.

Figure 13: Location maps in relation to the distance of 150 km from the corn producing municipalities considering the municipalities of interest (Cascavel and Foz do Iguaçu)

Source: Elaborated by the Authors (2022)

Through the dendrogram presented in Figure 14, it is observed the formation of three groups of municipalities, within the group the municipalities have a greater similarity among themselves and between the groups a greater dissimilarity. The central group contains the municipality of Cascavel, already in transshipment operation, and municipalities with similar characteristics.

Figure 14: Representation of the cluster analysis of municipalities between the years 2018 to 2020
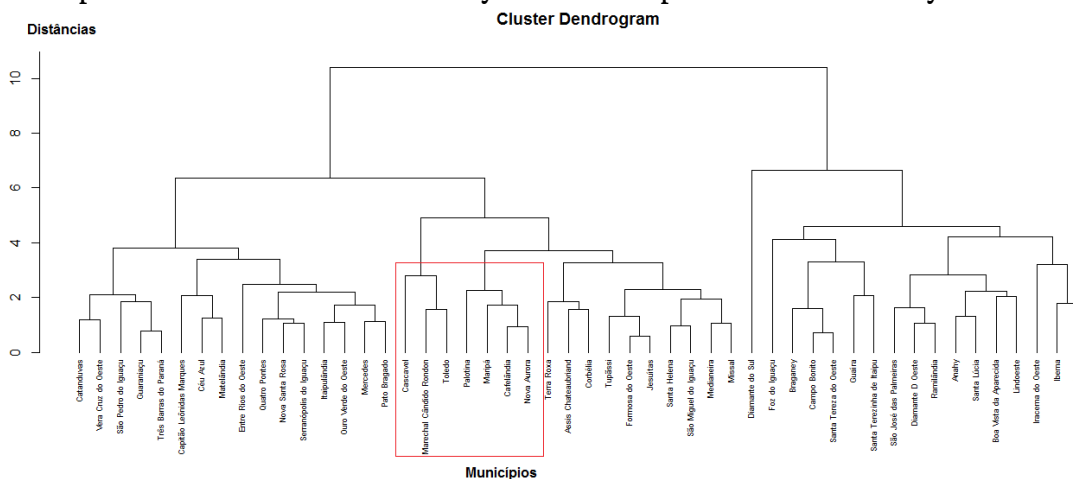
Source: Elaborated by the Authors (2022)

It is possible to observe (Figure 14) that in the grouping of similar municipalities that contains the transshipment municipality Cascavel, with high potential for agricultural production and gross value of agricultural production (highlighted in red), the group on the right contains the municipality of Foz do Iguaçu , previously elected as a candidate to become a transshipment post, similar results with hierarchical cluster analysis on agricultural production were found in recent studies by Araújo et al. (2013).

Table 2 shows that the likeness within each group was similar, with the similarity of the variables in group 3 being higher (94.34%).

Table 2: Description of groups by similarity of municipalities

Number of Groups	Groups	Distance Difference	Similarity Level	Number of Municipalities Grouped
1	QTAVES18 VBP18 Corn18 Soy19	0,148	85,11%	16
2	PIB18 VAPC18	0,151	84,92%	17
3	QTSUI18 PROLE18	0,046	94,34%	17

Source: Elaborated by the Authors (2022)

According to the results found in Table 2, the participation of agricultural production and economic variables in the municipalities are suggested, these production chains associated with economic indicators promote the growth and development of the studied region (SEAB, 2022a).

Conclusion

Based on the proposal for a new route for Nova Ferroeste, within a radius of 150 km, the result suggests that the new route may provide the fifty municipalities in the studied region with a greater opportunity for development, favoring the generation of new foreign exchange, employment and income.

There was significant global spatial autocorrelation for milk production, swine production, corn production and cattle production.

By the cluster analysis, it was identified that the central group contains the municipality of Cascavel already in transshipment operation and the municipalities with similar characteristics to this group and that mostly grouped municipalities with high potential for agricultural production, gross value of agricultural production , additional tax per capita value and gross domestic product.

Acknowledgements

References

ALVES, L. R.; OSTAPECHEN, L. A. P.; PORCÉ, M.; PARRÉ, J. L. Atividade leiteira no Paraná: uma análise espacial e econométrica. **Redes**, v. 25, n.2, p. 2432-2453, 2020. DOI: https://doi.org/10.17058/redes.v25i0.14974.

ARAÚJO, E.C.de.; URIBE-OPAZO, M.A.; JOHANN, J.A. Análise de agrupamento da variabilidade espacial da produtividade da soja e variáveis agrometeorológicas na região Oeste do Paraná. **Revista**

Engenharia Agrícola, v.33, n.4, p. 782-795, 2013. DOI: https://doi.org/10.1590/S0100-69162013000400018.

BILBAS H. T. A.; MAHMOOD S. H.; OMER C. A. A Comparison results of factor analysis and cluster analysis to the migration of young people from the Kurdistan Region to Europe. **Journal of Pure and Applied Sciences**, v. 29, n.4, p. 44-55, 2017. DOI: http://dx.doi.org/10.21271/ZJPAS.29.4.5.

CHILIATTO LEITE, M.V. (Organizador). **Alternativas para o desenvolvimento brasileiro**. Novos horizontes para a mudança estrutural com igualdade. Naciones Unidas-CEPAL. Santiago, Comissão Econômica para a América Latina e o Caribe (CEPAL), 2019. 255p.

CIMA, E.G.; URIBE-OPAZO, M. A.; JOHANN, J.A.; ROCHA- JUNIOR J, W.F.; DALPOSSO, G.H. Analysis of spatial autocorrelation of grain production and agricultural storage in Paraná. **Revista Engenharia Agrícola**, v. 38, n.3, p. 395-402, 2018. Jaboticabal, São Paulo. DOI: http://dx.doi.org/10.1590/1809-4430-Eng.Agric.v38n3.

CIMA, E.G.; URIBE-OPAZO, M. A.; JOHANN, J.A.; ROCHA- JUNIOR J, W.F.; GUEDES, L.P.C. Grain storage system in the state of Paraná, Brazil, from the perspective of multivariate analysis. **Revista Engenharia Agrícola**, v. 40, n.3, p. 280-288, 2020. Jaboticabal, São Paulo. DOI: http://dx.doi.org/10.1590/1809-4430-Eng.Agric.v40n3p280-288/2020.

CIMA, E. G.; Da ROCHA-JUNIOR, W. F.; URIBE-OPAZO, M. A.; FRAGOSO, R. M.S. A spatial analysis of Western Paraná: Scenarios for Regional Development. **Revista Brasileira de Gestão e Desenvolvimento Regional G&DR**, v. 17, n.2, p. 151-164, 2021.

CONFEDERAÇÃO NACIONAL DO TRANSPORTE. CNT. Transporte e Desenvolvimento: Entraves Logísticos ao Escoamento da Soja e do Milho. **Estudo Técnico**, Brasília, 2015.

DUNMORE, C.J.; WOLLNY, G.; SKINNER, M.M. *MIA*-Clustering: a novel method for segmentation of paleontological material. **Peer Journal**, v. 6, n.1, p.1-18, 2018. DOI: https://doi.org/10.7717/peerj.4374.

GABRIEL, C. C. E.; URIBE-OPAZO, M. A.; DALPOSSO, G. H.; CIMA, E. G. Spatial analysis of soybean yield in the western mesoregion of Paraná using agrometeorological variables. **Research, Society and Development**, v. 11, n.3, p. 1-18, 2022. DOI: https://doi.org/10.33448/rsd-v11i3.25962.

GILIO, L.; JANK, M.S. **O Brasil no Agro Global: reflexões sobre a inserção do agronegócio brasileiro nas principais macrorregiões do planeta**. São Paulo: Editora Insper, 2021.

LIMA, F.J de. **Economia territorial**: teoria e indicadores – Campina Grande – EDUEPB, 2022. 158p.

MORAN, P. A. P. Notes on Continuous Stochastic Phenomena. **Biometrika,** v.3, n.1/2, p. 17-23, 1950.

NEVES, M.C.R.C.; CASTRO, L.S. de.; FREITAS, C. O. de. O impacto das cooperativas na produção agropecuária brasileira: uma análise econométrica espacial. **Revista de Economia e Sociologia Rural**, v. 57, n.4, p. 559-576, 2019. DOI: https://doi.org/10.1590/1806-9479.2019.187145.

ORGANIZAÇÃO DAS COOPERATIVAS DO PARANÁ. OCEPAR. **C.VALE: Premiada em duas categorias no Quem é Quem Maiores e Melhores Cooperativas**, 2022. Available at: https://paranacooperativo.coop.br/ppc/index.php/sistema-ocepar/comunicacao/2011-12-07-11-06-29/ultimas-noticias/140469-cvale-premiada-em-duas-categorias-no-quem-e-quem-maiores-e-melhores-cooperativas. Acessado in: 15 de may 2022.

PARANÁ. Secretaria da Comunicação Social e da Cultura. Puxado por Toledo, Paraná avança e mira novos mercados internacionais na carne suína, 2021. Available at: https://www.aen.pr.gov.br/Noticia/Puxado-por-Toledo-Parana-avanca-e-mira-novos-mercados-internacionais-na-carne-suina. Accessed in 15 may 2022.

PARANÁ. **Nova Ferroeste. Resumo do Projeto da Nova Ferroeste**: consulta pública. Curitiba, 2017. Available at: http://www.novaferroeste.pr.gov.br/modules/conteudo/conteudo.php?conteudo=1> accessed in 24 march 2022.

PARANÁ. **Estrada   de   ferro   Paraná,**   2022a.   Available   at: https://www.ferroeste.pr.gov.br/Pagina/empresa . Accessed in 16 june 2022.

PARANÁ. Secretaria da Comunicação Social e da Cultura. **Lideranças do Oeste Apostam na Nova Ferroeste Para Incrementar o Desenvolvimento da Região**, 2022b. Available at: https://www.aen.pr.gov.br/Noticia/Liderancas-do-Oeste-apostam-na-Nova-Ferroeste-para-incrementar-o-desenvolvimento-da-regiao#:~:text=A%20Nova%20Ferroeste%20%C3%A9%20uma,do%20Paraguai%20e%20da%20Argentina. Accessed in: 22 february 2022.

PETRANSKI, J.; TERNOSKI. S. Relação entre políticas públicas, crescimento e desenvolvimento no centro paranaense. **Revista de Discentes de Ciência Política da Universidade Federal de São Carlos** v. 9, n. 1, p. 307-337. DOI: 2021https://doi.org/10.31990/agenda.2021.1.11

 SECRETARIA DA AGRICULTURA E DO ABASTECIMENTO DO PARANÁ / Departamento de Economia Rural (Paraná). **Banco de Dados da Produção Agropecuária no Paraná**. Valor Bruto da Produção   Agropecuária,   2018.   Available   at: https://www.agricultura.pr.gov.br/sites/default/arquivos_restritos/files/documento/2020-04/relatoriovbp2018.pdf. Accessed in 20 february 2022.

 SECRETARIA DE ESTADO DA AGRICULTURA E DO ABASTECIMENTO. SEAB. **Números da Pecuária   Paranaense**,   2019a.   Available   at: https://www.agricultura.pr.gov.br/system/files/publico/Conjuntura/nppr.pdf. Accessed in 18 may 2022.

SECRETARIA DE ESTADO DA AGRICULTURA E DO ABASTECIMENTO. SEAB. **Números da Pecuária Paranaense**, 2019b. Available in: https://www.agricultura.pr.gov.br/Noticia/Estados-do-Sul-querem-avancar-em-sanidade-na-producao-de-leite. Accessed in 18 de may 2022.

SECRETARIA DE ESTADO DA AGRICULTURA E DO ABASTECIMENTO. SEAB. **Dinâmicas das culturas de soja e milho no estado do Paraná**, 2020. Available at: https://www.agricultura.pr.gov.br/Noticia/Dinamicas-das-culturas-de-milho-e-soja-no-Estado-do-Parana. Accessed in 20 de may 2022.

SILVA, J. A.; SILVA, R. M. A.; CANÇADO, A. C. Políticas públicas e desenvolvimento regional: uma reflexão sobre a política estadual de apoio ao cooperativismo no Tocantins. **Revista Humanidades e Inovação**, v. 7, n.14, p. 19-36, 2020.

SILVA, A. P. S. C. de.; ASSIS, D. M. de.; FRUTUOSO, L. C. V.; SAID, R. F.C. Do. Varredura espacial para identificação de áreas de risco epidêmico e fatores associados a dengue: experiência em Belo Horizonte, Minas Gerais. **Revista Brasileira de Geografia Médica e da Saúde**, v.17, n.1, p. 14–25, 2021. DOI: 10.14393/Hygeia17057163.

VIEIRA, J.C.; OLIVEIRA, L.A.S. Ferrovia norte-sul: impactos no desenvolvimento de Açailândia e Porto Nacional. **Revista de Desenvolvimento Regional em Debate**, v.10, n.1, p. 609-633, 2020. DOI: https://doi.org/10.24302/drd.v10i0.2793

WAHBA, G. Optimal convergence properties of variable knot, kernel, and orthogonal series methods for density estimation. **Annals of Statistics**, v. 3, n.1, p. 15-29, 1975.

WAND, M. P.; JONES, M. C**. Kernel Smoothing**. London: Editora Chapman & Hall/CRC, 1995.

WORTON, B. J.   Using Monte Carlo simulation evaluate kernel-based home range estimators. The **Journal of Wildlife Management**, v.59, n.4. p. 794-800. 1995. Available at: https://www.jstor.org/stable/3801959. Accessed in: 20 march 2022.