Geographical Indication and Centrality: A Hypothesis test in the Northeastern Region of Brazil

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Abstract— Geographical Indications (GIs) refer to products and services with unique characteristics of a given region, granting a certain level of excellence to these goods and services. Moreover, GIs are connected to the locations, in recognition of their territoriality, as well as to the region's cultural and historical identity, being attached to the level of centrality of the region and promoting greater trust, as centrality is directly linked to its catchment area. In this regard, the present work is aimed at carrying out a temporal comparison of the centrality indices of the five groups of Geographical Indications in Northeastern Brazil between the years of 2006 and 2017, in order to test the hypothesis established, determining whether such event is enough to explain the influence of the products and goods on their respective cities of origin. This is a quality-quantitative research, based on a bibliographic and documentary survey by analyzing five GI groups from the Northeastern region of Brazil, focused on their relative share of the Gross Domestic Product of private services in certain municipalities and taking into account five higher-order spatial cutouts: microregion, mesoregion, state, region and country. Besides determining the centrality indices, carried out using the well-known Principal Component Analysis (PCA), the Analysis of Variance (ANOVA) was also applied. The results of the present research did not identify any indications that granting GIs is enough to promote a distinct level of development to the municipalities. Therefore, GIs did not exhibit any relevant effect on the municipal levels of centrality.

Keywords— Centrality, Geographical Indications, Northeastern Brazil.

I. INTRODUCTION

Two different theoretical frameworks comprise the analytical support of the present study: the Central Place Theory and Geographical Indication. The former theory contributes to the perception that the existence of a provision of services structure reflects the level of development of a certain geographical location, with larger stocks being associated to greater levels of centrality. On the other hand, a Geographical Indication is a certification that allows to not only add greater value to products, but also to distinguish and qualify the production, boosting development and making the production unique, as well as creating competitivity in the internal and external market through local production chains that are connected to the territory of origin, to the unique traditions and customs.

Brazilian geographical indications are regulated by Law no. 9.279/96 (Industrial Property Law), which establishes the National Institute of Industrial Property (INPI, in Portuguese) as the entity responsible for granting a certification of Geographical Indication according to Normative Instruction PR no 095/2018, from 28/12/2018. Geographical Indications are subdivided into Indication of Provenience (IP) and Designation of Origin (DO). Between 2002 and 2019, 75 geographical indications were granted by INPI in Brazil, consisting of 55 Indications of Provenience and 20 Denominations of Origin, divided into 11 national DOs and 9 foreign DOs. According to the national scenario in Brazil, the regions with the most GI grants are as follows: Southeast (22), South (20), Northeast (14), North (06) and Central-West (04) (INPI, 2019).

It is worth pointing out that the first GI granted in the Northeastern region of Brazil was an Indication of Provenience (IP) from the sub-medium São Francisco Valley in 2009, located in the Brazilian semiarid (west of the State of Pernambuco and north of the State of Bahia) associated to the production of table grapes and mangoes. Another important highlight for the Brazilian Northeast was the first label of indication of provenience, granted to Porto Digital, in the city of Recife, for its technological services. Other Northeastern products with Geographical Indications include: Black Coast Shrimp (from the State of Ceará), Divina Pastora Lace (in the State of Sergipe) and the Cariri lace (in the State of Paraíba), Abaíra cachaça (in the State of Bahia), green coffee grains, from the Coffea Arábica species (from the State of Bahia), opal and artisanal jewelry of Pedro II (in the State of Piauí), red propolis from the mangroves of the State of Alagoas, colored cotton from Paraíba, the melon from Mossoró (in the State of Rio Grande do Norte), cajuína from the State of Piauí and embroidery from the region of Alagoas de Mundaú-Manguaba (in the State of Alagoas). Only the Northeastern State of Maranhão does not hold a geographical indication.

The Northeastern region of Brazil is the largest in terms of the number of States, distributed over nine Federal States: Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe. Its territory comprises 1,554,257.0 m^2, being the third largest regional complex in Brazil, occupying 18.2% of the country's area (IBGE, 2010).

With this vast territorial extension, the country has a myriad of products, with a wide range of cultural and touristic identities, with a vast environment and biodiversity, besides the local knowledge of its territories. In this regard, the Brazilian Northeast shows a great potential for awarding Geographical Indications, granting unique attributes to products and services, which have a positive impact on aspects related to the local production chains and to the development of the region.

With this in mind, the present work was aimed at carrying out a temporal comparison of the performance of centrality in the five subregions of Geographical Indications in the Brazilian Northeast, between the years of 2006 and 2017, testing the influence hypothesis.

This hypothesis is based on the fact that the existence of a Geographical Indication is able to hierarchize the municipalities from the Northeastern region of Brazil, as the municipalities with higher centralities are a reference in terms of their social and economic organization.

II. THEORETICAL BACKGROUND

Central Place Theory

The Central Place Theory (CPT) is an attempt of explaining the nature of spatial arrangements, their sizes, numbers and foundations. This conceptual design was developed in 1933 by Walter Christaller, a German geographer who studied the colonization patterns in southern Germany (CANTARIM, 2015).

The results of his research conclude that cities of a given size are approximately equidistant. The author subsequently developed a combination of assumptions taking into account the spatial arrangement structures and their respective catchment areas, having then proposed a model to be used in the interpretation of location patterns of cities (HSU, 2012).

Such assumptions are rather strong and can be combined into the following topics:

• a flat surface with little or no changes in its profile as the distance increases (isotropic);

• Proportionally distributed economic resources;

• Similar levels of purchase power of economic agents;

• Consumption preference for closer markets (aversion to travel);

• The markets are structured in a context of perfect competition, in which the possibility of extraordinary profits is inexistent.

According to the CPT, a central location is that which exhibits a specific combination of goods and services to its surrounding population, so that basic and ubiquitous activities are provided in places of lower order (inferior), while complex and specialized activities are found in places of higher order, considered superior (VIONIS; PAPANTONIOU, 2019).

It is worth noting that it can be possible to identify the presence of basic and ubiquitous activities within higher-order locations. Nevertheless, within the context of the CPT, the opposite is not possible, as more elaborate transactions are those which define the importance of a given location.

Therefore, higher-order locations are sources of more elaborate goods and services, which will meet the demand for these in the lower-order locations, thus forming its catchment area, i.e. its centrality perimeter (SILVA, 2011).

This catchment area is determined by two factors:

• Population density – a minimum demographic threshold is required to enable the provision of certain

goods and services. The more elaborate these services are, the greater this threshold will be and, consequently, the higher the catchment area of the central location;

• Measurement of maximum distance travelled – communities favor the lowest travelling distance possible. Thus, centrality is also determined by minimizing this average distance travelled for most inhabitants (HSU, 2012).

In this regard and taking into account these factors, the spatial threshold and range of central locations are established. Goods and services which attract the greatest frequency of attention of consumers generate a maximum distance, which is then unfeasible or not to those who travel to supply their needs (IPEA, 2002).

Under the Central Place Theory (CPT), cities are hierarchized in the form of a hexagon, as this polygonal shape can best describe the location of these territorial units within their own geographical coverage, maximizing the relation between distance and demographics more than any other figure (STAMM, 2013).

Based on the geographical assumptions of his model, Christaller (1966) developed the idea that the hierarchical organization between geographical locations can be defined under three different perspectives: the marketing principle, the transport principle and the administrative principle. According to Portela (2016), in each of these perspectives, the coordination shape between locations is changed, thus modifying their spatial arrangement.

Under the aegis of the administrative principle, cities are ordered according to their political power and cities with the least importance orbit those with greater prominence. In this perspective, each group of cities – represented by Christaller's hexagonal patterns – is inserted in a single perimeter and do not affect any contiguous groups, thus, contiguity is directly correlated with distance, besides influencing the polarization of contiguous groups which are socioeconomically connected to a central city (FERRERA DE LIMA, 2010b).

The drawback of this format is the interaction between the arrangement, which prevents the relationship between locations and terminating the contact between those included within the same spatial arrangement, as if only political factors determine the exchange between places (BESSA, 2012).

In turn, in the market principle, the quality of services provided defines the hierarchy between places, under which the quality of economic transactions will establish the importance of each spatiality. Higher-level locations are those which provide more elaborate goods and services,

while those lower-level locations provide lower value-added goods and services (PORTELA, 2016).

This analytical perspective leads to a more fluid setting of the inter-relationship between locations, placing each city on the limit with other centrality arrangements, as it interacts with several other locations (TINEU, 2012).

Finally, the transport principle determines spatial ranking as a function of market distances. The more accessible a given place is, the greater the chances of centralizing its surroundings (PORTELA, 2016).

Therefore, the spatial arrangement is adapted to the transport offers, in which faster, safer and cheaper journeys, which are able to reach the highest number of central destinations, will result in highest levels of centrality of a given location. In fact, this is the classic approach of the Central Place Theory (CANTARIM, 2015).

Nevertheless, the CPT has some practical restrictions, including the fact that, differently to what the approach proposes, production costs are not uniform in relation to space, which, in turn, are systematically changed not only by economies of scale but also by internal factors associated to the location (NASCIMENTO ARAÚJO; SOARES ALMEIDA; RODRIGUES, 2009).

Moreover, the predictability of the theory is also hampered by the fact that unit transport costs are not constant in all directions, i.e. it does not vary proportionally to the distance travelled (ALMAS, 2012).

Therefore, agricultural production is not uniformly dispersed, varying according to both soil and weather conditions but also due to production decisions of all stakeholders and entities involved in the activity (ALVES, 2011).

Moreover, the presence of market failures which erode economic efficiency levels is another noticeable drawback, which disguises the possibility of competitive markets, with market power emerging from some handful agents (LIBERATO, 2008).

Nonetheless, the Central Place Theory (CPT) is a valid framework to understand the hierarchization of locations and of urbanization profiles. Accordingly, this theory is in constant progression within this subject, as spatial planning is a fact (CANTARIM, 2015).

Geographical Indication

Geographical Indications (GIs) recognize the quality of a certain product originated from a region with unique characteristics within its geographical area. The GI recognition depicts a quality connected to human and

natural factors, with particularities which ensure territorial specificity and gives certain notoriety to the product (MAIORKI; DALLBRIDA, 2015). Therefore, it constitutes a product with unique qualities due to aspects such as know-how, climate, vegetation and soil conditions (SAKR; DALLABRIDA, 2015).

Although Geographical Indications were only recognized in Brazil under law no. 9.279/96 (BRASIL, 1996), its recognition in other countries around the world is long dated. In ancient times there were already signs to distinguish certain commercial products according to their properties. Over time, the term "geographical indication" has been adopted by consumers and producers to recognize the characteristics of a product with a particular origin. Officially, the first institutional act to protect GIs was established in Portugal in 1756, when the Marquis of Pombal established a decree to recognize the designation Porto for wines produced in this Portuguese region, thereby protecting local producers from any disloyal and barbaric market competition (BARBOSA; PERALTA; FERNANDES, 2013).

Therefore, GIs have a strong potential of promoting the production of certain products which bear fruit of local knowledge and the traditional culture of certain places. This recognition is one of the legal frameworks (the Brazilian Industrial Protection Law) to protect market principals and intangible products (SILVA; BRITO, 2016).

In Brazil, manufacturing registrations with GIs have increased every year. These include products manufactured in certain places which are directly linked to the production by using specific manufacturing and cultivation methods, climate, land use, etc. Such specificity adds value to the final product, having a great impact on the local economic and social development (MAIORKI; DALLABRIDA, 2015).

Moreover, there are national and international regulations in place which grant geographical indications to certain products and may be understood as a way of facilitating the insertion of regional products in the international market, further promoting the regional social and economic development under a legal protection against any disloyal market competition. Thus, this subject is clearly not only of socioeconomic concern, but also involves legal and judicial considerations (SIEDENBERG; THAINES; BAGGIO, 2017).

Under a legal perspective, Geographical Indications are recognized as a type of industrial property, granting private rights of collective importance. With this right granted, a specific product is recognized as originating from a certain location, region or territory when certain characteristics,

reputation or quality is explained by the geographical space where this product is produced or manufactured (MARINS; CABRAL, 2015).

GIs have been demonstrated to be an instrument for promoting personal freedoms, as they enable local and regional development. Moreover, GIs ensure appreciation and promotion of traditional regional know-how, resulting in the production of services and/or products (SILVA; BRITO; DANTAS, 2016).

This is observed as the product's notoriety has a direct connection with the place where it is produced, that is, it associated with harvesting factors, production methods, climate and soil. These particularities distinguish the product and add greater value, generating greater financial returns to products and may have a positive impact on the population's quality of life (MAIORKI; DALLABRIDA, 2015).

In their work, Maiorki and Dallabrida (2015) showed how a Geographical Indication is important in the development of certain regions and territories. The authors highlighted that this does not occur autonomously but requires the support of the economic sector and from civil society, otherwise GIs would be worthless.

Only an integrated and articulated work between local actors enables a Geographical Indication to act as an enabler of development and innovation, culminating in real changes under a country's cultural, social and economic sphere (MARINS; CABRAL, 2015).

Therefore, GIs become relevant as a strategic action for supporting regional development, as the recognition of specific good and services with unique potential, identity and characteristics prevents the theft of intellectual property. At the same time, GIs add greater financial, cultural, social, economic and even environmental value to a product's manufacturing process (SAKR; DALLABRIDA, 2015).

III. METHODOLOGICAL PROCEDURES

The present study is characterized as exploratory, descriptive, documentary, historical and quali-quantitative.

The research was based on the Gross Domestic Product of private services of municipalities within five spatial cutouts: microregion, mesoregion, state, region and country.

Subsequently, the centrality indices of all municipalities were calculated using the technique of Principal Component Analysis (PCA) within a range of seven years. Having calculated this parameter, the cities

with GI registrations were compared with cities without any GI registration, through a one-way ANOVA test.

A spatial and temporal cutout grid was applied, with the present study analyzing the years of 2006 until 2017. With these restrictions, two GI registrations were excluded: South of the State of Bahia (granted in 2018) and West of Bahia (granted in 2019).

The spatial cutout used in this research, taking into account GIs in the Northeastern region of Brazil, covers six Federal States which have been recognized with GI registrations for their agricultural products, except for the State of Piauí.

Accordingly, the catchment areas of the GIs are as follows:

a) the Sub-medium São Francisco Valley, which englobes two states (Bahia and Pernambuco), with a total of 75 municipalities, including 17 municipalities in the State of Bahia and 58 in Pernambuco;

b) Costa Negra, comprising 04 municipalities in the State of Ceará;

c) Mangroves of Alagoas, including 16 municipalities in the State of Alagoas;

d) Mossoró, consisting of 13 municipalities in the State of Rio Grande do Norte;

e) Abaíra Microregion, consisting of 04 in the State of Bahia.

The period analyzed corresponds to 100% of the data population provided by the Brazilian Institute of Geography and Statistics (IBGE) regarding the GDP of services in Brazilian municipalities.

The variation of the level of centrality of the municipalities where the respective GI registrations originated from was compared with the remaining municipalities from the respective States in order to analyze any possible difference in their development patterns.

Therefore, the following parameters were verified:

• The centrality of municipalities from the States where the Geographical Indications are registered;

• Calculation of the variation of the centrality indices for the municipalities of the States where the Geographical Indications are registered;

• Null-hypothesis testing that the variation in centrality indices of the locations with registered Geographical Indications is different than those with no GI registration.

The centrality indices were measured according to the methodology proposed by Garcia, Silva, Souza, Bisneto and Silva (2019) and considering the data regarding the municipal products, provided by the Brazilian Institute of Geography and Statistics (IBGE) in their automatic database system (SIDRA), in Table 5938, with the Northeastern agricultural Geographical Indications granted by the Intellectual Property Institute (INPI).

Principal Component Analysis (PCA) was applied for the period of seven years, using the data collected in each operationalization (Geographical Indication), with the registration year of the title being taken as the reference date in this phase, according to the study carried out by GARCIA et al. (2019).

The degree of variation of the municipal centrality indices was determined by the ratio between the final indicator and the initial indicator obtained in each period. The higher this ratio, the greater the intensity of this phenomenon and vice-versa.

The hypothesis that the average variation of the centrality indices of the municipalities with GI, in each seven-year period, was different than the index presented in the respective State was then tested with the one-way analysis of variance (ANOVA). Thus, each group of GIs was tested against a group of municipalities within their own States, thereby ensuring randomness by using a random-number generator page[1].

The PCA was carried out in the GNU Regression, Econometric and Time-series Library (GRETL) statistical package, version 1.9.14, with the remaining computational routines being applied in a Microsoft Excel 2010 spreadsheet.

The results are presented for each of the six (06) Geographical Indications analyzed, except for the Cajuína GI, from the State of Piauí, as this GI covers most of the State's municipalities, which prevents the application of the present research protocol.

IV. ANALYSIS OF THE RESULTS

The analyses of the documents identified demonstrated that between 2009 and 2019, six Geographical Indications related to agricultural products have been granted in the Northeastern region of Brazil, as presented in Figure 1.

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[1] Available at: www.invertexto.com/numeros-aleatorios. Access on: 16 June 2020.

Geographical Indication	State	Products	Type	Concession
Submedium São Francisco Valley	PE, BA	Table grapes and mango	Indication of Provenience	07/07/2009
Costa Negra	CE	Shrimps	Designation of origin	16/08/2011
Mangroves of Alagoas	AL	Red própolis and red propolis extract	Designation of origin	17/07/2012
Mossoró	RN	Melon	Indication of Provenience	17/09/2013
Piauí	PI	Cajuína	Indication of Provenience	26/08/2014
Abaíra microregion	BA	Sugarcane brandy, cachaça type	Indication of Provenience	14/10/2014

Fig.1: Geographical Indications related to agricultural products in the Northeastern region of Brazil, granted between 2009 and 2017

Note: AL= Alagoas, BA= Bahia, CE=Ceará, PE= Pernambuco, PI= Piauí, RN = Rio Grande do Norte

Source: Author's own compilation (2020)

Sub-medium São Francisco Valley

This GI comprises 75 municipalities, including 58 located in the State of Pernambuco and other 17 in Bahia, being the oldest GI in the Northeast of Brazil and it is of most strategic importance for the Brazilian Northeast, regarding the production of grapes and mangoes.

The PCA applied on the municipalities of both States involved with this GI showed that the 602 municipalities have expanded their centrality indices over the past seven years when reaching some level of regional or national notoriety, with the centrality at a microregional level having the least explanatory influence over this phenomenon.

On average, between the years of 2006 and 2012 – period of time established for determining the centrality indices – the indices attached to the respective municipalities increased approximately 3.5-fold. In comparative terms, in the municipalities of both States, an average growth of 5.7 times was observed. Nevertheless, it is important to note that in the year of 2012, 93.3% of these municipalities exhibited centrality indices above the average of the Northeast region.

Within the catchment area of the Sub-medium São Francisco Valley GI, the five municipalities with the

highest degrees of variation in the centrality indices were: Ouricuri (PE), Moreilândia (PE), Remanso (BA), Iguaracy (PE) and Macururé (BA). Similarly, the worst performance levels were observed in Santa Filomena (PE), Glória (BA), Solidão (PE), Inajá (PE) and Jaguarari (BA).

It is worth highlighting that the cities with the highest relative shares in the GDPs of the States of Pernambuco and Bahia are Arcoverde (PE), Juazeiro (BA), Paulo Afonso (BA) and Petrolina (PE) observed a reduction in their centrality indices. On the other hand, this measurement increased in those municipalities with the lowest share in the states' gross domestic product, namely in Afogados da Ingazeira (PE), Salgueiro (PE) and Serrita (PE).

The results of the hypothesis test through the one-way ANOVA test prevents rejecting the null-hypothesis, in which there is no significant difference between the average centrality index of the municipalities inserted in the GI's catchment area and those within this area, as pointed out in Figure 2.

SUMMARY				
Group	**Count**	**Sum**	**Average**	**Variance**
IG Group	75	2.625.717	3.500.956	4.177.247
Control Group	75	4.398.901	5.865.201	6.937.031
ANOVA						
Variation	*SQ*	*Gl*	*MQ*	*F*	*P-value*	*Critical F-value*
Between groups	209.612	1	209.612	0.377194	0.540052	390.506
Within the group	82245.65	148	5.557.139	82245.65		
Total	**82455.27**	**149**				

Fig.2: One-way ANOVA –Sub-medium São Francisco Valley

Source: Author's own compilation (2020)

Mangroves of Alagoas

The catchment area of this GI consists of 16 out of the 102 municipalities form the State of Alagoas, with the GI being granted in 2012. Among the five areas observed in the present work, the area comprising the Mangroves of Alagoas is the only including a State capital city, the city of Maceió.

The PCA applied to the cities of Alagoas showed that throughout the seven-year period, the municipalities of the region observed an increase in their centrality indices as a result of greater state, regional and national relevance, with the microregional centrality having the least explanatory influence.

On average, the degree of variation of the centrality indices of the municipalities was of 0.992, that is, between

2009 and 2015, the local notoriety level was constant, without any particular features.

Incidentally, the centrality profiles of the State of Alagoas were practically constant throughout the seven-year period studied, as the average variation in the centrality indices was of 1.070 at a municipal level. Only the municipality of Olho D´água do Casado presented a noteworthy performance, observing a 13-fold growth of their products and services.

Therefore, it can be deduced that the effects of the Mangroves of Alagoas – GI is irrelevant for changing the centrality patterns of the municipalities involved, as this recognition had little influence on the economic growth of the area.

The results of the ANOVA (Figure 3) show that the F-value obtained was below the critical F-value, i.e. outside the rejection region and with a statistical level of significance higher than the acceptable value.

SUMMARY				
Group	**Count**	**Sum**	**Average**	**Variance**
IG Group	16	1.587.799	0.992375	0.106099
Control Group	16	1.332.073	0.832546	0.283703
ANOVA				
Variation	*SQ*	*Gl*	*MQ*	*F*	*P-value*	*Critical F-value*
Between groups	0.204362	1	0.204362	1.048.541	0.31403	4.170.877
Within the group	5.847.026	30	0.194901			
Total	**6.051.388**	**31**				

Fig.3: One-way ANOVA – Mangroves of Alagoas GI

Source: Author's own compilation (2020)

Mossoró

The catchment area of this GI consists of 13 municipalities from the State of Rio Grande do Norte and is associated to the production of melon. The region is considered one of the largest producers and exporters of high-quality melon.

The PCA applied to this GI showed a similar centrality profile to the State of Alagoas, where the three higher geographical levels are determinant in economic terms.

The average variation of the centrality indices was of 0.553 points. This result corroborates the assumption that a loss of economic importance was observed in the municipalities. Nine of the region's municipalities obtained a lower-than-average share of services and goods when compared to the 167 municipalities from the State of Rio Grande do Norte.

The performance of this GI, in terms of centrality, was not worse as the municipality of Mossoró observed an eight-fold increase in the relative share of services and goods, while the municipality of Açú doubled this share. However, all other municipalities experienced a decrease in their centrality indices.

The results of the one-way ANOVA process applied to the municipalities inserted within the Mossoró – GI was not able to attest that the development of services in these locations was different than all other municipalities in the State of Rio Grande do Norte, as demonstrated in Figure 4.

SUMMARY				
Group	**Count**	**Sum**	**Average**	**Variance**
IG Group	13	1.898.824	1.460.634	2855982
Control Group	13	1.369.171	1.053.209	0.141894
ANOVA				
Variation	*SQ*	*Gl*	*MQ*	*F*	*P-value*	*Critical F-value*
Between groups	1.078.970.418	1	10.789.704	0.719823	0.404585	4.259.677
Within the group	359.745.162	24	1.498.938.175			
Total	**3.705.348.661**	**25**				

Fig.4: One-way ANOVA –Mossoró GI

Source: Author's own compilation (2020)

Abaíra Microregion

The catchment area of this GI consists of only four municipalities in the Chapada Diamantina region, in the State of Bahia: Abaíra, Jussiape, Mucugê and Piatã. The Indication of Provenience granted to these municipalities is associated to the production of sugarcane brandy/cachaça. All four locations presented a much higher variation in the centrality indicator when compared to the combination of municipalities from the State of Bahia.

A new PCA was carried out to validate the null-hypothesis of this research, having demonstrated that the basic driver of this association was the share on the municipal services and products at a national level, with the total contribution to the microregional gross domestic product also having a lower explanatory power.

Between 2011 and 2017, the shares of the products and services in the economy of the State of Bahia did not change significantly, which resulted in little changes in its centrality hierarchy. Unsurprisingly, the average variation of this indicator was of 0.999 (stagnated).

Once again, the ANOVA process rejected the hypothesis that the progress of the levels of centrality of the municipalities with GI was different than those from the other municipalities in the Abaíra Microregion (Figure 5).

SUMMARY					
Group	Count	Sum	Average	Variance	
IG Group	4	4.110.343	1.027.586	0.013091	
Control Group	4	3.845.054	0.961263	0.008831	
ANOVA					
Variation	SQ	Gl	MQ	F	P-value	Critical F-value
Between groups	0.008797	1	0.008797	0.802593	0.404826	5.987.378
Within the group	0.065767	6	0.010961			
Total	0.074564	7				

Fig.5: One-way ANOVA – Abaíra Microregion

Source: Author's own compilation (2020)

Costa Negra

This GI from the State of Ceará consisted of four cities (Acaraú, Cruz, Itarema and Jijoca de Jericoacoara) and is dedicated to shrimp farming. Its levels of centrality are lower than the State's average, exhibiting negative scores in the seven years covered in the present research.

The degrees of variation of this area were also, on average, lower than that of their peers, having observed a decrease of 18% in their centrality levels, against an increase of 24% in the remaining municipalities from the State of Ceará.

Similar to the other GIs, the ANOVA test could not approve the alternative hypothesis – average variance of the group of municipalities different than that of the remaining population – as observed in Figure 6.

SUMMARY					
Group	Count	Sum	Average	Variance	
IG Group	4	3,278822	0,819706	0,047175	0,047175
Control Group	4	4,313213	1,078303	0,019236	0,019236
ANOVA					
Variation	SQ	Gl	MQ	F	P-value	Critical F-value
Between groups	0,133746	1	0,133746	4,027799	0,091542	5,987378
Within the group	0,199234	6	0,033206			
Total	0,332979	7				

Fig.6: One-way ANOVA – Costa Negra

Source: Author's own compilation (2020)

It is important to highlight that this was the test which was the closest to the possibility of rejecting the null-hypothesis – of similarity between the variance of the average centrality indices. This enables the possibility of retesting such reality, by carrying out new ANOVA tests with other municipality samples, in a research specifically aimed to this purpose.

However, the results of the present research indicate that granting Geographical Indications (GIs) to agricultural products in the regions analyzed herein did not have a

significant effect on the socioeconomic context in order to change the levels of productions associated to the degree of centrality of these municipalities.

In the municipalities with noteworthy changes in their levels of centrality, the phenomenon was similar in most of the other municipalities of their respective States. Thus, the changes observed could be have a different nature than that necessarily linked to the concession of GIs.

Regarding the concession of GIs, it is worth noting that it cannot be claimed that substantial changes to the socioeconomic profile of the region have occurred due to this fact. Nevertheless, a more precise analysis of the specific social indicators can contribute to settling any remaining doubts and can be the scope of future researches.

However, certain assumptions can be drawn regarding the reason for such behavior pattern, such as the different structures of the activities involved, the absence of a better integration between the economic agents, which would promote greater synergies and more complex inter-industrial demand. Moreover, it is worth noting that the institutions have a relevant role in supporting and promoting the correct functioning of GIs in Brazil.

Other studies have been carried out in other Brazilian regions, such as in Paraty, South of the State of Rio de Janeiro, in a study carried out by Almeida, Alimonda, Meirelles Júnior et al. (2015). The study analyzed the chachaça label, having concluded that the GI led to a positive local effect, improving the local quality of life. Moreover, there are also several other positive examples in the international literature, such as the work by Marie-Vivien, Garcia, Kushalappa and Vaast (2014) on Indian coffee. The introduction of a GI in the Indian region of Kodagu was of fundamental importance to increase the socioeconomic development of the region, but also for protecting its biodiversity, thus, with positive extra-market effects.

Fagundes, Padilha, Sluszz et al. (2012), for instance, argue that the introduction of GIs led to a better economic performance in the region of Vinhedo Valley, in the State of Rio Grande do Sul. According to the authors, the certification resulted in a greater number of tourists, higher value of rural properties, substantial changes in the technological standards, among other empirical improvements.

A similar case was analyzed by Pellin and Vieira (2015), when studying the region of Urussanga, in the State of Santa Catarina. The authors argue that after the recognition of GIs, a significant increase of economic performance was observed, with consequent surge in the

sale of traditional and sparkling wine, besides greater access to other markets and the development of complementary activities. These examples show the positive effect of the introduction of GIs on local development, different than the result of the present study, which showed that the concession of GIs associated to agricultural products in Northeastern Brazil did not have a significant effect on the level of centrality.

V.   CONCLUSION

The findings of the present research show that more in-depth studies regarding GIs in the Northeastern region of Brazil are needed, in order to clearly identify their deficiencies and intensity. As inferred herein, GIs are aimed at strengthening regional productive activity, reinforcing the connection between the different sectors, as they would otherwise be further apart. Moreover, GIs also expected to consolidate the expertise of a certain region, in terms of the production of a certain good or service, with positive externalities and socioeconomic impacts on the entire State.

This is crucial as GIs from Northeastern Brazil are mostly formed by municipalities of little economic relevance, in terms of economic volume, density and dynamics. These are small municipalities still linked to primary activities (agriculture or extraction), which reinforces the low technological complexity in the case of small producers, which is the result of a labor-intensive sector, thus reinforcing their important role for job generation.

The findings found in the present study allow to draw conclusions regarding the municipalities from Northeastern Brazil which were granted Geographical Indications, indicating that their respective centrality levels were not influenced by such concession. This phenomenon was observed as the importance of the gross domestic products of the municipalities in the private service sector was a result of systemic reasons – having reached the group of Northeastern municipalities – rather than due to specific reasons associated to each municipality.

On the other hand, the results of present study do not prove that the implementation of GIs does not contribute to regional socioeconomic development, rather showing that, under an overall regional behavior, no significant changes were observed wherever GIs were present. Therefore, further research is necessary, focusing on social indicators which motivate these changes.

Thus, the elements that constitute the concession of GIs and the levels of municipal centrality are more pronounced

in the market structure. The absence of institutional support and of a regional strategy for integrating the different markets may hamper the extraction of positive effects under an economic and social perspective. With this in mind, Geographical Indications from the Brazilian Northeast should be subject to more thorough research, which can identify their deficiencies and intensity, with a collective interest, ensuring the economic relevance, density and dynamics of small-scale municipalities inserted in the region where GIs have been granted.

Finally, it is worth highlighting the relevance of the agricultural sector for the region, which has a significant importance for generating wealth, particularly in a continental country such as Brazil. Accordingly, there is also a significant need of further studies applied to the sector, especially regarding the understanding of socioeconomic impacts, measured by indicators such as GDP per capita, HDI, the Gini coefficient, among other indicators which can assess marginal or structural changes.

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