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Environmental degradation and agriculture: an approach in countries by middle of indexes

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ABSTRACT: *Society evolution is commonly followed by changes; however, some of them bring negative implications for the community. One of these consequences refers to environmental degradation, which has agricultural activity as one of its influencing agents, which is essentially characterized by man's predatory actions. Accordingly, this research analyzed the environmental degradation in 167 pattern in the agricultural world. Therefore, the Agricultural Environmental Degradation Index (IDAA) was used as a proxy for agricultural environmental degradation and the factor analysis technique. Results indicated that the most degraded country was Russia, which belongs to the European continent; however, the other positions were occupied predominantly by Africa, followed by North America and Oceania. Issues such as rural poverty and primitive natural settings can leverage this phenomenon. The lowest rates of degradation were concentrated on Central America and Europe, where agricultural activity was most incipient. In this sense, a directly proportional relationship between environmental degradation and agricultural practice was reported considering that countries dependent on this phenomenon had the most worrying results. Thereby, there is an emerging need for public policies that integrate economic and environmental dimensions that reduce negative impacts in the regions most degraded.*
Key words: *environmental degradation, degradation index, countries.*

Degradação ambiental e a agropecuária: uma abordagem em países por meio de índices

RESUMO: *A evolução da sociedade comumente vem acompanhado de mudanças, no entanto, algumas delas têm trazido implicações negativas para a comunidade. Uma dessas consequências, diz respeito a degradação ambiental que tem como um de seus agentes influenciadores a atividade agropecuária, protagonizada essencialmente por ações predatórias do homem. Nesse sentido, o objetivo desse trabalho é analisar o padrão de degradação ambiental agropecuário de 167 países do mundo. Para tanto, foi utilizada a metodologia do Índice de Degradação Ambiental Agropecuária (IDAA) como proxy para a degradação ambiental agropecuária e a técnica de análise fatorial. Pelos resultados, identificou-se que o país mais degradado é a Rússia, pertencente ao continente europeu. Entretanto, as demais posições dos países mais degradados, foram predominantemente africanos, seguido do continente da América do Norte e Oceania. Questões como pobreza rural e cenários naturais primitivos podem alavancar esse fenômeno. Os menores índices de degradação concentraram-se nos continentes da América Central e Europa, onde a atividade agropecuária é mais incipiente. Nesse contexto, averiguou-se uma relação diretamente proporcional entre degradação ambiental e prática agropecuária, tendo em vista que países dependentes desse fenômeno foram os detentores de resultados mais preocupantes. Com isso, é emergente a necessidade de políticas públicas que integrem as dimensões econômicas e ambientais que atenuem os impactos negativos nas regiões mais degradadas.*
Palavras-chave: *degradação ambiental, índice de degradação, países.*

INTRODUCTION

Society development is usually accompanied by changes, derived from new means, technologies and techniques, in order to develop economic production and social improvement. However, these changes cause some complications for the community itself, because they affect environment quality. In this sense, one of the major centers of discussion of the 21st century is related to natural resources management, instigating the population to become conscious for the need of nature conservation (PINTO & CORONEL, 2015).

Thus, environmental degradation arises as a debate. Therefore, natural resources deterioration

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can be characterized as the wear and tear caused to environment, due to disordered practices that attack it. There are several causes of environmental degradation, for example, pollution, global warming and one of the factors that worsen this situation is agricultural exploitation, since it significantly modifies the affected area, contaminating water and soil, resulting in gradual loss of biodiversity (LEMOS, 2001; CUNHA et al., 2008; LEITE; et al, 2011). It is important to highlight that agricultural practice seeks to satisfy the needs of the market and, in turn, becomes one of the degradation actors (BRAGA et al., 2004).

Many regions of the world have agriculture as a source of subsistence, since this activity provides jobs, generates income, exports and food provision (PINTO; et al, 2014a). So, agriculture is seen as an activity that promotes economic growth and; therefore, development for the localities. However, agricultural activity, in many countries, has grown in a predatory manner, causing changes in the local structure, as soil compaction, rivers silting, erosion and deforestation. Consequently, reconciling economic performance with stable environmental conservation has become the major barrier for countries (ECHEVERRÍA, 1998; PINTO et al., 2014b).

With exploration at levels higher than what is considered acceptable, the rate of resources replacement is limited, emerging the constant need for debates and discussions about environmental degradation. These procedures search for listing some public policies that assist in the decision-making process, minimizing the negative impacts of this phenomenon. Therefore, countries seek to unite, with the objective of planning measures to make the society conscious of environment preserving. One of these activities consist in mapping the degradation of countries and regions through indexes, in order to publish these information, assisting in corrective measures in the most deteriorated places (BRAGA et al., 2004).

In this sense, the situation of environmental degradation is extended to all countries, since factors related to livestock and agriculture have been spreading emphatically in the last times. In this conception, some researches emerge with the purpose of measuring the diagnosed problem, clarifying the main causes. The measurement of this situation is carried out based on the construction of an Agricultural Environmental Degradation Index (IDAA), which helps in determining the degradation area of an established region, caused by agricultural activity. It is important to emphasize that this index works as a proxy to check the local of degradation, caused by agricultural activity.

The first research that depicted this methodology was LEMOS (2001), being replicated by other studies as (SILVA; RIBEIRO, 2004; CUNHA et al., 2008; PAIS et al., 2012) and more recent studies such as those of (PINTO & CORONEL, 2014; PINTO et al., 2014a; PINTO; et al., 2014; PINTO; et al, 2018). Among these results, a certain heterogeneity was identified, as degradation affects differently the regions focused on the research, feeding the need for new studies that study this phenomenon.

Consequently, in order to represent global environmental degradation, this research analyzed the pattern of agricultural environmental degradation in various countries of the world since the universe of this study is all countries in the world. In view of the universe of study, its sample was filtered among the countries that have data available in the database where the information was collected (WORLD BANK, 2019). The research proved to be relevant, since when assessing environmental degradation, it was possible to identify how the situation of natural resources is. Moreover, from environmental mapping degradation, it is possible to visualize the regions that need more emphatic corrective measures. Also, researches that approaches environmental degradation over the years are incipient, in addition to linking this issue with regional development, and empirical researches that dialogues with degradation rates (PINTO& CORONEL, 2015).

This paper was structured in four sections, the first section was the introduction, the second section the theoretical references, with an environmental degradation and environmental degradation index approach. In the third, the methodology is presented and then the results obtained and analyzed. Finally, the final considerations of the study are presented.

METHODOLOGICAL PROCEDURES

This research was based on predecessor researches that also appropriated a characteristic method to generate the General Degradation Index (IGD). This index was evaluated as a proxy for the environmental degradation of a place that was the product of the study (SILVA & RIBEIRO, 2004). The research was configured as quantitative and descriptive, since observations and findings were made in order to archive data, correlating them without manipulating the phenomena (RAMPAZZO, 2002).

Due to the magnitude of the problem of environmental degradation, this phenomenon requires the coverage of a network of variables that included local characteristics. Therefore, the variables used different aspects and; therefore, the most appropriate technique in this case was the multivariate analysis, essentially the procedure of factor analysis to accomplish the proposed objective (CUNHA et al., 2008).

Therefore, the factor analysis procedure, using the main elements methodology, was used in the study variables, as a way of capturing the intensity of the degradation process. In addition, the factorial scores derived from this technique helped in the composition of the index, in view of quantifying this fact in the global situation.

The main purpose of the factor analysis procedure is to compile the data, in order to identify variables that faithfully portray a group of variables for their application in future multivariate analyzes (HAIR et al., 2009). A segment of factor analysis according to MINGOTI (2005) is followed in a matrix form, being presented as follows:

$$Xi = a_{ij} F_J + \in_\iota \quad (1)$$

where

$Xi = [(X_1, X_2,\ldots, X_p)]$ ^ t is a transposed vector of observable random variables;

a_{ij} = is a matrix (p x m) of fixed coefficients denominated factor loads, which describe the linear relationship of X_i and F_J;

$F_J = [(F_1, F_2, \ldots, F_p)]$ ^ t is a transposed vector (m <p) of latent variables that describe the unobservable elements of the sample; and

$\in_\iota = [(\in_1, \in_2,\ldots, \in_p)]$ t is a transposed vector of random errors, corresponding to measurement errors and the variation of *Xi* that is not explained by the common factors F_J.

As the study variables are expressed in different scales, the need for standardization emerged. This technique is necessary, given that there are several divergences in the data that are on heterogeneous scales, or even configured incoherently (GREENE, 2008). Thus, it is suggested to make the objects of study comparable, which caused the minimization of data problems that are at different scales (BASSAB; et al, 1990). The procedure for standardizing variables is given by:

$$Z = ((X_i - \bar{X}))/ S, \ i = 1,\ldots, n \quad (2)$$

Where:

Z = standardized variable

X_i = variable to be standardized

$\bar{X}$ = mean of all observations

S = sample standard deviation

With the standardization of the observable random variables X_i, they can be replaced by the standardized variables Z_i, with the purpose of helping to solve the problem of differences in scale units, as shown in Equation 2 (MINGOTI, 2005). In this way, Equation 1 can be reproduced according to the following Equation:

$$Z_i = a_{ij} F_j + \in i \quad (3)$$

For the creation of the Agricultural Environmental Degradation Index (IDAA), it is necessary to evaluate the scores that are related to each factor after orthogonal rotation. In this research, we used the orthogonal transformation of the original factors by the Varimax method, which demonstrated a more simplified formulation that can be understood by grouping the correlations of each variable into one factor (HAIR et al., 2009).

Bartlett's Sphericity tests and the Kaiser-Meyer-Olkin Criterion (KMO) were used in order to assess suitability for factor analysis for the purpose to identify whether the factor analysis used is in accordance with the model information. The first model, provided the statistical probability that the correlation matrix has significant correlation in at least some variables. Thus, the result of this procedure must reject the null hypothesis, that is, the equality of the matrices. The KMO test verified the adaptation of the data with the generation of an index that oscillates between 0 and 1, contrasting the simple and partial correlations between the variables, with data greater than 0.5 showing that the data are appropriate for the factorial analysis.

From this procedure, IDAA can be created. Thus, the generation of the index followed the steps used by CUNHA et al. (2008), PAIS et al. (2012), PINTO, et al (2014b), PINTO, et al (2014a) and PINTO, et al (2018). Thus, the creation of IDAA emerged with the compilation of the generated factors, according to equation 4:

$$IDAA_i = \sum_{j=1}^{p} \frac{\lambda_j}{\sum \lambda_j} F_{ji}^* \quad (4)$$

Where:

$IDAA_i$ corresponds to the General Degradation Index of the i-th country analyzed;

j to the j-th characteristic root;

p is the j^th factor score of the i th country analyzed;

F_{ji}^* is the j-th factorial score of the i-th country analyzed;

$\sum \lambda_j$ represents the sum of the characteristic roots referring to the *p* factors extracted, being $\lambda_j / (\sum \lambda_j)$ relative to the participation of factor *j* in explaining the total variance captured by the p factors extracted.

It is important to highlight that the IDAA methodology appropriates from the symmetric distribution procedure that revolves around zero average of the factor scores of each country. As a way of preventing large negative factor scores from increasing, the magnitude of the indices related to subdivisions with negative factor scores, a change is made in order to bring them to the first quadrant (LEMOS, 2001). This technique needs to be done before estimating the IDAA, represented algebraically by

$$F_{ji} = \frac{(F_{ji} - F_j^{min})}{(F_j^{max} - F_j^{min})} \quad (5)$$

where:
F_{ji} are the factorial scores;
F_j^{max} is the maximum observed value for the jth factor score associated with the ith country; and
$F_j^{min}$the minimum observed value for the jth factor score associated with the ith country;

The universe of this study is all countries in the world; although, the sample was filtered among the countries that have data available in the database where the information was collected. From that, data were collected from 167 countries on 6 continents and distributed between the years 1991 to 2015. (WORLD BANK, 2019).

For the construction of the index, 10 variables were collected in the World Bank database (WORLD BANK, 2019). Variables were based on the information existent and on agricultural indicators displayed by academic theory, mainly those related to labor, activity conditions, environment, economic development and infrastructure (WONG& CARVALHO, 2006; SILVA; et al, 2010; PERAL et al., 2011; COSTA et al., 2013). The variables are based on the availability of data sources and on the determinants of agriculture pointed out by the academic literature, mainly those related to labor, activity conditions, environment, economic development and infrastructure (SILVA; et al, 2010; COSTA et al., 2013).

Among the variables used were: surface area (Srfae), rural population (Rurlp), cultivated area (Landa), food production index (Foodp), crop production index (Cropp), arable land (Arabl), renewable energy consumption (Renew), access to energy (Eletr), employment of men (Emplm) and women in agriculture.

It should be noted that there are other variables that can be worked on, but that were not reported in the database. They are: number of agricultural establishments, number of individuals living in households linked to agricultural activity, number of individuals working in the agricultural activity, mechanization of establishments - number of tractors, use of correctives and technical assistance, quantity of plant production, quantity of animal production, quantity of total production, quantity of production of the main product. The data collected in the countries under analysis and the *Statiscal Package for the Social Sciences (SPSS) 20.0* and *Microsoft Excel* software were used.

ANALYSIS AND DISCUSSION OF RESULTS

To point out whether the variables analyzed are adequate for factor analysis, the Bartlet test was performed, which expressed statistical significance, rejecting the null hypothesis of matrices equality and evidenced this procedure appropriation (MINGOTI, 2005). Another procedure carried out to determine the adequacy of the factor analysis was the KMO test, which reached a number of 0.728, and because it is greater than 0.5, it showed that the use of factor analysis is feasible (HAIR et al., 2009).

By the procedure of the principal component method and the Varimax orthogonal rotation method, by factor analysis, it was identified that the ten variables object of study, were associated in three factors that are convenient to express 79.05% of the information variance, according to table 1. From the definition of the number of factors, the factor loads and the commonality associated with each of them can be analyzed according to table 2.

According to table 2, the factor analysis resulted in 3 factors. Thus, with regard to Factor

Table 1 - Matrix eigenvalues and explained variance of correlations for countries in the world.

Factor	Eigenvalue	Variance explained by the factor (%)	Accumulated Variance (%)
1	3.99	39.90	39.90
2	2.01	20.13	60.03
3	1.90	19.02	79.05

Source: Prepared by the authors.

Table 2 - Factor loads after orthogonal rotation and communalities.

Variables	--Factorial loads---			Communalities
	F1	F2	F3	
Emplm	0.95	0.00	-0.04	0.90
Emplf	0.91	0.02	-0.04	0.83
Eletr	- 0.91	- 0.01	0.07	0.83
Renew	0.85	0.01	-0.02	0.72
Rurlp	0.82	-0.09	-0.02	0.68
Landa	- 0.12	0.98	0.05	0.98
Srfae	-0.12	0.98	0.05	0.98
Arabl	-0.07	0.86	0.09	0.80
Cropp	-0.02	-0.05	0.97	0.94
Foodp	-0.06	-0.05	0.97	0.96

Source: Prepared by the authors.
Note: Values in bold denote the highest factor load of the variable in one factor.
Emplm (employment of men).
Emplf(and women in agriculture).
Eletr (access to energy).
Renew (renewable energy consumption).
Rurlp (rural population).
Landa (cultivated area).
Srfae (surface area).
Arabl (arable land).
Cropp (crop production index).
Foodp (food production index).

1, the following variables were grouped: Emplm (employment of men); Emplf (and women in agriculture); Eletr (access to energy); Renew (renewable energy consumption) and Rurlp (rural population). It should be noted that these variables synthesized in Factor 1 are related to aspects that characterize the characterization of agricultural establishments, and this factor can be defined as Structure Factor of the Agricultural Sector. It is noticed that the variable "Eletr" presented a negative value, which indicates an inverse impact on the factor, but the fact that the sign is negative makes theoretical sense, as this variable represents a conception that degradation has less impact if people have access to energy.

In factor 2, the variables prevailed: Landa (cultivated area); Srfae (surface area) and Arabl (arable land). As a result, the second factor is more associated with the issues of planting agricultural activity, which can be designated as the Rural Production Area Factor. The constituent variables of Factor 3 are: Cropp (crop production index) and Foodp (food production index) and this factor can be called the Production Index Factor.

The communalities express the effectiveness of explaining the data for each variable, considering that values greater than or close to 0.5 are plausible for approval and data greater than 0.6 indicate greater contribution of the supported variable to justify a certain factor. Information obtained regarding communalities, revealed that all variables have their variability explained by the three factors.

From these values, there is the possibility of verifying the Agricultural Environmental Degradation Index in the countries studied, that is, the potential for degradation, with greater intensity of agriculture. Table 3 shows the relationship with the highest average IDAA in countries with their respective continents.

Results showed that the countries of Africa occupied the positions of the most degraded regions of the world, since twenty of the highest indexes, seventeen are the responsibility of African countries, all with values above 50%. It is worth mentioning that Africa is a continent that has a history marked by poverty and malnutrition, a primitive environmental structure, in addition to the fact that the per capita income of most is inferior to the other nations of the world (TEWARI& KUSHWAHA, 2008; ADEYEYE et al., 2017). Thus, with the high rates of environmental degradation in African countries, it can be said that

Table 3 - Highest and lowest average IDAA of countries and their respective continents.

Highest ID	Country	IDAA	Lowest ID	Country	IDAA
Russian Federation	EU	82.91%	Japan	AS	16.53%
Congo, Dem. Rep.	AF	72.64%	France	EU	16.08%
Chad	AF	70.36%	Spain	EU	16.04%
Ethiopia	AF	66.27%	Italy	EU	15.74%
China	AS	65.58%	Cyprus	EU	15.56%
Burundi	AF	65.33%	Czech Republic	EU	15.25%
Somalia	AF	63.60%	Korea, Rep.	AS	14.99%
Malawi	AF	63.48%	Bahamas, The	CA	14.83%
Mozambique	AF	63.38%	Kuwait	AS	14.76%
Tanzania	AF	63.32%	United Kingdom	EU	14.74%
Central African Republic	AF	62.87%	Germany	EU	14.49%
Niger	AF	62.29%	Netherlands	EU	14.11%
Rwanda	AF	61.57%	Lebanon	AS	13.64%
Madagascar	AF	60.42%	Brunei Darussalam	AS	13.08%
Zambia	AF	60.28%	Jordan	AS	12.86%
Guinea-Bissau	AF	60.18%	Denmark	EU	12.32%
Burkina Faso	AF	57.65%	Hungary	EU	12.24%
Nepal	AS	57.27%	United Arab Emirates	AS	11.30%
Mauritania	AF	56.98%	Malta	EU	10.50%
Uganda	AF	56.52%	Israel	AS	10.36%

Source: Elaborated by the authors.

this situation is possibly related to rural poverty, added to the lack of knowledge from the population about measures for preservation and sustainable use of environmental resources, since they are countries dependent on agriculture with a series of limitations to agricultural development (FINCO; et al, 2004; NCUBE, 2017; JUSTICE et al., 2017).

Therefore, it is ratified that the productive structure of these countries is based primarily on agriculture, with the cultivation of monocultures such as coffee, cocoa, cotton, peanuts in large tracts of land, produced sequentially for several years until the soil fertility is compromised. Subsequently, new areas are sought in which the same process is replicated; however, it is a destructive procedure for the territories, in addition to producing food with low nutritional value (MASHELE & AUERBACH, 2016). LOKE et al. (2019) explained that monoculture crops over longer periods cause land degradation, affecting soil quality, which, attached with the region's climate, stimulates the desertification growth.

In addition, in South Africa, the mining industry plays a vital role in the country's economic growth and development. Mining operations often result in environmental degradation in mining communities if mine owners fail to comply with regulations that have been put in place to ensure that the environment is not harmed and degraded during these activities (PRETTY & ODEKU, 2017).

Furthermore, through the index studied, it can be seen that as the countries of Africa are dependent on agriculture and were the regions that presented the highest degradation rates, it can be said that there is a directly proportional relationship between agriculture and degradation, confirming the results of LEMOS (2001); Cunha et al. (2008) and PINTO et al. (2014). In addition, African countries have activities related to livestock, which according to RASMUSSEN et al. (2018), due to the high pressure caused by grazing stimulates the reduction of vegetation, leading to land degradation (BLAKE et al., 2018). ABDALLA et al. (2018) corroborated these statements as they identified a direct link between pasture degradation and global warming, since the release of carbon dioxide is the major contributor to the greenhouse effect (MONTEIRO et al., 2018).

Despite the predominance of African countries in the most devastated regions, Russia occupied the first position of the most degraded countries with 82.91%. It is revealed that due to its territorial extension, having land both in Asia and in Europe, its large size leads to a wide diversity of natural conditions, which creates the need for the development of terrestrial resources (DRONIN; & KIRILENKO, 2012).

Tourism was another booster of degradation in this country, since in the study by MOBAREZ & ABDOU (2018) it was identified that tourism has a strong relationship with the devastation in that country, since many inappropriate actions by tourists such as incorrect garbage dumping may increase levels of degradation.

Likewise, SOROKIN et al (2016) reported that degradation in Russia occurs in different ways, such as desertification, soil erosion, salinization, flooding, which modifies the soil's fertility. Thus, the authors argued that unsustainable agricultural practices, industrial activities, agricultural production in infertile places and irregular maintenance of irrigation networks are catalysts for environmental degradation in the country (ZOLOTOKRYLIN, 2019).

The other two countries that did not belong to Africa and had a high IDAA were China (65.58%) and Nepal (57.27%). It is pointed out that China's soils are primarily oxidized with low production levels, which requires the use of fertilizers for land reclamation (REHMAN& JINGDONG, 2018). Pinto et al. (2014) revealed that the intense practice of fertilizers damages the environment, which can cause some negative consequences such as rivers silting, burning and loss of biodiversity.

Likewise, ABLER (2015) pointed out that the flow of nutrients in chemical fertilizers and cattle manure are significant problems for China and that measures to minimize these impacts are incipient. This fact is corroborated in the research by LI et al. (2010) in which the production of corn due to the use of fertilizer has polluted groundwater and degrading the country's soil.

From the results, there is a heterogeneity between the countries of Asia, since China has one of the highest IDAA (65.58%) and Israel has one of the lowest indexes (10.36%). These findings bring to light the idea that some territories even belonging to the same continent are more degraded than others, showing the emerging need of monitoring and corrective measures to minimize these impacts. In this sense, these differences in behavior demonstrated how degradation is complex and diffused among the countries of the continent (BOBOEV et al., 2019).

Results were worrying, since the intensive use of fertilizers generates negative consequences such as silting of rivers, burning, and loss of biodiversity . Therefore, with the production of grains, vegetation is affected and can influence climate change in the regions, indicating the need for changes that minimize the impacts of degradation (RAFINDADI& USMAN, 2019)

The ranking according to the IDAA average for the continents is shown in table 4.

According to table 4, it can be seen that agricultural degradation is more pronounced in Africa. Much of Africa's agricultural vulnerability can be explained by taking into account the precariousness of agricultural systems, as they are ruled by rain. Moreover, agricultural practices are exercised by small farmers with limited knowledge and financial resources for infrastructure. Economic inequality, low levels of development and poverty stood out, which contributed to the continent being in that position (BARBIER, 2015; PEREIRA, 2017).

It should be noted that there is an investment gap in agriculture in many developing countries, which contributes to this vulnerability (ZHAN; et al, 2017). Agriculture in many African countries depends on irrigation, with water supplied through open channels built over many centuries, in which due to limited knowledge of these distribution channels, water management practices are difficult (KIMARO et al., 2019).

North America was in the second position of the most degraded continents, which can be explained by the modernization of agricultural equipment that has negative consequences on the soil. Thus, the countries of Mexico and the United States have presented more delicate positions on this issue, which requires public policies in order to reduce the impacts of this problem. According to HILIMIRE (2011), the United States is specializing in agricultural production, which causes environmental concerns with the loss of biodiversity. NOCCO, et al. (2019) showed that using modernization devices such as irrigation, alter the temperature and humidity of the territories and can camouflage the region's climate. Likewise, Sah et al. (2019), corroborated that using more robust production technologies, productivity tends to leverage, which can lead to higher levels of degradation.

Oceania ranked the third position on the most degraded continents. According to GANG et al. (2014) Oceania was in third place losing to Asia and North America due to pastures degradation. According to Jupiter, MANGUBHAI & KINGSFORD (2014) the islands' biodiversity have a history of biodiversity degradation, pollution, water diseases, altered rain patterns, deforestation and fires. These aspects can trigger global climate change, increasing climate

Table 4 - Ranking of the average IDAA on the continents of the world.

Country	Placement	IDAA Average	IDAA Maximum	IDAA Minimum	Number of cases	Standard-Deviation
Africa	1º	48.82%	90.66%	12.54%	1250	0.15
North America	2º	42.14%	62.21%	21.38%	75	0.12
Oceania	3°	39.58%	60.53%	11.35%	200	0.13
Asia	4°	33.52%	78.44%	0.00%	1000	0.16
South America	5°	29.06%	65.07%	5.85%	300	0.11
Central America	6°	27.72%	100.00%	5.96%	400	0.12
Europe	7º	21.83%	91.55%	5.60%	950	0.12
Total		35.01%	100%	0.00%	4175	0.17

Source: prepared by authors.

risks for local communities (BAMBRICK, 2018). ROOS, et al (2016) pointed out that many farmers belonging to the countries of Oceania, use some archaic practices, in which excessive use can cause soil degradation.

Analyzing Asia, disparities are evident between the countries of that continent, since it was the only continent that had representatives in the highest and lowest IDAA, with a standard deviation of 0.16. Such a panorama can be justified by the differences in agriculture in the region, as well as in the issues of development and wealth on the continent. It is noteworthy that agriculture continues to boost a significant portion of the economy in these countries (GILLESPIE, 2019). Thus, most countries on that continent have a rice-based economy with smallholders. Also, traditional techniques of animal traction and precarious tools are used, in addition to much of the work being developed manually for the management with irrigation and distributed irregularly among countries and SHAH (2011) pointed out that Asia's agriculture has land degradation and desertification, water scarcity, pesticide pollution, and loss of agricultural biodiversity.

In addition, Asia has land in semi-desert areas that are more vulnerable to soil degradation processes, losing its fertility, besides forests degradations through illegal exploitation with fires that cause erosion. Thus, another major factor in the degradation of the land of that continent, is due to inappropriate agricultural practices, using heavy machinery that, coupled with the low level of organic material, increases salinity, causing losses in soil fertility, since these traditional techniques corroborated the degradation (NURBEKOV et al., 2016). MILLAR & ROOTS (2012) reported that weak soils increase the dependence on chemical substances to soil recovery.

Regarding the countries of Central and South America, there was a more conscious and less degraded use of these regions. Europe was the continent that presented the lowest levels of environmental degradation, which can be justified by the low representativeness of the primary sector for the economy, since the sector that contributes the most to the economy is the tertiary (HODGE, et al., 2015). This fact is reinforced because Europe imports fresh products from countries that have greater representation in the primary sector of the economy. It is also noteworthy that this continent has programs that aim to ensure the preservation of the environment such as the PAC (Common Agricultural Policy) that seek for measures to conserve nature. Thus, the use of soil in Europe takes place in a more satisfactory way with fertile soils that guarantee good production without denigrating the land so much (BATÁRY et al., 2015).

FINAL CONSIDERATION

Environmental degradation is an issue that is being discussed worldwide, since it has consequences in the environmental, social and economic spheres. Although, there are different factors that can aggravate this phenomenon, such as deforestation, global warming, an overpopulation and strong a strong contributor to accentuate this problem is the agricultural issue. Researchers have already studied the subject, but there are few studies that quantify the degradation of territories. In this sense, the objective of this research to analyze the pattern of environmental and agricultural degradation in 167 countries on 6 continents the countries of the world was carried out.

From the construction of the environmental degradation index (IDAA), it was identified that the African countries had the highest degradation rates. It is noteworthy that these are countries that have a direct connection with agricultural activity, which, attached to the vulnerability of agricultural systems, rural poverty, precarious social services exacerbate environmental degradation.

Therefore, taking into account the index studied, agriculture played a significant part for higher levels of degradation in these places, since where these activities were more intense, higher levels of degradation were detected.

Asia had the largest standard deviation with countries in the highest and lowest IDAA, which can be explained by economic and territorial differences. European countries had the lowest IDAA, since the primary sector does not have as much economic representativeness for the continent and areas that are cultivable for grain production have government support for environmental protection and more corrective measures in order to minimize any impacts degradation.

The construction of this type of indicator, that is, of an environmental nature, has the objective of providing assistance in the formulation of public policies, international agreements and in the decision-making of public and private entities. In addition, these indicators allowed us to detail the situation of the interaction of human activity in the environment. In this way, there must be, on the part of the public power, a greater status in order to avoid the aggravation of environmental degradation as well as an awareness of the population and more sustainable attitudes in the environment.

The consequences of degradation can result in several implications, which can cause loss of biodiversity, pollution, species extinction, climate change. Such concerns raise the emerging need for measures that minimize degradation impacts. In view of this, some practices are necessary to reduce these rates, such as greater performance the government in the most affected regions.

The study was limited to some methodological choices, such as not considering aspects related to regional development and the impact of this on degradation, as well as measuring degradation using only one index. Therefore, it is sought for future research to measure environmental degradation related to other factors such as economic and social issues, analyzing the determinants of agricultural exploitation and degradation

DECLARATION OF CONFLICT OF INTEREST

We declare for all purposes and effects that it is necessary that the article “Agricultural environmental degradation: a world approach through indexes” has no conflict of interest of any kind, whether financial, social, political or health.

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AUTHORS’ CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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