



## THE RELATIONSHIP BETWEEN ECOINNOVATION, SUSTAINABLE CONSCIOUSNESS, ENVIRONMENTAL STRATEGY, ORGANIZATIONAL PERFORMANCE AND ENVIRONMENTAL IMPACT IN NORTHEAST BRAZIL

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### Abstract

**Objective:** This article aims to analyze the relationship between eco-innovation, sustainable awareness, environmental strategy, organizational performance and environmental impact, in the face of 210 respondents from Northeast Brazil.

**Methodology:** The methodology used was a quantitative and descriptive research, through a survey applied to 210 respondents, analyzed using descriptive statistics, statistical tests and multiple linear regression.

**Originality:** Original with respect to the constructs developed for the research, where three constructs (eco-innovation, sustainable awareness and organizational performance) were adapted from the literature and two (environmental strategy and environmental impact) were developed by the researchers, as it is a model that has no empirical validation in the studied environment (Northeast Brazil). Understanding the relationships between the constructs is relevant, which are paramount for companies, for reducing the environmental impact and consequently improving the quality of life of people and the planet.

**Results:** The results show that the most important relationship occurred with the factors that influence the reduction of the environmental impact, which presents as predictors, issues associated with the environmental strategy to reduce the degradation of natural habitats and long-term sustainability.

**Theoretical Contributions:** The study statistically validated the Constructs and scales of research, so this Framework can be used by other researchers, as well as contributing to the advancement of academic studies related to the researched themes.

**Keywords:** Eco-innovation. Sustainable awareness. Environmental strategy.

### AS RELAÇÕES ENTRE A ECOINNOVAÇÃO, CONSCIÊNCIA SUSTENTÁVEL, ESTRATÉGIA AMBIENTAL, PERFORMANCE ORGANIZACIONAL E IMPACTO AMBIENTAL NO NORDESTE DO BRASIL

### Resumo

**Objetivo:** Este artigo tem como objetivo analisar as relações entre a ecoinovação, consciência sustentável, estratégia ambiental, performance organizacional e impacto ambiental, perante a percepção de 210 respondentes do Nordeste do Brasil.

**Metodologia:** A metodologia utilizada tratou-se de uma pesquisa quantitativa e descritiva, por meio de uma survey aplicada a 210 respondentes, analisados por meio da estatística descritiva, testes estatísticos e regressão linear múltipla.

**Originalidade:** Original com relação aos construtos elaborados para a pesquisa, onde três construtos (ecoinovação, consciência sustentável e performance organizacional) foram adaptados da literatura e dois (estratégia ambiental e impacto ambiental) foram desenvolvidos pelos pesquisadores, pois trata-se de um modelo que não tem validação empírica no ambiente estudado (Nordeste Brasileiro). Entender as relações entre os construtos é relevante, os quais são

primordiais para as empresas, para a diminuição do impacto ambiental e consequentemente melhoria da qualidade de vida das pessoas e do planeta.

**Resultados:** Os resultados evidenciam que a relação mais importante ocorreu aos fatores que influenciam a diminuição do impacto ambiental, o qual apresenta como preditores, questões associadas a estratégia ambiental para reduzir a degradação de habitat naturais e a sustentabilidade a longo prazo.

**Contribuições Teóricas:** O estudo validou estatisticamente os Construtos e escalas da pesquisa, assim este Framework pode ser utilizado por outros pesquisadores, bem como contribui para o avanço dos estudos acadêmicos relacionados aos temas pesquisados.

**Palavras-chave:** Ecoinovação. Consciência sustentável. Estratégia ambiental.

### LA RELACIÓN ENTRE ECOINNOVACIÓN, CONCIENCIA SOSTENIBLE, ESTRATEGIA AMBIENTAL, DESEMPEÑO ORGANIZACIONAL E IMPACTO AMBIENTAL EN EL NORESTE DE BRASIL

### Resumen

**Objetivo:** Este artículo tiene como objetivo analizar la relación entre ecoinnovación, conciencia sostenible, estrategia ambiental, desempeño organizacional e impacto ambiental, frente a 210 encuestados del Nordeste de Brasil.

**Metodología:** La metodología utilizada fue una investigación cuantitativa y descriptiva, mediante una encuesta aplicada a 210 encuestados, analizada mediante estadística descriptiva, pruebas estadísticas y regresión lineal múltiple.

**Originalidad:** Original respecto a los constructos desarrollados para la investigación, donde tres constructos (ecoinnovación, conciencia sostenible y desempeño organizacional) fueron adaptados de la literatura y dos (estrategia ambiental e impacto ambiental) fueron desarrollados por los investigadores, por ser un modelo que no tiene validación empírica en el entorno estudiado (Nordeste de Brasil). Es relevante comprender las relaciones entre los constructos, primordiales para las empresas, para reducir el impacto ambiental y, en consecuencia, mejorar la calidad de vida de las personas y del planeta.

**Resultados:** Los resultados muestran que la relación más importante ocurrió con los factores que influyen en la reducción del impacto ambiental, los cuales presentan como predictores, cuestiones asociadas a la estrategia ambiental para reducir la degradación de los hábitats naturales y la sustentabilidad a largo plazo.

**Aportes Teóricos:** El estudio validó estadísticamente los Constructos y escalas de investigación, por lo que este Marco puede ser utilizado por otros investigadores, además de contribuir al avance de estudios académicos relacionados con los temas investigados.

**Palabras clave:** Ecoinnovación. Conciencia sostenible. Estrategia ambiental.

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## 1 Introduction

As a result of a mistaken way of seeking to satisfy human needs, in which economic development and more profit and wealth, characteristic of the capitalist system of production, are sought, the environmental problem was neglected for a long time, until, around the 1960s, it became part of the debates that considered the plans for economic and environmental development for the future.

The environmental impact, reverberating worldwide, brings a new look to the questions related to the protection and preservation of the environment, thus the first international movements emerge, emerging the understanding that it is possible that economic growth can develop together with environmental sustainability, suggesting the possibility that the economic growth of organizations, reach their objectives in balance with the environment.

In this context, organizations are among the biggest contributors to environmental unsustainability (Robertson & Barling, 2013; Ab Wahab, 2021; Channa, Hussain, Casali, Dakhan & Aisha, 2021), is a major problem currently experienced, the world level. Accordingly, the United Nations highlights the 17 Sustainable Development Goals (SDGs), which aim at sustainable management and efficient use of natural resources, for companies and people, proposing to ensure more sustainable production and consumption patterns (Agenda 2030, 2021).

The environmental management of the responsible institutions was under pressure to develop new strategies to face daily environmental problems. Innovation represents an efficient way to improve the organization's competitiveness and performance. In this sense, innovation is attributed to optimize the use of resources in organizations and improve market positioning, as well as environmental sustainability (De Guimarães, Severo, Campos, El-Aouar & De Azevedo, 2019; Orji & Liu, 2020). Today, society in search of solutions for sustainable development, through the association between innovation and sustainable development, has become a subject of great apprehension (Iqbal, Khan, Gill & Abbas (2020).

Alos-Simo, Verdu-Jover, and Gomez-Gras (2020) show that all sectors are impacted by new technologies. According to Welter, Sausen, and Cappellari (2019), innovation is one of the biggest challenges for organizations to maintain a sustainable competitive advantage. Therefore, in the environmental scenario, in the face of difficulties in recent years, turning to the business environment, eco-innovation emerges as an alternative to minimize or eliminate the impacts of its operation (clean production), reducing production costs, environmental responsibility, and consequently, improvement in organizational performance (Severo, De Guimarães, Dorion, & Nodari, 2015).

However, eco-innovation differs from conventional innovation in that it is more related to external sources of information, using techniques related to the environment (Frigon, Doloreux & Shearmur, 2020; García - Sánchez, Gallego - Álvarez & Zafra - Gómez, 2020). However, although eco-innovation has been practiced in business for years, few studies have investigated eco-innovation

decisions when horizontal and vertical relationships exist (Lin, Wang & Yang, 2020). In this scenario, it is not enough for companies to innovate. They must develop sustainably considering three dimensions: social, supporting the community; environmental, observing the legislation; and economic, linked to profit and competitiveness. Product innovation is an important source of organizational performance, being responsible for increasing the financial performance of organizations (Yamin, Mavondo, Gunasekaran & Sarros, 1997; De Guimarães, Severo, Dorion, Coallier & Olea, 2016; Zeng, Zhang, Matsui & Zhao, 2016; Severo, Dorion & Guimaraes, 2020).

Awareness of environmental degradation and harmful effects is growing considerably. As a result, consumers are more cautious about the impact of their consumption on the environment and, as a result, organizations can achieve better organizational performance by taking advantage of this caution of consumers by offering green products or brands.

Given the above, eco-innovation and sustainable awareness must be linked to the organization's strategy, as principles of environmental strategy, which excel for organizational performance, as well as in reducing the environmental impact on the environment. Coherently, environmental strategies (Ma & Chang, 2019; Gunarathne & Lee, 2020) are driving forces, strategic drives, capable of contributing to the advancement of science, both in the academic and managerial fields.

In this context, this article brings a research question: what are the relationships between eco-innovation, sustainable awareness, environmental strategy, organizational performance, and environmental impact? Therefore, the study aims to analyze the relationship between eco-innovation, sustainable awareness, environmental strategy, organizational performance, and environmental impact, in the face of the perception of 210 respondents from Northeast Brazil.

## 2 Theoretical reference

### 2.1 Eco-innovation

Considered as a fundamental tool for sustainable development (Chassagnon & Haned, 2015), eco-innovation presents itself as a response to the challenges related to environmental preservation and rational use of natural resources, assuming a high position of importance both for society and for people. organizations (Jo, Roh, Kim, Youn, Park, Han & Jang, 2015; Jabbour, Saturnino, Gobbo, de Souza Ribeiro & de Sousa Jabbour, 2015).

The concept of eco-innovation is associated with new processes or the improvement of these, and with new products that produce positive effects or the reduction of negative impacts on the environment (Horbach, Rammer & Rennings, 2012). According to the Organization for Economic Co-operation and Development (Oecd), this concept must be studied considering its three dimensions: objectives and goals, methods of introducing actions related to achieving the objectives, and their consequent effects on the environment (Oecd, 2009).

Arranz, Arguello, and Arroyabe (2021) classify the eco-innovation engines into three categories: internal factors, market factors, and institutional factors. Also, according to the authors, the factor that most affects eco-innovation is the previous experiences in eco-innovation, in comparison with variables such as external financing or capacity for innovation, which have a very small impact. These results can have important repercussions from the point of view of the development of environmental incentive policies.

Within innovation strategies, eco-innovation has become very relevant in recent years, as they seek to reduce the environmental impact of products and production processes through the use of new technologies and ways of working that contribute to sustainable development and at the same time they help to promote the competitiveness of companies (García - Sánchez et al., 2020). In this context, eco-innovation aims at activities strongly focused on innovation in products, processes, and organizational philosophies to improve environmental performance (Mavi & Mavi, 2021).

According to Hofstra and Huisingh (2014), eco-innovations must meet legal standards and reduce costs, whose focus is on optimizing processes to reduce the consumption of natural resources and the generation of polluting waste; associated with the interaction between the individual and the social environment, proposing solutions to increase the capacity of the ecosystem, as the negative impacts harm the environment (Hofstra & Huisingh, 2014).

Cheng, Yang, and Sheu (2014) show that the systemic view of the organization is paramount in the process of implementing eco-innovations, given that through it it would be possible to assess which organizational innovations have the potential to generate positive impacts on the environment or reduce those which are negative, both internally, processes and management and externally, relationship with the macro environment (Santos, Lima, Basso, Kimura & Sobreiro, 2017).

It should be noted that eco-innovation is an evolving research area, and may have practical implications for cleaner production (Latupeirissa & Adhariani, 2020), as well as the importance of policy alongside demand to foster eco-innovation (Lee, Shin & Lee, 2020).

## *2.2 Sustainable awareness and environmental impact*

The lack of sustainable awareness and the lack of caution in the exploitation of natural resources, emphasize the environmental impact, therefore, in the last part of the 20th century, concerns about the sustainability of human activity grew and questions were raised, if and when the capacity of the planet in supporting human civilization would be achieved (Horton & Horton, 2019).

The construction of sustainable awareness, according to Gonçalves-Dias, Teodósio, Carvalho and Silva (2009), brings didactics aimed at instituting a new thought, linked to behavioral changes, with new habits, changing attitudes and destructive actions for sustainable actions. Individual consumption of people, in general, goes against the interests of collectivities and, for this reason, environmental problems should be seen as a problem that concerns collective action (Doyle, 2018).

However, this consumption has been added to the pressure that society has exerted for environmental control, preservation and recovery (Anzilago, 2017; Doyle 2018).

From the environmental movements, laws are created, giving positive norms for protection and guarantees to the environment. Almeida, Nascimento, Gallardo and Ruiz (2018) emphasize, in 1981, the first Brazilian law focused on the environment, Law 6938/1981, known as Environmental Impact Assessment, is instituted, having relevant importance when it determines that the environment should be rewarded for the harmful and harmful actions of human beings. For Silva, Reis and Amâncio (2011) reducing and compensating the damage caused to nature is the role of the organization, seeking not to compromise the future use of natural resources, generating positive results, not only for shareholders but also for society in general.

Regarding the environmental impact, ABNT NBR ISO 14001 specifies the requirements of an Environmental Management System (EMS), as well as allowing a company to develop a structure for the protection of the environment, and a quick response to changes in environmental conditions, listing the environmental aspects influenced by the organization, as well as others that can be controlled by it (Abnt, 2015).

According to Cechin and Pacinei (2012), environmental impacts can be positive when applying the green economy, which is an economic system dominated by investment, production, commercialization, distribution, and consumption, which respects the limits of ecosystems. To meet consumer expectations for greener, better quality products, as well as ensuring effective compliance with emission regulations, companies began investing in improving the quality and green (low carbon) of existing products (Yang, Ji & Tan, 2020).

Given the above, the concept of circular economy, proposed by Kirchherr, Reike and Hekkert (2017), stands out, which gained momentum both among scholars and among professionals. However, critics claim the same has several meanings. Also according to the authors, 114 definitions of circular economy encoded in 17 dimensions were presented, in which the results indicate that the circular economy is most often described as a combination of reduction, reuse and recycling activities, while it is often not highlighted that the circular economy needs systemic change. Accordingly, the circular economy is supported by a transition to renewable energy sources, the circular model builds economic, natural and social capital, based on three principles: i) eliminate waste and pollution from the beginning; ii) keep products and materials in use; and, iii) regenerating natural systems (Ellen Macarthur Foundation, 2021).

In this sense, to have economic growth reducing the environmental impact, it is necessary that the industry and new technologies are focused on a production and product style that reduces the degradation of the environment (Almeida et al., 2018).



### 2.3 Environmental strategy

Modern life has become more complex due to the environmental crisis and the growth of cities, so the environmental management of the responsible institutions was under pressure to develop new strategies to face daily environmental problems (Galván & Tapia, 2019). According to Severo, De Guimarães, Gomes, Amaral, Nascimento and Andrade (2019b), due to the fierce competitiveness existing in the national and international market, companies started to look for strategies and differentials that guarantee their maintenance, their development to maximize their organizational performance in a fickle, unpredictable and complex business environment. However, in recent years, heavy pollution companies have often adopted the green merger and acquisition strategy to obtain green technology and resources, to carry out the transformation and updating of the pollution industry (Lu, 2021).

According to Galeazzo and Klassen (2015), previous studies paid relatively little attention to how the organization's strategic objectives are executed for sustainability. In this scenario, strategies can play a primary role, aiming at the use of environmental practices, which minimize the environmental impacts on the environment (Gunarathne & Lee, 2021; Mishra & Yadav, 2021).

According to Santos, Walter and Bertolini (2019), market competitiveness challenges organizations to seek differentiated strategies to maximize results, because of this, management practices are guided towards economic aspects. In this scenario, from the last decades, companies started to be pressured by new demands from society to present a more conscious and sustainable behavior, and adapting to this new paradigm, a good part of the medium and large companies has directed their strategies and actions for socio-environmental aspects, with environmental management as an essential tool to guide them (Araújo, Cohen & Silva, 2014).

In the past two decades, the concern of organizations to implement environmental strategies has become evident. Several aspects interfere in this attitude: by the harmful effects caused by nature, when disrespected, that generate losses and cause fear to people, sensitizing them to the change of conduct; due to legal requirements, that is, the collection of Brazilian legislation; pressure from consumers and non-governmental organizations; as required by audits by countries interested in closing contracts with foreign companies (Sehnen & Rossetto, 2014).

At the international level, through the European Green Agreement, Europe is trying to achieve climate neutrality by 2050, taking into account the Circular Economy Strategy, and the United Nations Sustainable Development Goals (UNSDGs) (Loizia, Voukkali, Zorpas, Pedreño, Chatziparaskeva, Inglezakis, Vardopoulos & Doula, 2021). In this scenario, the proactive environmental strategy can produce better performance for companies (Wu, Wu, Chen & Goh, 2014), as well as the environmental strategy and green innovation, are instruments that also improve environmental performance (Kraus, Rehman & García, 2020), as well as the image and brand of organizations (Dellarmelin, Moraes, Hoeckesfeld, Severo & Hahn, 2018).

#### 2.4 Organizational performance

Regardless of their nature, organizations aim to fulfill their respective mission and, in this sense, do so through adequate performance, in which companies can choose different performance evaluation parameters (Lopes & Milani 2019). The dynamics of different aspects of the operating and business environment influence the performance of organizations. The process of organizational diagnosis, based on its exploratory and analytical nature, supports decision making, through the survey and analysis of information about the conjuncture of environments (Wagner, 2018). Depending on this, several measures can be measured to assess organizational performance.

In the study by Hindasah & Nuryakin (2020), organizational capacity and learning positively affect financial performance, however the age factor of the organization does not moderate the relationship between organizational capacity and financial performance, but it is significant in organizational learning; the manager's experience insignificantly moderates the relationship between organizational capacity and financial performance, however, it is significant for organizational learning. The research by Ghasemaghahi (2020), reports that when companies process big data, performance reaches its highest level, through the use of sophisticated tools, while this is not the case when companies do not process big data.

Organizational performance can be enhanced through the use of tools such as entrepreneurial orientation, collaborating in the implementation of a favorable climate for the development of initiatives and entrepreneurial proactivity by its employees, being able to exercise better competitiveness (Severo et al., 2019b). According to Paladino (2007), the organizational performance can be measured by factors of indirect measures, such as the reduction of operational costs, use of assets, optimization of the use of resources, as well as in the comparison of the results of the organization against the competition (De Guimarães et al., 2016).

According to Maletič et al. (2018), in moderate environmental contexts (moderate competitiveness and uncertainty), sustainability exploration practices seem to be a predominant predictor of organizational performance. For Mehralian et al. (2016), managers can incorporate total quality management, strengthening relationships with stakeholders and, ultimately, improving organizational performance, if social responsibility with stakeholders is embedded in the routines and operational processes.

Many organizations started to invest in specialized processes and professionals, to demonstrate concern to the environmental issue, and those who adhere to this concept tend to receive a beneficial return, reducing costs, adding value to products, as well as the health benefits of the product. environment and citizens (Zanatta, 2017).

In this context, organizational performance and entrepreneurial orientation have stood out over the past decades, as important strategic drivers for the performance of organizations, helping in the

implementation of a favorable climate for the development of entrepreneurial initiatives and proactivities by its employees (Severo et al., 2019b).

### 3 Method

The methodology used in this study is quantitative and descriptive research, through a survey applied to 210 respondents. According to Hair, Black, Bardin & Anderson (2010), quantitative research aims to measure numbers, where data must be adequately arranged for statistical analysis. According to Malhotra, Rocha, Laudisio, Altheman & Borges (2005), quantitative research can also be descriptive, whose data must be collected in a structured way in representative samples. In this scenario, Vergara (2009) highlights that the descriptive research exposes characteristics of the investigated population, enabling correlations between the variables.

In this context, a universe of hundreds of elements is assumed as a survey-type (Malhotra et al., 2005). Accordingly, this research took place through a survey applied to 210 respondents. Therefore, the sample is characterized as non-probabilistic, for convenience (Hair et al., 2010).

The research was made possible, through a questionnaire, which was applied through the online form of Google Docs, shared by the researchers' social networks. For data collection, the research also used the Snowball method, in which the researchers sent it to their contacts and they later passed on the research to other individuals, from March 13 to June 4, 2020.

According to Lee and Spratling (2019), the effectiveness of the snowball sampling technique using social media was detected. The snowball technique was also used and validated in the research by Severo, De Guimarães and Dorion (2018), Severo, Guimarães, Dellarmelin and Ribeiro (2019), and Severo, De Guimarães and Dellarmelin (2021), in which the researchers they sent the questionnaire to their contacts through social networks, and they subsequently passed on the survey to other contacts. A safe and efficient method, mainly at the time of the Covid-19 Pandemic, in which social isolation is valued (Severo et al., 2021).

In addition to the questions related to the respondents' profile, the questionnaire presents 31 statements on a 5-point Likert scale, which vary between (1) strongly disagree and (5) strongly agree, which were divided into five research constructs (Table 1): i) Construct of Eco-innovation - adapted from research by Severo et al. (2018) and Severo et al. (2020); ii) Sustainable Awareness construct - adapted from the study by Severo et al. (2019a); iii) Construct of Environmental Strategy - elaborated by the researchers; iv) Organizational Performance construct - adapted from studies by Paladino (2007), De Guimarães et al. (2016) and Severo et al. (2019b); and, v) Environmental impact construct - developed by the researchers. Accordingly, the questionnaire was previously validated by two doctors who are experts in the thematic areas of study, as well as a pre-test with 13 respondents to understand the questions.



For data analysis, the descriptive statistics technique was first used (Hair et al., 2010), which is used to transcribe the data for a given sample using measures of variance (mean and standard deviation). Subsequently, by the recommendations of Hair et al. (2010), multivariate data analysis was used, using statistical tests and multiple linear regression (stepwise method), the latter being a descriptive statistical analysis to assess the influence suffered by a dependent variable about the effects of more than one independent variable. Therefore, in the treatment of the research data, the SPSS® Version 21 software for Windows was used.

**Table 1 – Research construct** (continued)

<b>Construct Eco-innovation</b>	<b>Autores</b>
(Eco-innovation is an innovation that aims at environmental sustainability)	
(EI1) – Eco-innovation reduces the consumption of raw materials.	Adapted from research Severo et al. (2018) e Severo et al. (2020).
(EI2) – Eco-innovation reduces the impact on the environment.	
(EI3) – Eco-innovation improves the quality of life on the planet.	
(EI4) – Eco-innovation reduces atmospheric emissions.	
(EI5) – Eco-innovation aims to treat effluents / sewage in an appropriate way.	
(EI6) – Eco-innovation aims at people’s health and well-being.	
<b>Construct Sustainable Awareness</b>	
(Environmental awareness is related to how you perceive environmental issues)	
(SA1) - In my residence, I perform the separation of organic and recyclable waste.	Adapted from research Severo et al. (2019a).
(SA2) - When I shower, I use water efficiently, as this is a finite environmental resource.	
(SA3) - Destination electrical and electronic waste (eg batteries, batteries, televisions) to suitable collection points.	
(SA4) - When I buy information technology equipment (ex: smartphone, notebook, TV sets) I look for one that is made up of recyclable materials and uses less energy.	
(SA5) - I reduce the generation of waste in my home through prevention, recycling and reuse.	
(SA6) - When I shop at the supermarket I take my own bags, or I prefer to accommodate the products in cardboard boxes, to avoid the consumption of plastic bags from the supermarket to transport the products.	
(SA7) When I have expired or no longer used drugs, I dispose of these drugs to the pharmacies that have the collection for this type of waste.	
<b>Construct Environmental Strategy</b>	
(The Environmental Strategy is one that cares about the environment)	
(ES1) - The most innovative companies use the Environmental Strategy to improve the efficiency of natural resources.	Prepared by the researchers.
(ES2) - The most innovative companies use the Environmental Strategy to reduce the generation of waste through prevention, reuse and recycling.	
(ES3) - The most innovative companies use the Environmental Strategy to reduce climate impacts.	
(ES4) - The most innovative companies use the Environmental Strategy to reduce the degradation of natural habitats, and to stop the loss of biodiversity.	
(ES5) - The most innovative companies use the Environmental Strategy for long-term sustainability.	
(ES6) - The Environmental Strategy promotes the improvement of the image and brand of the most innovative companies.	
<b>Construct Organizational Performance</b>	
(Organizational Performance is linked to the profitability, differentiation and competitiveness of the most innovative companies)	
(OP1) - The most innovative companies have superior product quality compared to their competitors.	Adapted from research Paladino (2007), De Guimarães et al.
(OP2) - The most innovative companies have a higher profitability than their competitors.	

	(conclusion)	
(OP3) - The most innovative companies have a wider geographic scope (market niche) compared to their competitors.	(2016) e Severo et al. (2019b).	
(OP4) - Government policies benefit the most innovative companies to improve financial performance.		
(OP5) - The most innovative companies are more competitive than their competitors.		
(OP6) - The most innovative companies offer profit sharing (PLR) policies that benefit employees financially.		
<b>Construct Environmental impact</b>		
(Environmental impact are human and business actions that harm the environment)		
(EImp1) - I understand that the use of renewable energy sources (wind and solar) aim to reduce the Environmental impact.		
(EImp2) - I understand that the adequate removal of water from water sources reduces the impact on the environment.		
(EImp3) - I understand that the conservation of protected areas preserves the biodiversity of terrestrial and marine species.	Prepared by the researchers.	
(EImp4) - I understand that the most innovative companies use filters in the chimneys so as not to emit gases that cause the greenhouse effect.		
(EImp5) - I understand that the most innovative companies do not carry out activities that negatively impact the terrestrial and marine environment.		
<b>Source:</b> Prepared by the authors (2020).		

## 4 Results and discussions

With the data collection, a sample of 210 respondents was obtained, which fall into different generations. The generations were classified according to the year of birth criterion, according to the research by Severo et al. (2018). Of the total number of respondents, Generation Y (born after 1981) had the highest representativeness, reaching 42.9%, that is, ninety (90) respondents. Generation X (born from 1965 to 1981) was represented by sixty-six (66) respondents, with a percentage of 31.4%, and finally, the Baby boomers (born before 1965) with fifty-four (54) respondents, whose percentage reached 25.7%. However, the sample consisted of 73.8% of female respondents and 26.2% male. Referring to the job market, 89% of the respondents stated that they were working, occupying auxiliary positions (2.6%), analyst/technician (33.2%), manager (12.1%), teacher (3.7 %), among other functions (48.4%).

With regard to education, only 1.0% of respondents have elementary school, 8.1% reported having completed high school, 30.5% with a college degree, 42.9% specialists, 17.1% have a degree master's degree and 0.5% doctors. Regarding family income, the data show that 8.6% are in the range of up to 02 minimum wages, 21.9% are in the range of 02 to 04 minimum wages, 33.3% are in the range of 04 to 10 minimum wages, 21.9% in the range of 10 to 20 minimum wages and 14.3% receive more than 20 minimum wages.

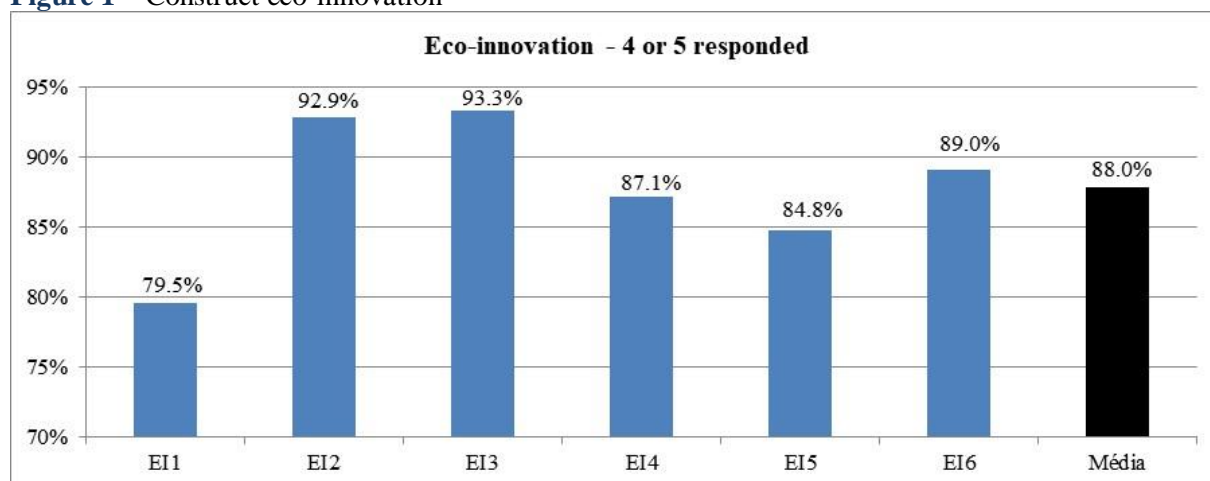
### 4.1 Perceptions about eco-innovation

To highlight the positive perception of respondents regarding questions related to Eco-innovation, the averages of responses 4 (partially agree) and 5 (totally agree) were used in the statements presented in Table 1. In the Construct de Eco-innovation, the statements (EI2) and (EI3) are shown with a percentage of above 92%, that is, 92.9% and 93.3, with averages of 4.56 and 4.59

and standard deviation of 0.744 and 0.735 respectively (Figure 1), showing that Eco-innovation reduces the impact on the environment and improves the quality of life on the planet, a result that corroborates the theoretical assumptions of Horton and Horton (2019), regarding environmental awareness acting as a catalyst for concerns on environmental impacts and bringing Eco-innovation as an essential factor to minimize such impacts (Jabbour et al., 2015; García-Sánchez et al., 2020). This also corroborates with the research by Mavi and Mavi (2021), in which Eco-innovation contributes to improving environmental performance and reducing the degradation of natural resources, as well as the development of environmental incentive policies (Arranz et al., 2021).

The statement that obtained the lowest percentage of agreement is related to the reduction of raw material consumption (EI1), however, with 79.5%, an average of 4.18, and a standard deviation of 0.960, as shown in Figure 1. This result is relevant because people in the Northeast realize the importance of reducing the consumption of raw materials, which contributes to the sustainability of environmental inputs and resources.

**Figure 1** – Construct eco-innovation



Source: Prepared by the authors (2020).

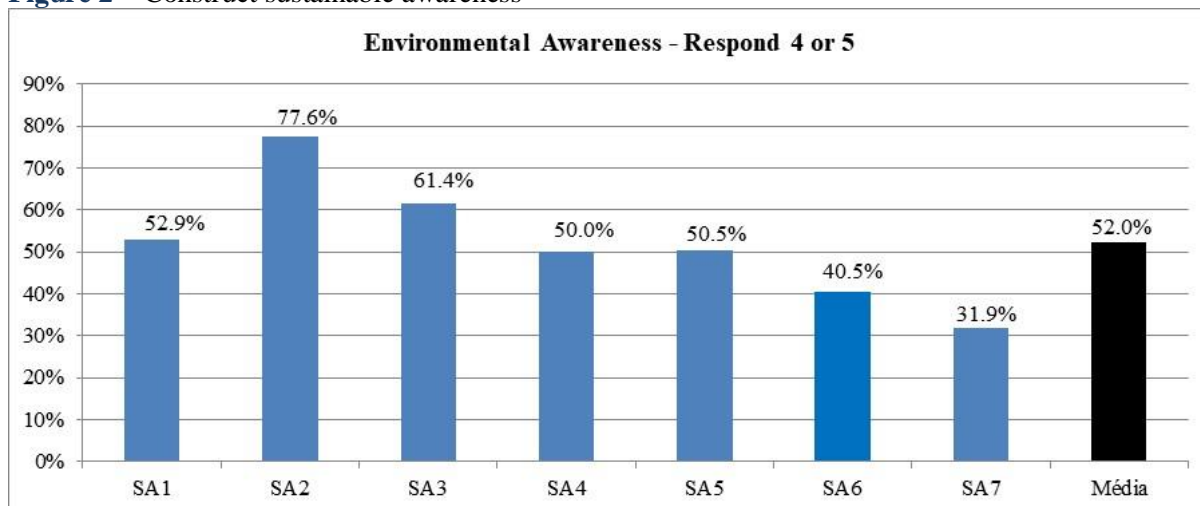
#### 4.2 Perceptions about sustainable awareness

In the Construct of Sustainable Awareness (Figure 2) it can be seen in question SA2, 77.6% of the respondents stated that when they bathe, they make efficient use of water, as this is a finite environmental resource (Figure 2), presenting an average of 4.20 and a standard deviation of 1.084. This result is in accordance with the study by Gonçalves-Dias (2009), which states that the construction of Sustainable Awareness brings a great challenge, a didactic aimed at instituting a new thought, linked to behavioral changes, with new habits, changing the destructive attitudes and actions for sustainable actions.

The findings of the research on Sustainable Awareness, corroborate with the assumptions of ABNT NBR ISO 14001, in which a structure for the protection of the environment is listed, highlighting the environmental aspects that can be controlled (Abnt, 2015). This is also linked to the

research by Severo et al. (2019a), because the Sustainable Awareness of people, can change their actions in favor of sustainable development.

**Figure 2** – Construct sustainable awareness



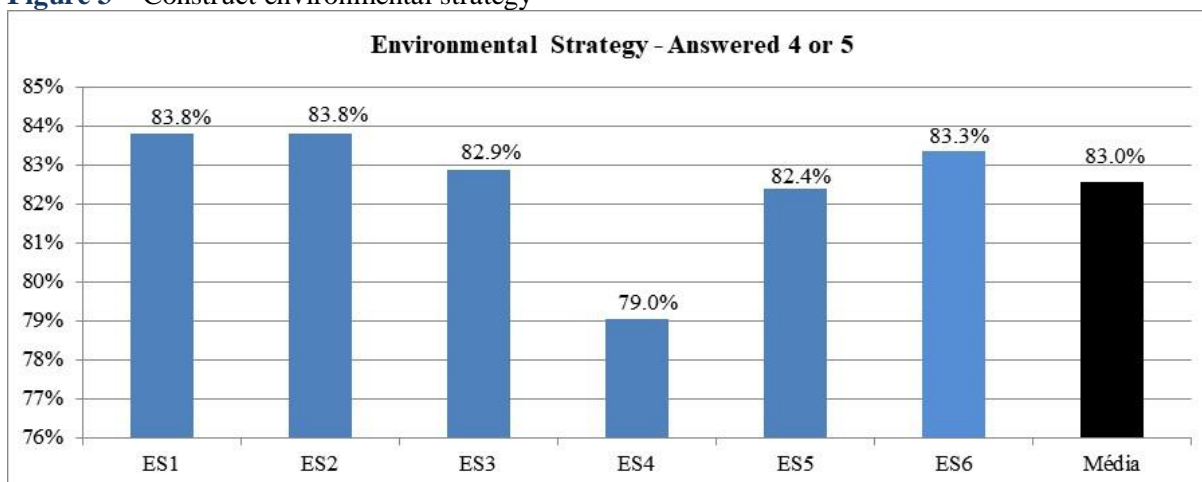
Source: Prepared by the authors (2020).

However, it is clear that, about question SA7, 31.9% of the respondents stated that, when they have expired medicines or that they are no longer used, they send these medicines to pharmacies that collect this type of waste, presenting an average of 2.71 and a standard deviation of 1.549. Consequently, this result is worrying, since the disposal of inappropriate medication has a negative environmental impact on the environment, which can contaminate springs, rivers, and watercourses, as well as the water table.

#### 4.3 Perceptions about environmental strategy

In the Construct de Environmental Strategy, in question ES1, 83.8% of the respondents stated that the most innovative companies use the Environmental Strategy to improve the efficiency of natural resources (Figure 3), presenting an average of 4.30 and a standard deviation of 0.953, as shown in Figure 3.

Figure 3 – Construct environmental strategy



Source: Prepared by the authors (2020).

In this scenario, question ES2 obtained the same index as ES1, where 83.8% of respondents stated that the most innovative companies use the Environmental Strategy to reduce the generation of waste through prevention, reuse, and recycling, corroborating with the assumptions of Araújo et al. (2014) when they affirm that companies started to be pressured by new demands from society to present a more conscious and sustainable behavior. Adapting to this new paradigm, a large part of medium and large companies have directed their strategies and actions towards socio-environmental aspects, with environmental management as an essential tool to guide them (Wu et al., 2014). Accordingly, the Environmental Strategy is a valuable tool that excels in improving environmental performance (Kraus et al., 2020).

Coherently, these results, concerning the Environmental Strategy, confirm the research by Gunarathne and Lee (2021) and Mishra and Yadav (2021), in which the strategies aim at the use of environmental practices, which reduce the impacts caused on the environment and they improve people's quality of life, as well as promoting the organization's image and brand (Dellarmelin et al., 2018).

It is noteworthy that the question ES4 obtained the lowest percentage of agreement, 79.0% of the respondents stated that the most innovative companies use the Environmental Strategy to reduce the degradation of natural habitats and stop the loss of biodiversity, presenting an average of 4, 21 and a standard deviation of 0.926.

#### 4.4 Perceptions about organizational performance

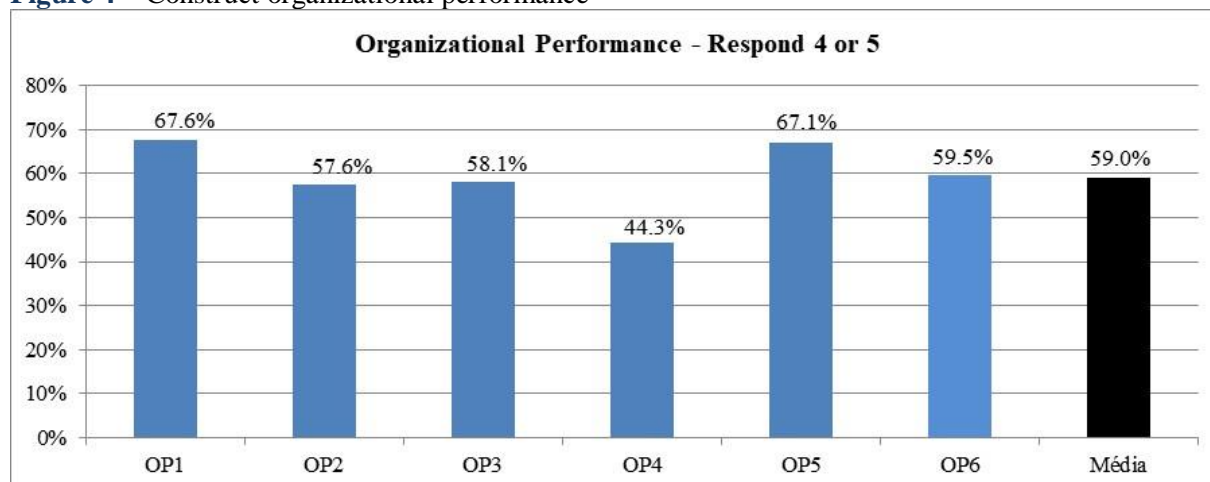
In the Construct of Organizational Performance (Figure 4), it is noted that, concerning question OP1, 67.6% of the respondents stated that the most innovative companies have superior product quality about competitors, presenting an average of 3.92 and a standard deviation of 0.987, in line with Zanatta's literature (2017), where it is emphasized that organizations started to invest in specialized processes and professionals to demonstrate more satisfactory performance about the environmental



issue. And that organizations that adhere to this concept tend to receive a beneficial return, reducing production costs, adding value to products.

Paladino (2007) emphasizes that the most innovative companies have superior product quality concerning their competitors, which is in line with the findings of this study. The research results confirm the study by Mehralian et al. (2016), where managers can incorporate total quality, and strengthen relationships with stakeholders, focusing on Organizational Performance.

**Figure 4** – Construct organizational performance



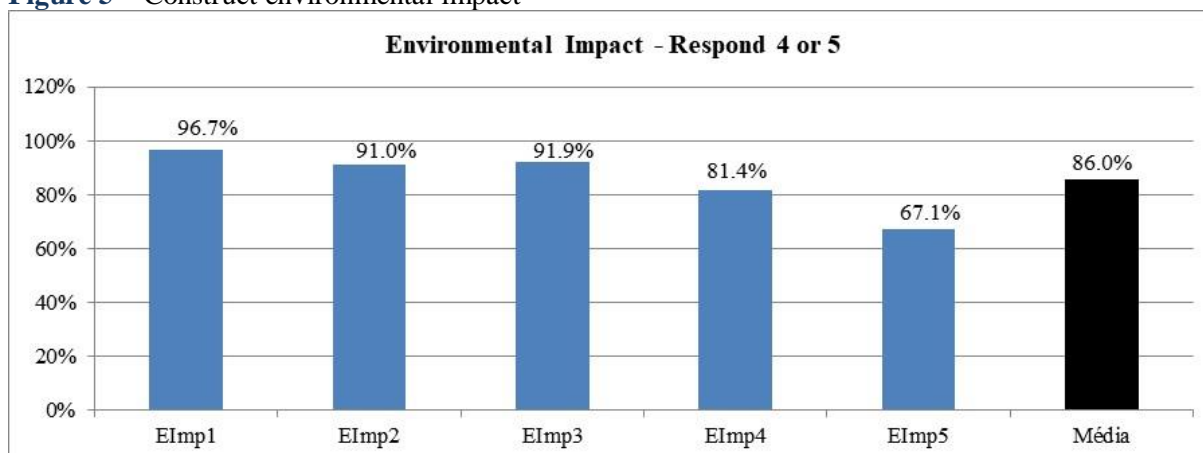
Source: Prepared by the authors (2020).

It is noteworthy that the question OP4 obtained the lowest index, where 44.3% of the respondents stated that government policies benefit the most innovative companies to improve their financial performance, with an average of 3.44 and a standard deviation of 1.132. This finding opens a link for the development of new government policies, which can benefit organizations of different sizes and sectors; with an emphasis on innovation, as innovation is a strong competitive differential for companies (Orji & Liu, 2020).

#### 4.5 Perceptions about environmental impact

Regarding the Construct of Environmental impact (Figure 5), it is highlighted that in the question EImp1, 96.7% of the respondents understand that the use of renewable energy sources (wind and solar) aims to reduce the environmental impact, presenting an average of 4.69 and a standard deviation of 0.608, in line with what Almeida et al. (2018), because to have economic growth reducing the Environmental impact, it is necessary that the industry and new technologies are focused on a production and product style that reduces the degradation of the environment, that is, that reduces emissions of polluting gases that cause the greenhouse effect, and consequently, pollution, improve energy efficiency, as well as resources and the preservation of biodiversity.

Figure 5 – Construct environmental impact



Source: Prepared by the authors (2020).

In this scenario, the EImp5 question has the lowest index, where 67.1% of the respondents understand that the most innovative companies do not carry out activities that negatively impact the terrestrial and marine environment, presenting an average of 4.24% and a standard deviation of 1.032. Coherently, companies need more scientific and technological knowledge to implement environmental practices that are positive for organizations and that do not harm the environment (Severo et al., 2020).

### 5 Analysis of the relationships between constructs

Initially, data reliability and normality tests were performed (Hair et al., 2010) related to the five Constructs defined for research. It was observed that all Constructs presented Cronbach's Alpha (simple reliability), and the Kaiser-Meyer-Olkin (KMO) are greater than 0.7, showing a satisfactory result when compared to that recommended by Hair et al. (2010), as well as for Bartlett's sphericity test ( $p > 0.001$ ), were within the parameters and were considered statistically adequate, as shown in Table 2.

Table 2 – Degree of reliability and normality of constructs

Constructs	Observable Variables	Degree of reliability*	KMO	Sphericity Test - Bartlett
Eco-innovation	6	0.882	0.831	0.000
Sustainable Awareness	7	0.872	0.885	0.000
Environmental Strategy	6	0.938	0.884	0.000
Organizational Performance	6	0.890	0.888	0.000
Environmental impact	5	0.835	0.801	0.000
All Constructs	30	0.929	0.892	0.000

Note: \* Standards-based Cronbach's alpha.

Source: Prepared by the authors (2020).

Through multiple linear regression analysis (step-by-step method), we sought to verify which relationships exist between the Constructs established for the research, performing five multiple linear regressions. In this context, the individual averages of each Construct (Eco-innovation - EI; Sustainable consumption - SA; Environmental Strategy - ES; Organizational Performance - OP; Environmental impact - EImp) were used, which were considered as dependent variables and other statements of the other Constructs were considered independent variables, resulting in the data shown in Table 3.

**Table 3 – Multiple linear regressions**

Model	R	R <sup>2</sup>	R <sup>2</sup> Adjusted	Standard Error of the Estimate
<b>SA, ES, OP, EImp--&gt;EI</b> Predictors (Constant EImp1, ES4, EImp3, OP6, OP4) Dependent Variable (Mean EI)	0.659	0.434	0.420	0.5040
<b>EI, ES, OP, EImp--&gt;SA</b> Predictores (Constante OP1, ES1, OP3) Dependent Variable (Mean SA)	0.505	0.255	0.244	0.8969
<b>EI, SA, OP, EImp--&gt;ES</b> Predictors (Constant EImp1, EImp5, SA6, EI4, OP5, EImp4, SA3, EI3) Dependent Variable (Mean ES)	0.720	0.518	0.499	0.5713
<b>EI, SA, ES, EImp--&gt;OP</b> Predictors (Constant SA5, EImp5, ES6, SA6) Dependent Variable (Mean OP)	0.572	0.327	0.314	0.6725
<b>EI, SA, ES, OP--&gt;EImp</b> Predictors (Constant ES4, EI3, OP6, ES5, SA2, SA6, SA4, EI5) Dependent Variable (Mean EImp)	0.757	0.573	0.556	0.4250

**Source:** Prepared by the authors (2020).

According to Lee and Spratling (2019), the effectiveness of the snowball sampling technique using social media was detected. The snowball technique was also used and validated in the research by Severo, De Guimarães and Dorion (2018), Severo, Guimarães, Dellarmelin and Ribeiro (2019), and Severo, De Guimarães and Dellarmelin (2021), in which the researchers they sent the questionnaire to their contacts through social networks, and they subsequently passed on the survey to other contacts. A safe and efficient method, mainly at the time of the Covid-19 Pandemic, in which social isolation is valued (Severo et al., 2021).

In addition to the questions related to the respondents' profile, the questionnaire presents 31 statements on a 5-point Likert scale, which vary between (1) strongly disagree and (5) strongly agree, which were divided into five research constructs (Table 1): i) Construct of Eco-innovation - adapted from research by Severo et al. (2018) and Severo et al. (2020); ii) Sustainable Awareness construct - adapted from the study by Severo et al. (2019a); iii) Construct of Environmental Strategy – elaborated by the researchers; iv) Organizational Performance construct - adapted from studies by Paladino (2007), De Guimarães et al. (2016) and Severo et al. (2019b); and, v) Environmental impact construct

- developed by the researchers. Accordingly, the questionnaire was previously validated by two doctors who are experts in the thematic areas of study, as well as a pre-test with 13 respondents to understand the questions.

For data analysis, the descriptive statistics technique was first used (Hair et al., 2010), which is used to transcribe the data for a given sample using measures of variance (mean and standard deviation). Subsequently, in accordance with the recommendations of Hair et al. (2010), multivariate data analysis was used, using statistical tests and multiple linear regression (stepwise method), the latter being a descriptive statistical analysis to assess the influence suffered by a dependent variable in relation to the effects more than one independent variable. Therefore, in the treatment of the research data, the SPSS® Version 21 software for Windows was used.

According to the parameters of Hair et al. (2010), concerning the degree of importance of  $R^2$ : i) below 0.3 there is a low influence; ii) between 0.3 and 0.5 there is a moderate influence; iii) above 0.5 is considered a high influence. Evaluating the data presented in column  $R^2$  of Table 3, it can be evidenced that the highest result (0.573), of high influence, is related to the factors that influence the Construct of Environmental impact, which presents as predictors, issues associated with Environmental Strategy to reduce the degradation of natural habitats, long-term sustainability, Eco-innovation as a point of improvement in the quality of life on the planet, as well as the objective of treating effluents/sewers appropriately. These results corroborate the research by Cechin and Pacinei (2012) since environmental impacts can be minimized using the green economy, which is an economic system dominated by investment, production, commercialization, distribution, and consumption, which respects the limits of ecosystems. Yang et al. (2020) highlight that by meeting the expectations of consumers about environmental / emissions regulations, companies improve the quality of life on the planet.

Second, also with high influence ( $R^2$ ) (0.518), for the Construct of Environmental Strategy, which is influenced by issues related mainly to environmental impacts on renewable sources, gas emissions, and processes/activities that do not harm the environment. Sustainable Awareness issues such as reducing the use of plastics and proper disposal of batteries, batteries, and televisions and greater competitiveness also appear as influencing the Environmental Strategy average. Therefore, the results demonstrate the high influence exerted by the predictors of the Construct Environmental Strategy under the Construct of Environmental impact and vice versa, a fact that reaffirms the results presented by Severo et al. (2018), where they show that organizations reduce the Environmental impact of their performance through environmental practices and the adoption of clean production.

When referring to the factors that influence Eco-innovation, whose  $R^2$  resulted in 0.434, representing a moderate influence, we highlight statements related to the Constructs of Environmental impact regarding the use of renewable energy sources and the conservation of protected areas with the objective of preserving the biodiversity of terrestrial and marine species, evidencing the statement that environmental practices are positively related to Eco-innovation (Latupeirissa & Adhariani, 2020;

Severo et al., 2020). The same Construct is also influenced by questions associated with Organizational Performance, where respondents conceptualize the innovative company, there are profit distribution policies that benefit its employees financially, as well as government policies that help innovative companies financially.

Table 3 shows the result of  $R^2$  at 0.327, also as a moderate influence on the Construct of Organizational Performance, in explaining the variability of the data in the dependency relations between EI, SA, ES, EImp  $\rightarrow$  OP. Recycling and reducing the use of plastic bags, reducing or eliminating activities that negatively impact the terrestrial and marine environment and the statement that Environmental Strategy promotes the improvement of the image and brand of the most innovative companies appear as items that influenced the Construct average in question, demonstrating positive impacts on the relationship between innovation and market orientation (Paladino, 2007), as well as on the rise of Organizational Performance through innovation (De Guimarães et.al., 2016; Severo et al., 2019b). Maletič et al. (2018) also emphasize that environmental sustainability practices seem to be a predominant predictor of Organizational Performance.

And finally, the Construct of Sustainable Awareness had a low influence, with  $R^2$  at 0.255, consistently, there is less power of influence, in which the statements linked to the Constructs of Organizational Performance and Environmental Strategy, being that the innovative companies have products with superior quality and a wider geographical scope (market niche) compared to competitors, as well as using the Environmental Strategy to improve the efficiency of natural resources. It is noted in this result, that Sustainable Awareness does not suffer significant influence from the other Constructs, however, it can encourage new consumption behaviors and implement social responsibility in individuals (Anzilago, 2017; Doyle 2018; Severo et al., 2019a).

## 6 Final considerations

This study aimed to analyze the relationships between Eco-innovation, Sustainable Awareness, Environmental Strategy, Organizational Performance, and Environmental impact, in the perception of 210 respondents from Northeast Brazil. In this context, the Construct of Eco-innovation presented the highest average of responses (88%), which corroborates the theoretical assumptions of Severo et al. (2018), regarding the importance of Eco-innovation as an essential element to reduce environmental impacts. However, the Construct of Environmental Awareness was that the one with the lowest average response (52%), this indicates that in the Northeast there is still a great opportunity to expand the Sustainable Awareness of people, which can also influence their actions for waste segregation, recycling, and consumption of natural resources. The opportunity for public and educational policies in the environmental field is evident, emphasizing information on the importance of the correct segregation of waste, the impacts caused by human and industrial actions, the importance of preserving natural resources for future generations, as well as for people's quality of life.



About the relationships between the Constructs used in the research, five multiple linear regressions were made, which showed a high influence (57.30%) on the influencing factors of the Construct Environmental impact, which presents as predictors, the issues associated with Environmental Strategy as reducing the degradation of natural habitats.

Management contributions are linked to information for managerial decision making, since the themes of Eco-innovation, Sustainable Awareness, Environmental Strategy, Organizational Performance, and Environmental impact, can be used to outline new managerial decisions, which aim to increase the competitiveness of companies and reduce aggression to the environment.

It is worth mentioning that, in organizational strategies, it is essential to use environmental precepts, which aim at Eco-innovation, as well as the use of environmental practices, which bring a better performance to companies. These findings contribute to the advancement of science, concerning strategy, listing environmental and Organizational Performance assumptions.

About theoretical contributions, the study statistically validated the Constructs and scales of the research, so this Framework can be used by other researchers, as well as contributing to the advancement of research related to the themes. However, the results cannot be generalized, because in the sample there are respondents from the Northeast region. For future studies, an expansion to other regions of the country is suggested, which would allow a comparison between the regions, in addition to a vision at the level of Brazil.

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