THE POTENTIAL IMPACT OF AGRICULTURAL PATENTS ON SUSTAINABLE DEVELOPMENT GOALS: A STUDY IN A BRAZILIAN ACADEMIC UNIT

ABSTRACT

Nowadays, humankind faces significant challenges related to environmental preservation, social welfare, and reducing inequalities. In the technological field, the existing technologies are insufficient to overcome these challenges. As such, it is necessary to develop new technologies that can pave the way for a more sustainable future. Despite these urgent challenges, the current study of the development and diffusion of technological innovations remains focused only on the role of free markets in their development and diffusion. As such, this perspective is insufficient to guide a sustainable future. To expand the scope of analysis of technological innovation, the Sustainable Development Goals (SDGs) seem to be a promising approach. In this context, universities in their academic units can contribute to the development of new technologies through applied research. To the best of our knowledge, literature is still lacking in studies that gather topics, SDGs, and the development of technological innovation in the university context. Addressing this research gap, this study evaluates the potential performance of patents related to the SDGs at a Brazilian academic unit that generates patents in the fields of agriculture, forestry, and veterinary science. Through a documentary approach, a total of 24 patents were screened. Of the 17 SDGs, 13 were identified as having potential positive impacts of the patents. As the main contribution, this article demonstrates that universities can play a pivotal role in developing more sustainable technologies. This article extends the current view of technological development beyond the market perspective to provide a holistic view based on SDGs. For the practice, it can guide the development of policies to promote technological development, guided by the environmental, economic, and social benefits.

Key-words: green innovation; SDGs; sustainable development goals; university-industry; technological innovations; innovation.

1 INTRODUCTION

Technological innovations have been responsible for profound societal transformations in several fields. (Chaminade & Randelli, 2020), ranging from significant increases in production capacity to social and cultural changes, with both positive and negative outcomes (Batabyal & Nijkamp, 2013). Thanks to the importance of technological innovation in economic development, it has been the subject of interest for several researchers for a long time. Joseph Schumpeter is one of the first and most prominent thinkers in this field. (Velardo, 2025). According to Schumpeter, technological innovations occur when a new good or process is commercialised in the economic system. As such, technological innovations are typically a result of entrepreneurial creativity in capitalist systems. (Nunes, 2016).

Since Schumpeter, the literature has approached innovation from the perspective of its effect on productivity and profit for firms (Antonelli & Scellato, 2011). The profit should be considered; however, the present socio-economic challenges are currently challenging this monotonic perspective, considering the numerous environmental and social challenges. From an environmental perspective, in addition to the climatic changes caused by global warming, other problems include soil, water, and ecosystem degradation (Mobilia et al., 2023; Zea et al., 2022). In the social field, it has been observed that the existence of hunger (van Dijk et al., 2021), and the difficult access of a considerable part of humankind to the basic means of a dignified existence, such as access to clean water (van Vliet et al., 2021)), education, health,

and even institutional stability (Bose & Khan, 2022). Although the market mechanism has been proven to be an efficient means for introducing technological innovation, benefiting a considerable part of the global population, given the current social and environmental challenges, this perspective, focused solely on profit and individual interest, seems insufficient to address the current social and ecological challenges. As such, this perspective should shift from this strict scope to a broader scope based on the sustainability principles.

Sustainability refers to the ability of society to provide sufficient resources for the well-being of the current population without compromising the well-being of future generations. (Pascual et al., 2023). Among the approaches to better associate this concept with reality, the United Nations Sustainable Development Goals (SDGs) offer a detailed and practical perspective that enables the assessment of sustainability levels in various fields for specific phenomena, encompassing 17 SDGs. As such, considering the current challenges, the performance of technological innovations may be assessed in terms of their contribution to the improvement of SDGs. To the best of our knowledge, despite the importance of adopting a holistic perspective to determine the contribution of technological innovations in the contemporary world, this approach is still not commonly used. Consequently, current studies are still primarily focused on their economic assessment, to the detriment of their social and environmental performance.

The purpose of this article is to assess the potential performance of patents on SDGs at a Brazilian academic unit that generates patents in the agricultural, forestry and veterinary fields. Through a documentary approach a total of 24 patents were screened. From the 17 SDGs, a potential positive impact of the patents was identified in 13 SDGs. As such, this study examines the implications of shifting the current perspective on technological innovation from a market-based to a sustainability-based approach.

2 SUSTAINABLE DEVELOPMENT GOALS AND INNOVATION

2.1. SUSTAINABLE DEVELOPMENT GOALS AND PATENTS

The Sustainable Development Goals (SDGs) are fundamental principles established in the 2030 Agenda by the United Nations to guide nations and humankind toward a sustainable future. SDGs comprise 17 interdependent goals, comprising several targets. (United Nations, n.d.). Namely, each one of the 17 SDGs seeks to: SDG1: End poverty; SDG2: End hunger; SDG3: Ensure health; SDG4: Ensure education; SDG5: Gender equality; SDG6: Clean water and sanitization; SDG7: Access to sustainable energy; SDG8: Decent work; SDG9: Sustainable industrialization; SDG10: Reduce inequality; SDG11: Sustainable cities; SDG12: Sustainable consumption; SGD13: Mitigate the climate change; SDG14: Promote life below water. SDG15: Promote life on land; SDG16: Promote peace; SDG17: Promote partnership to attain the goals.

In the context of the SDGs, the agricultural sector is pivotal, as it provides the basic means of human existence, based on food and various raw materials essential for contemporary life. (Byerlee & Fanzo, 2019). As such, Figure 1 illustrates the mutual relationship between the SDGs and agricultural activities. It is also necessary to consider that improving agricultural systems to enhance their performance in achieving the SDGs requires the adoption of technological innovations.

2.2. A POST-SCHUMPETERIAN PERSPECTIVE OF INNOVATION – THE SUSTAINABILITY

Considering the main theoretical streams on the role of technological innovation in the capitalist system, it is possible to identify, firstly, the Schumpeterian perspective, which

conceives creative destruction as a central phenomenon, referring to the emergence and decline of industries due to the continuous launching of new products that can cannibalise existing ones in markets. (Velardo, 2025). One example is the substitution of sailing ships by steamships, followed by ships powered by combustion engines. (Mendonça, 2013).

In the context of new Schumpeterian research streams, capitalist transformation is associated with the emergence and decline of technological paradigms. A technological paradigm encompasses a set of knowledge and material elements designed to address specific problems through collaboration among various agents, including universities, firms, and the government. (Dosi, 1982). Finally, the evolutionary perspective of Nelson & Winter (2002) Considers the importance of organisational processes and human creativity in the creation of innovations, as well as the continuous effort of firms in achieving success in markets. For these authors, free markets are essential as a mechanism for selecting individuals (or firms) that constantly strive to differentiate themselves in an ever-dynamic system.

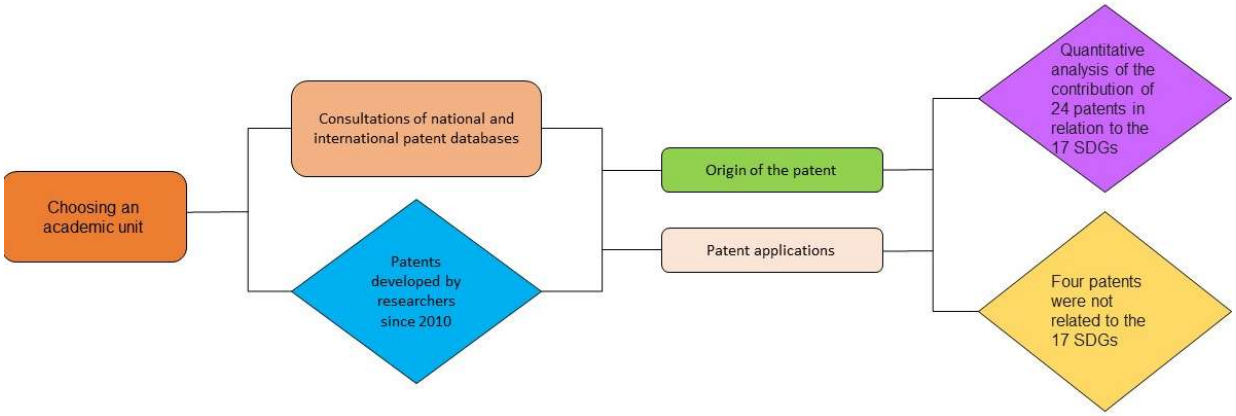
One can consider that a common assumption of several theoretical strands about innovation is based on two principles, which seek to maximise profits through innovation and the utilitarian choice of consumers.(Antonelli & Scellato, 2011). As such, the predominant perspectives still lack a view of technological innovation that transcends the free market perspective towards one based on sustainability**.**

3. METHODOLOGY

This research was based on a documentary analysis of patents developed by researchers assigned to an academic unit of a Brazilian public university. Figure 1 shows its basic steps. The unit conducts research, teaching, extension, and innovation activities in the fields of agriculture, forestry, and veterinary science. Trademark and software registrations were not considered. The choice to analyse patents related to agricultural technologies is because this field is closely linked to the issue of sustainability, both in terms of its connection to food provision and environmental preservation.

The academic unit (henceforth referred to as AU) in question offers nine undergraduate programs and 17 graduate programs, with over 100 researchers. The study aimed to understand how patents developed in the AU can potentially contribute to the improvement of the SDGs, whether they are incorporated into markets as products or services.

Figure 1: Research methodological design



Source: Developed by the authors

Based on the university report, within which the AU is located, 28 patents were identified by this unit, of which four are related to pure science, such as patents related to genetic coding and manipulation, without a direct application in agriculture or a related field at the time of the research. As such, this research considered only 24 patents that demonstrated clear

applications and, consequently, relations with the SDGs. For data collection and codification, each patent document was screened, and the authors held discussions to systematically identify how each patent could contribute to the improvement of the SDGs.

4. RESULTS

4.1. GENERAL DATA

For the general analysis of the patent data, two initial variables were considered: the patent origin and its applications. When analysing the 24 patents, five origin groups were initially observed according to their scientific origin: agriculture (28.6% of patents), biological sciences (25% of patents), engineering (25% of patents), chemistry (14.3% of patents), and food science (7.1%). Based on the analysis of patent origin, patent applications were classified, with four of the 28 patents having functions that did not apply to the SDGs. The applications were classified into five groups: agronomy (50% of patents), industry (33.3% of patents), veterinary science (8.3% of patents), ecology (4.2% of patents), and forestry (4.2% of patents). After this classification, this study evaluated the potential impacts of patents on SDG performance.

4.2. PATENTS' POTENTIAL IMPACT ON SDGs PERFORMANCE

Through the screening of the patents deposited by the AU, it was possible to identify the potential impacts of the inventions on the SDGs. From the seventeen SDGs, this research verified the potential positive impact of the 24 inventions on thirteen (see Table 1). In this sense, the eventual introduction of inventions from the 24 patents into markets tends to contribute to reducing poverty (SDG 1). Seventeen patents can directly contribute to achieving SDG 2, which aims to eliminate hunger, by increasing the efficiency of agricultural production. In this same vein, the eventual introduction of all the patent inventions in markets can contribute positively to the generation of new jobs (SDG8). From the 24 patents, 14 described the development of materials that can be employed in the production of medicines (SDG3), and 10 can be introduced in new industrial processes making them cleaner (SDG9), nine can improve the life on lands (SDG15), 6 generates materials that can contribute to the sanitization (SDG6), and four can be used to improve the life quality in cities (SDG11). In a minor quantity there was identified inventions that can improve the educational content (SDG4), as the case, of a method to determine the ecological quality of a specific environment, one can contribute to production of clean energy (SDG7), two that can contribute to the mitigation of emissions (SDG13), and two to the improvement of life under the water (SDG14). Finally, among the 24 patents, in 17 cases, the participation of the university where the AU is located was verified, along with other agents, such as firms, funding agencies, and other universities, indicating partnerships for achieving SDGs (SDG 17).

Table 1 – The potential impact of patents on SDGs.

SDG	1	2	3	4	6	7	8	9	11	13	14	15	17
Item	Pov.	Hunger	Heal.	Educ	San.	Ene.	Wor.	Ind.	Cit.	Clim.	Wat.	Land	Part.
Qte	24	17	14	1	6	1	24	10	4	2	2	9	13
%	100	70,8	58,3	4,1	25	4,1	100	41,66	16,6	8,3	8,3	37,5	54,1
Legend: Pov. – No Poverty; Hung. – No Hunger; Heal. – Health; Educ. – Education; San. – Sanitization; Ene. – Energy; Wor. – Work; Ind. – Industry; Cit. – Cities; Clim. – Climate; Wat. – Water; Part. - Partnership													

5. DISCUSSION

There are some differences among the SDGs impacted by the patents. It is possible to observe that the inventions of the AU generates more impact (more than 50% of the inventions) on the SDGs 1 (no poverty), 8(more jobs) 2 (no hunger), and 3 (health), a moderate impact (between 20 and 49%) on the SDGs 15 (land), 6 (sanitization), and a minor impact on SDGs 4 (education), 7 (energy), 4 (cities), 13 (climate). This difference can be attributed to two aspects: the nature of the research conducted by the AU, which is primarily in the fields of agriculture, forestry, and veterinary sciences, and is greatly supported by the basic sciences of biology and chemistry. In this case, it is natural to expect that researchers in agriculture can generate a positive impact in the elimination of hunger and create technologies to preserve life on land. However, the second factor that influences the invention of the AU is the research focus of its researchers. Despite the academic unit's focus on agriculture, forestry, and veterinary, there was a low emphasis on inventions in clean energy and life below water, reflecting a limited focus in some fields that fall within the scope of these disciplines.

While there was consideration of the impact of the inventions on the twelve SDGs, the partnerships for the improvement of SDGs, as outlined in SDG 17, play an opposite role. That is, the articulation of agents can be viewed as a necessary cause, rather than a potential consequence, for the improvement of SDGs. Finally, the lack of association of the inventions with the SDGs, gender, reduction of inequality, and peace can be interpreted as being in the technical domain of agricultural, forestry, and veterinary; they are not directly related to these SDGs, which are inherently related to the existence of social systems and institutions that ensure them.

6. CONCLUSION

This study analyses how inventions of an academic unit can contribute to the improvement of SDGs. It shows that of the 17 SDGs, patents can generate benefits for 12 and depend on the articulation of several societal stakeholders (SDG 17). Its main contribution is to build a framework that relates academic research and technological innovation to their impacts on the SDGs. As a practical implication, this highlights the necessity of establishing a clear relationship between academic research, its implementation through new technologies, and its impact on achieving the SDGs. As a suggestion for future studies, this research could be enhanced by a more detailed examination of how academic units in various fields can contribute to achieving the SDGs and, consequently, to improving economic, environmental, and social welfare. Finally, it introduces a normative perspective on technological innovation that considers the sustainable impact of new technologies, beyond a purely market-based view.

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