The meso-institutions as a collaborative instrument of the circular economy: a comparative study of bioplastics between Brazil and France

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Summary
The role of meso-institutions is fundamental in the organization of production chains and public policies on plastics. The aim of this article is to analyze and make a comparative approach, through which we will show the specific role of meso-institutional intermediaries. The theoretical approach used in the article takes an analysis of the performance of meso-institutions designed to guarantee safety. The methodology is based on a narrative review of the literature, documentary and normative research, and semi-structured interviews with relevant players in the sector. This is exploratory qualitative research. We can conclude from this article that the absence of a globally standardized definition of bioplastics favors negative effects, such as greenwashing. In France, the role of meso-institutions exists, whereas in Brazil, meso-institutions do not exist due to the absence of macro-institutions.

Keywords: bioplastic, meso-institutions, circular economy

1. Introduction

This article analyzes the differences and similarities in the implementation by meso-institutions, from certifiers in Brazil and France, concerning the bioplastics sector. Indeed, although bioplastics are important for reducing the externalities of the oil chain and the accumulation of plastic waste in the environment, there is a lack of regulation by macro-institutions in both countries concerning this type of material. In this sense, the role of meso-institutions is fundamental, particularly with regard to the organization of production chains and public policies on plastics.

The theoretical approach used in the article takes as its paradigm the article by Ménard et al (2022), *Governing food safety through mesoinstitutions: A cross-country analysis of the dairy* *sector*, which analyzes the performance of meso-institutions designed to guarantee the safety of raw milk delivered to a variety of users in three countries: Brazil, Canada and Italy. For the development of this article, several methods were used: a narrative review of the literature, documentary and normative research, and semi-structured interviews with relevant players in the sector. This is exploratory qualitative research.

In this article, the bioplastics sector was chosen for two main reasons. The first is the fact that environmental pollution by plastics, particularly those derived from petroleum and non-biodegradable, has led the scientific community to look for alternatives in sustainable materials. As a result, new materials are being developed and marketed as "environmentally friendly". However, in the wake of this socio-technical transformation, numerous conceptual and practical doubts have arisen, hampering the relationship between the various players involved, directly or indirectly, in the plastics production chain.

The second reason for choosing the bioplastics sector is the absence of macro-institutional regulation of this material. In Brazil, this fact inhibits a collective environment that favors the development of sustainable productive activity and the incorporation of socio-technical changes. In Europe, it leads to its exclusion by European Union (EU) Directive 2019/904, which, although aimed at reducing environmental impacts, only considers plastics that correspond to the idea of circularity for this purpose, even if these plastics are conventional, *i.e.* fossil-based and non-biodegradable. On the other hand, biodegradable and biobased plastics, when created for single-use purposes, are not directly encouraged, even though they simultaneously possess these characteristics and have less environmental impact.

Through this scenario, with the absence of regulation experienced by the Brazilian and French cases, meso-institutions assume, or should assume, the preponderant place in the places where they are installed. The analysis in this article will enable a comparative approach, through which we will show the specific role of meso-institutional intermediaries[1] .

1 According to Marotti et. al. (2022), institutions are linked to the theory of sustainable socio-technical transition. That determined the intermediaries: a) macro-institutional, which determine rules and regimes, as well as assigning rights; b) meso-institutional, which implement rules and regimes, through macro-institutional translation, monitoring, enforcement and feedback; c) micro-institutional, which develop strategies and establish organizational arrangements.

2. The role of certifiers in converting macro-institutions into socio-technical standards

According to the basis of the new institutional economy, three layers of institutions are assumed. At the top, within the institutional environment, are the macro-institutions, through which rights are constituted, defined, and allocated - in this sense, they are the "rules of the game and the general conditions for their implementation". At the lowest level, within organizations, we find micro-institutions, through which transactions are organized and the allocation/use of resources is shaped. (DAVIS, NORTH, 1971; NORTH, 1990; WILLIAMSON, 2000).

In the middle layer, there are the meso-institutions, which link micro-institutions to macro-institutions. It should be noted that through meso-institutions, general rules are transformed into specific technical norms for operators and users of devices and mechanisms (MÉNARD, 2018; MÉNARD, 2022). Regarding technical standards, their social purpose, contributing to collective character, has been acquired by considering that technology inevitably results from the interaction of human actions in a given social context, without the possibility of disentangling technical relations from social relations. Thus, technical standards are now seen as socio-technical standards, whereas by transforming general standards into specific ones, they should aim to reduce social impacts in the discipline of technological best practice (VALADÃO, et al., 2014).

Thus, by recognizing that meso-institutions play a key role in implementing the rules that shape the organization of transactions, we also acknowledge that they are indispensable to the realization of socio-technical change. From this perspective, meso-institutions are charged with four fundamental functions: 01) they translate the general rules and standards established at macro level, making them specific to a sector operating in a given time and space; 02) they oversee the effective implementation of the rules and standards thus adapted, by establishing protocols and/or procedures that actors must follow and that facilitate the monitoring of their compliance with the rules ; 03) they play a key role as enforcers, which requires their formal qualification to do so and their empowerment to constrain defaulting actors, ensuring compliance with rules and regulations, with sanction in case of non-compliance or reward in case of compliance; 04) they provide feedback to micro-institutional intermediaries on the application or formulation of macro-institutions (MAROTTI, et al., 2022).

It should be noted that, in this scenario, certifiers are understood as meso-institutions. In this sense, given the growing importance of certifications and the different standards and approaches introduced by EU member States, Regulation 765/2008 established a European accreditation system, with a general framework and principles for its management and organization. The regulation also aims to attest the technical competence of a body to carry out conformity assessment activities according to harmonized criteria. By establishing principles and general rules for accreditation, it aimed to reinforce the credibility of the certification system within the EU and ensure uniform application beyond the public interest of the free movement of goods and services within the EU (BELLISARIO, 2011, p. 27; ALTILI, 2012, p. 99).

It should be noted that standardization activity is a precursor to normalization, the latter evolving towards uniform technical standards, i.e. documents that establish criteria for projects, processes and methods. Standardization stems from concrete market demand, and spreads through the spontaneous use of standards in the production and distribution of products, services and processes. Technical standards are also intended to ensure that products do indeed meet the requirements set out in the overriding public interest: such as health, general safety or consumer and environmental protection. In this way, they play a strategic role in the development of the European common market, conceived as an area without internal frontiers, in which people, goods and services can move freely without discrimination or hindrance of any kind.

The European legislator itself defines the quality system as global, since it is made up of a multitude of elements (accreditation, conformity assessment, certification, standardization and market surveillance) designed and structured to guarantee compliance with applicable standards (EU, 2008). Each of these elements develops an autonomous function, but is instrumentally linked to all the others, so that the malfunctioning of one can determine the failure of the whole system. In this way, the EU has long used standardization in its various forms as an instrument of public policy. Furthermore, when we refer to ISO standards, we are talking about global governance, which associates the EU with the European Committee for Standardization (CEN).

3. The quest for global standardization and the lack of a definition of bioplastics by standardization bodies

Bellisario (2005, 1055-1066) explains the conceptual and historical aspects: technical standards are standards that contain specific norms, i.e. technical requirements that must be met. In order to obtain standardized technical standards, in 1901 the first institutional entity was created in Great Britain, the *Engineering Standards Committee*, which gave rise in 1919, at world level, to the *International Elettotecnical Commission* and the *International Federation of National Standardization Associations* (ISA); and at the end of the Second World War, the *International Organization for Standardization* (ISO). As a result, technical standards are articulated and developed at different levels - international, regional and national - to achieve standardization. To illustrate these levels, international organizations are cited such as: ISO; regional, such as the European Committee for Standardization (CEN), whose standards are identified by the acronym EN, and; national, such as UNI-EN (Italy) and the Brazilian Association of Technical Standards (ABNT, Brazil).

One of the main international standards bodies is ISO, based in Geneva, Switzerland, and made up of 167 national standards bodies, one for each country. Members are divided into full members, correspondents and subscribers. In the first category are those who influence the development and strategy of the standards issued, participate and vote at meetings, and sell and adopt the standard at national level. In the second category, there are those members who merely observe the evolution of standards and strategies, without voting rights at meetings, although they may sell the standard. In the third category are those members who keep abreast of ISO's work, but do not participate, sell or adopt ISO standards at national level. In the Brazilian case, it is the Associação Brasileira de Normas Técnicas (ABNT), a private non-profit association, which constitutes ISO as a full member (ISO, 2023).

In addition, ISO has over 800 technical committees and subcommittees made up of experts in the field of standardization, who are appointed by the full members. It should be emphasized that the technicians indicated are those who develop the draft standard in response to a market need in a specific field, for example, plastics. It is only with the vote of the full members that the draft is considered a standard. Consequently, there is a real marketing nature of the standards created by ISO, although an attempt is being made to dialogue with consumers through the Consumer Policy Committee (ISO, 2023).

Despite the worldwide importance of the technical standards created by ISO, this organization does not define bioplastics. In this sense, the concept developed by European Bioplastics is used and disseminated worldwide (JONES, 2020; BIOPLASTICS, 2022a). In this respect, to formulate its concept, European Bioplastics (2022a) brings together two fundamental characteristics: 1) biological basis, or ; 2) biodegradability. Based on these characteristics - and not on the bioplastic itself - a number of standards have been formulated by standardization bodies seeking to regulate the definition and methods of measuring 1) the biological basis and ; 2) the biodegradability of plastic products. These include technical standards issued by the *International Organization for Standardization* (ISO), the *European Committee for Standardization* (CEN) and the *American Society for Testing and Materials (ASTM).*

And as far as biobased materials are concerned, we can cite the ISO 16620 series, which aims to standardize the determination of the biobased content of plastics and has been reflected in European standards (EN) 16640, 16785-1 and 16785-2 (BIOPLASTICS, 2022). As far as biodegradability is concerned, there is an even longer list of standards, for example, those referring to: a) the inputs, outputs and potential environmental impacts of a product system throughout its life cycle: ISO 14040 and 14044, reflected in ENs 16760 and 16751; b) carbon footprint measurement, or green footprint: ISO 14067 and 22526; c) anaerobic biodegradation and industrial composting: ISO 18606 and 17088, reflected in EN 13432 and 14995; d) aerobic biodegradation of plastics on controlled composting conditions: ISO 14855; e) biodegradation in marine environments: ISO 18830, 19679, 22404, 22403, 22766; f) those that biodegradability in soil: EN 17033, and g) more currently, in 2022, conditions for biodegradation of plastics in home composting: CEN/TC 261 SC 4 WG 2. (BRITO, et al, 2011; BIOPLASTICS, 2022).

As there is no globally standardized definition of bioplastics, for example via an ISO standard, the tendency is for macro-institutions interested in environmental protection to exclude any concept of bioplastics. The absence of a definition generates: on the one hand, its absence leaves room for the perpetuation of environmental impacts; on the other, there is an extreme measure of macro-institutional exclusion of anything that might be considered bioplastic. What's more, the term bioplastic means that its use is not uniform. Sciences et Avenir journal has defined bioplastics as follows as a neologism coined by industry to cover plastics of widely varying composition and ecological interest (MULOT, 2007). The term bioplastic is used to designate two distinct realities: the origin of the resource (biobased) and end-of-life management (biodegradable and compostable).

European Bioplastics, which represents the interests of the bioplastics industry in Europe, and Metabolix, a leading bioplastics manufacturer, have adopted this definition (European

Bioplastics, 2021). "Bioplastics are recognized for their circular nature. These two directives (biobased and biodegradable) emphasize the potential to foster a European circular economy for mechanically recyclable biobased plastic packaging and compostable biobased plastic packaging," says François de Bie, President of European Bioplastics (EUBP), Europe's leading bioplastics association. He added: "The substitution of sourced petroleum resources with renewable resources is a key transition supported by this new legislation."

Biodegradation of a bioplastic depends on specific environmental factors such as temperature, humidity, oxygen, ph and the chemical structure of the polymer itself (KALE et al., 2007). According to Smith (2005), bioplastics can be categorized in several ways. Among other things, they can be classified according to their chemical composition, synthesis methods, manufacturing processes, economic importance or applications. Constraints limiting the development of bioplastics Confusion over terminology, high costs, properties that are not always favorable, end-of-life management issues and a negative image in terms of agricultural practices are all obstacles to the development of bioplastics.

Consumer perception and confusion about the concept of bioplastics is becoming an issue, as a major problem with bioplastics is confusion over terminology. Definitions of biodegradable, compostable and biobased bioplastics show that the distinctions between these terms are subtle and increase consumer confusion. The difference between the terms is unclear, and knowing how to distinguish these bioplastics is not obvious. This confusion leads many consumers not to pay attention to labels or certifications.

These factors create a bad perception among customers, because it is difficult to distinguish between the various types of bioplastics concepts and the format in which manufacturers market them are not the same.

bioplastic is the process that certifies, logos that are beneficial in giving credibility to the various claims made by manufacturers. These certifications also serve to inform consumers.

Costs are also a major obstacle to the development of bioplastics. Several sources are fairly unanimous on the price differences, and bioplastics are said to be 1.5 to 4 times more expensive than traditional plastics (MULOT, 2007; DIGREGORIO, 2009; DOUKHY, 2011).Despite the slowdown in the development of bioplastics, growth forecasts are excellent for the next few years. Bioplastics are a material in an acceleration phase. While bioplastics currently account for less than 1% of global plastics production, bioplastics production volumes are set to triple by 2027. As proof of this, more and more investments are being announced in this field (USINE NOUVELLE, 2023).

Based on the bioplastics picture, companies can develop awareness, source reduction, niche market development, certification and the use of resources that don't compete with food. Confente et al (2020) explore how consumers perceive innovative products made from bioplastics. The high perceived value of bioplastic products leads to greater purchase and exchange intentions, and in turn, this value is over-stimulated by consumers' green self-identification. Consumers thus show their willingness to accept bioplastic products whenever there is clarification of the product's value and potential positive effects on the environment, and when the alignment between the characteristics of these products and consumers' personal values is highlighted.

Cascading biomass use describes the efficient use of biomass for different purposes over time (for example, residues from agricultural food production used to produce bioplastics and residues from bioplastics production used for energy production. Next, we can observe Table 1 concerning the adaptation of biodegradation and disintegration criteria to biodegradation conditions.

Table 1. Adaptation of biodegradation and disintegration criteria to biodegradation conditions.

Biodegradation conditions	**Temperature**	**Biodegradation (over 90%)**	**Disintegration (less than 10% above 2mm)**
Industrial composting	50 - 70°C	Less than 6 months	Less than 12 weeks
Home composting	20 - 30°C	Less than 12 months	Less than 6 months
Biodegradation in soil	20 - 25°C	Less than 24 months	Not the requirement
Biodegradation in water	20 - 25°C	Less than 56 months	Not the requirement

Marine biodegration	20 - 25°C	Less than 6 months	Less than 12 months

Source: Sphere and Kaneka (2019).

From Table 1, we can identify the different biodegradation conditions such as: industrial composting, domestic composting, biodegradation in soil, biodegradation in water and marine biodegradation. This table also identifies analysis indicators such as temperature, biodegradation, em more than 90% and disintegration, em less than 10% above 2mm. We then turn to the next point concerning the case in France.

4. France: the case of bioplastics from the perspective of meso-institutions

In France today, two standards govern the designation of "biodegradable" and "biobased" packaging under composting conditions: NF EN 13432 for suitability for biodegradation under industrial composting conditions, and NF T51-800 for suitability for biodegradation under domestic composting conditions. EN" stands for European Standard. The letters "NF" stand for Norme Française, referring to a European certification. NF certification guarantees two elements. Firstly, the quality of the service or product. On the other hand, the safety of this product or service, in the sense that it has been verified to be complies with all applicable standards.

European and French standard NF EN 13432 on "packaging recoverable by composting and biodegradation" sets four acceptance criteria, all of which must be met for the material to be declared suitable for industrial composting. There are also specific labels for biodegradable materials, guaranteeing their biodegradability or compostability. Issued by certification bodies such as TÜV AUSTRIA, these marks of conformity are based on existing standards, in particular NF EN 13432 and NF T51-800, and are a direct continuation of them.

The revision of the Waste Framework Directive allows for the single collection of biodegradable and compostable packaging and biowaste, which can then be recycled through industrial composting or anaerobic digestion. Already in place in a number of member states, this scheme has already proved effective and will be mandatory across Europe by 2023.Biodegradable plastics verifiably enable more biowaste to be collected, helping to meet the new recycling targets. (SPHERE, KANEKA, 2019)

An ecotoxicity test is also mandatory, in line with OECD (Organisation for Economic Co-operation and Development) rules. "The claim that products made from biobased plastics contain harmful chemicals is not defensible because of the numerous tests required," denounces Hasso von Pogrell, referring to a study recently published by the University of Frankfurt. The methodology of the study, in which bioplastics were subjected to migration tests, seems highly questionable, as it differs considerably from the methodology of EU testing procedures. "Furthermore, the result of the study does not represent a specific characteristic of bioplastics. On the contrary, the different methodology leads to the same result when tested on conventional plastic products", explains Hasso von Pogrell.

Some biodegradable bioplastics do not meet the compostability requirements defined by European reference standard EN 13432. This standard specifies five main requirements, as shown in Table 2.

Table 2. Main requirements of standard EN13432.

The requirements	Explanation
The composition	The standard establishes a maximum concentration level not to be exceeded for volatile solids, heavy metals and fluorine present in the composition of the packaging material;
Biodegradability	The packaging material must be able to decompose rapidly, with a biodegradability threshold of at least 90% to be reached within 6 months.
The disintegration	After 3 months of composting, at least 90% (by mass) of the shredded packaging must pass throught the mesh of a 2mm sieve.
Final compost quality	The presence of packaging material must not affect the quality of the final compost (maintenance of chemo-physical parameters), nor present a danger to the environment.

Ecotoxicity	The standart includes ecotoxicity tests and requires performance to be greater than 90% of that of the corresponding control compost.

Source: Standard EN13432.

France has laboratories certified by TÜV AUSTRIA. APESA is the first French laboratory recognized by the leading certification body TÜV AUSTRIA to carry out tests for the OK Compost Home and OK Compost Industriel certifications, which certify the compostability of plastics and packaging.

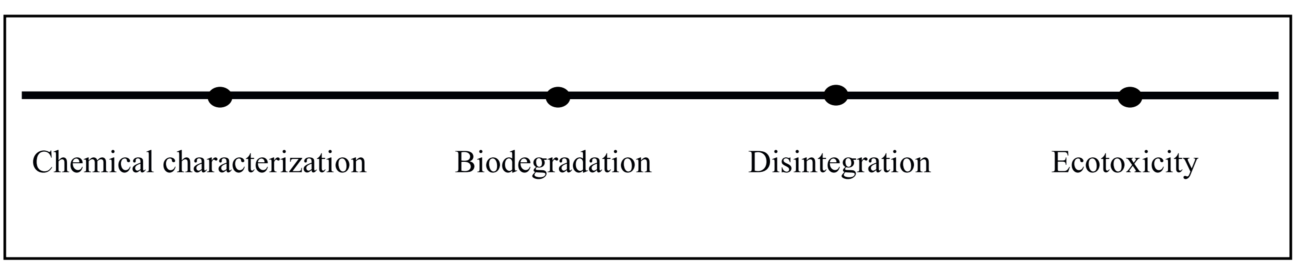
These labels guarantee that the materials can be composted completely without ecotoxicity for the environment. A total of 4 tests are required to obtain the label: a compositional analysis of the test material to check the content of pollutant compounds, in particular trace metal elements; the biodegradation test, which monitors the ultimate decomposition of the material in the form of CO_2; the disintegration test, which verifies that, under the conditions of the composting process, the material does indeed reduce to small particles.

This test ensures that the compost resulting from the processing of these bioplastics is not toxic to the environment, particularly with regard to plant germination and growth.

APESA carries out the entire test program, under industrial or domestic composting conditions, enabling us to obtain the OK compost HOME and OK compost INDUSTRIAL labels for plastics and packaging.

The other laboratory is WESSLING, which carries out compostability and biodegradability tests on products and packaging in its own laboratory. This French laboratory is doubly certified: by TÜV AUSTRIA and DIN CERTCO. Products undergo these successive tests: packaging that has passed all four tests in the laboratory can then be certified by TÜV AUSTRIA or DIN CERTCO.

Figure 1: Successive tests.



Source: Adpatation laboratoire Wesslin (2020).

Figure 1 shows the 4 stages of testing.

1 Test - Chemical characterization - Identification and chemical characterization of product components. Discover the product's components and physical characteristics.

2 Test - Product biodegradation - Determining the product's capacity to be consumed by an adapted microbial flora, via the conversion of organic carbon into carbon dioxide.

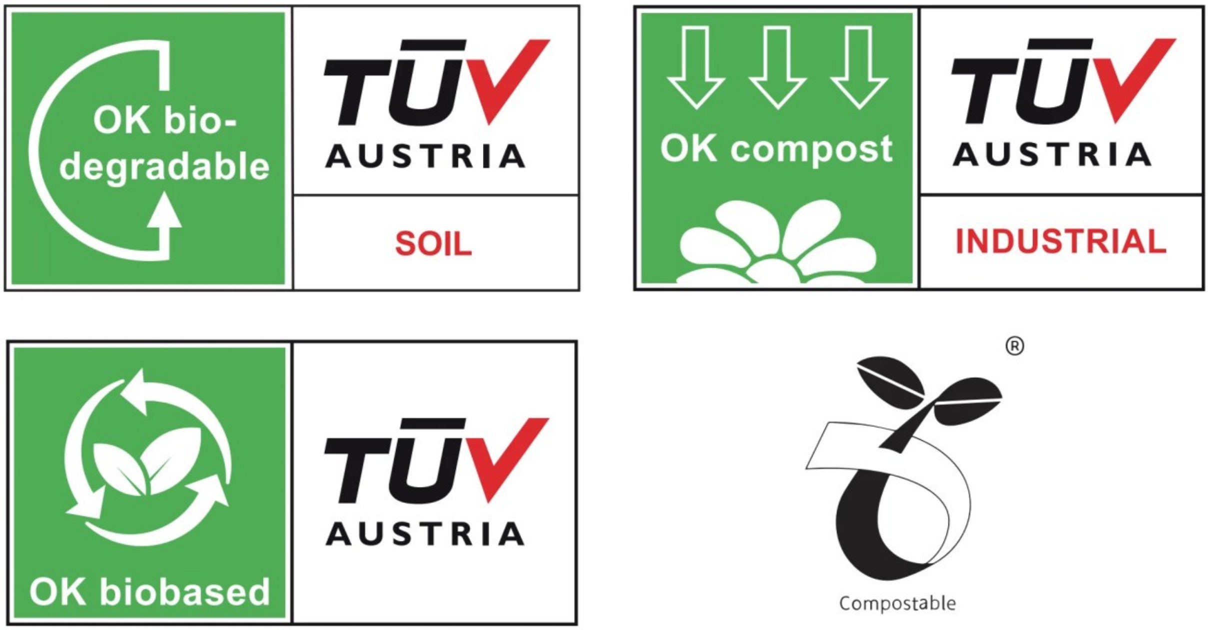
3 Test - Product disintegration - Determining the physical fragmentation of the product during composting.

4 Test - Ecotoxicity - Determination of the quality of the compost resulting from disintegration. Verification that residues of the tested product pose no risk to human or animal health, or to the environment.

The IPC (Centre Technique Industriel de la Plasturgie et des Composites) is the third French laboratory to be certified by TÜV AUSTRIA to carry out tests to assess the biodegradability of plastics in industrial and domestic compost (OK Compost Home, OK Compost Industrial and Seedling). These tests can be carried out on a wide range of products (plastics, composites, packaging, films, etc.). The tests carried out by IPC within the framework of this certification follow the specification standards in force at European level: N-FT 51800 and EN 13432, the certification for OK Compost Industrial and OK Compost Home.

Thanks to TÜV AUSTRIA's biodegradability assessment and certification, you can get a head start and communicate effectively with a label recognized at European level; guarantee the biodegradability of your products to your customers and consumers; test your plastics to recognized specification standards. The following diagram shows some of the labels issued by the certifier.

Figure 2: Examples of packaging logos.



Source: TUV (2022).

In the current scenario, biobased and biodegradable bioplastics are at least twice as expensive as conventional petrochemical plastics. However, if bioplastics production costs can be reduced, and a more viable business model developed, this could be one of the objectives of research and innovation.

5. Brazil: the case of bioplastics from the perspective of meso-institutions

Regarding bioplastic production in Brazil, there are still no statistical analysis demonstrating the volume of production or sales of this material in the country (JONES, 2020). On the question of bioplastics production technology, Karina Daruich, industrial chemist and biopolymer consultant, points out that "it's not difficult to do, pioneering companies like BASF, for example, have developed and the patents have already fallen. So, the whole world is producing, including Brazil. There's no such thing as a limit on production; there is a limit on demand”.

What's more, despite the lack of demand, as Jones (2020) points out, Brazil is "one of the world's largest producers of polymers from renewable sources, using sugarcane and ethanol". In this respect, one of the materials produced domestically is biobased polyethylene, or so-called green polyethylene, which comes from a renewable source, but is not biodegradable. As for this material, the Braskem company, in its "I'm green" product, has announced the extension of its production capacity from 200 thousand tons/year to 260 thousand tons/year, an increase of 30%, with a budgeted investment of US$61 million expected to be completed in the fourth quarter of 2022 (BRASKEM, 2021).

Another company with potential activities in Brazil is Earth Renewable Technologies, an American company based in Curitiba, Brazil. This company, in 2023, raised 50 million reais from XP Private and brokerage partners to finance the production of lactic acid-based bioplastic, which has both characteristics, a biological basis and biodegradability. With this investment, the company aims to increase its production from 3,500 tons/year to 35,000 tons/year (ERT, 2023).

As regards the concepts of bioplastics adopted by the Brazilian market, "there is that biobased, which is not biodegradable, there is that biobased and biodegradable, and there is also that fossil-based, however, biodegradable, there are these three definitions, essentially, of bioplastic", points out Karina Daruich. As a result, we observe that Brazil uses the generic concept disseminated by European Bioplastics, which excludes from the concept only conventional plastic, i.e., fossil-based and not biodegradable.

The bio-based non-biodegradable plastic has the same characteristics as conventional plastic, and can therefore replace it, however, it has a positive impact during the production process, by capturing carbon. In the other hand, in the post-consumer phase, its residues suffer from the same problems as fossil-based non-biodegradable plastics, since they don't degrade either. So, the waste from bio-based non-biodegradable plastic, such as green polyethylene, can lead to accumulation in rivers and oceans, as well as microplastics.

To produce plastic from a biological basis, various feedstocks are used, including starch, which can be obtained from organic compounds of cassava, potatoes, corn, soybeans, rice, among others, followed by ozonation (USP, 2019). Another potential feedstock is ethanol, obtained from the fermentation process of sugarcane. In this case, ethanol is dehydrated to obtain ethylene, which can be purified and used to plastic production (ERENO, 2007). We can also mention lactic acid, which can also be obtained from the fermentation of natural sources, such as sugarcane bagasse, followed by polymerization (DO AMARAL, BORSCHIVER, MORGADO, 2019).

Despite the existence of several studies on the sector in Brazil, it's clear that it’s the biobased non-biodegradable plastics that are gaining in importance. In this sense, bio-based and biodegradable plastic remain; as well as fossil-based and biodegradable one. In this context, there is a lack of infrastructure with regard to the biodegradability characteristic of plastics, whatever their origin. Although, biodegradability itself faces its problems, such as the definition of the time required and specific laboratory conditions for biodegradation (COSTA, 2018).

As an alternative to the very idea of biodegradability, compostability is presented. In this sense, composting is considered on the basis of defined temporal criteria and conditions more consistent with the everyday destination of plastics (COSTA, 2018). On the other hand, as Karina Daruich explains, "in Brazil, we have this deficiency: we don't work on composting, there are companies that do composting, but it's still in its initial phase".

However, more basic than the regulation of the actual composting activity itself, which could be implemented through macro-institutions, there is no action in Brazil at national level that regulates the subject of plastics, nor bioplastics, either by the Legislative Authority, or by the Executive Authority. Where they do exist, what is observed is the implementation by states and municipalities of ordinary laws that regulate specific actions (SENADO FEDERAL, 2021). As an example, we can cite Law no. 17.261, of January 13, 2020, of the Municipality of São Paulo, which concerns the prohibition of the supply of plastic products in specific places. The Law of São Paulo, in art. 2, determines: "In place of plastic products, others with the same function may be supplied in biodegradable, compostable and/or reusable materials, in order to enable recycling and accelerate the transition to a circular economy.".

Another Law, this time at state level, concerning the use of bioplastics is nº 16 268, of May 29 2008, of the State of Goiás. This Law prohibits the use of plastic bags in certain establishments, such as supermarkets and emporiums. However, its validity has already been modified twice, from 01 to 05 years and from 05 to 10 years. The lack of public regulation at national macro-institutional level is compounded by a lack of certification at meso-institutional level.

It should also be noted that in Brazil, there is no certifier for bioplastics. There are few laboratories, such as the SENAI Institute and the Technological Research Institute (IPT), which test biodegradability or the origin of a biological basis, without the certification of the report issued. Stelvio Mazza, CEO of the Já Fui Mandioca company, confirms the same, pointing out the absence of product inspection. As a result, in Brazil there is a real asymmetry between technical information, materialized by standardized norms and attested by certifiers, and the information transmitted to the end consumer.

So, at the micro-institutional and organizational level, the market for biobased biodegradable plastic - the true bioplastic - is constantly challenged in Brazil by three major issues: "the plastic industry still doesn't encourage it; there is no way to dispose of and recover the material due to [the absence] of composting and the lack of certification", as Karina Daruich understands it. The following factors are integrally linked to these three points: lack of demand, lack of infrastructure, high raw material prices and lack of legal incentives.

When analyzed from a macro-institutional point of view, we perceive the inadequacy of national plastics regulations. Not only that, but also an absence of public policy based on the following central pillars: a) tax incentives for organizations investing in the sector; b) infrastructures, such as the implementation of the implementation of composting in communes, beyond the abstract scenario of the National Solid Waste Policy; and c) environmental education.

As far as the meso-institutional layer is concerned, it is understood that with established demand and public incentives, it would be possible to establish certifiers and laboratories in Brazil. In this context, in addition to certification, it is understood that certifiers could also take on the meso-institutional roles of communication and inspection of the true bioplastic product. Consequently, through meso-institutions, an organizational culture on bioplastics could be established, in line with globally standardized technical standards that attest the biological basis and biodegradability.

6. Final considerations

Once the study is complete, several lessons should be drawn. The first is that, in both the EU and Brazil, there is no public policy to encourage the creation, innovation, production or marketing of bioplastics, nor any macro-institution that determines its conceptualization. As a result, given this lack of regulation, we observe an open scenario for meso-institutions to form at the expense of macro-institutions.

The second lesson concerns the situation in France regarding bioplastics. In this respect, it should be noted that in this country, the technical standards, which include concepts, established by ISO are followed by certifiers based in the EU. So, even if there is no concept of bioplastics per se by the standards bodies, certifiers are able, through the basic concepts of 1) biological basis and 2) biodegradability, to inform the consumer with greater confidence and precision about the characteristics of the plastic product marketed.

In this sense, in France, the asymmetry between technical information and the information transmitted to the consumer is reduced, and the role of certifiers is better recognized by consumer practice. What's more, even in the French case, we observe a trend towards the biodegradability characteristic of the plastic product, since domestic composting practices are encouraged, through the implementation of public policies aimed at environmental education, and industrial composting, through policies focused on public service infrastructures.

The third lesson concerns the Brazilian sample. In this way, it is understood that in Brazil, in addition to having no direct incentives through macro-institutions about bioplastics, there are also no indirect incentives through public policies aimed at infrastructure and environmental education. Nor are there any meso-institutions that certify, promote reverse logistics and inform consumers about the characteristics of a biobased biodegradable plastic.

Faced with this lack of macro and meso-institutions, Brazil, through its own economic agents, is highlighting the biological basis of plastic products. This is due to the absence of public policies that promote the biodegradability characteristic through the creation of infrastructures and environmental education, as well as to the fact that there is a large supply of biomass residues on the market. Moreover, in the absence of any institutional support, the concept of biodegradability is corrupted by common usage, and can be used for *greenwashing* purposes.

It is understood that an alternative that would strengthen material research in Brazil would be the implementation of a public policy aimed at the circular economy, with the definition of bioplastic and incentives for infrastructure and environmental education. In this way, it would be possible to create a favorable environment for the action of meso-institutional agents, duly recognized by consumers and the market through certified labels. Consequently, in addition to reducing informational asymmetries, an internal demand for the product could be created, encouraging not only production, but also the arrival of certifiers.

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