

СОЦИОЛОГИЯ ИНЖЕНЕРНОЙ ДЕЯТЕЛЬНОСТИ

VICTOR MOURÃO

Professor, Federal University of Viçosa,
Viçosa, Brazil;
e-mail: vmourao@ufv.br



DANIELA ALVES DE ALVES

Professor, Federal University of Viçosa,
Viçosa, Brazil;
e-mail: danielaa.alves@ufv.br



Macaúba as an Internationalizable Object: the Sociotechnical Imaginaries of a Tropical Plant

УДК: 581.6:316.4

DOI: 10.24411/2079-0910-2021-11006

The internationalization of science has been an emerging topic within the Sociology of Science. The aim of this article is to contribute to this trend, while analyzing the process of internationalization of science taking as a point of analytical departure a Brazilian laboratory specialized in researching macaúba which is a South-American tropical plant. Based on the literature produced within the field of Science Technology and Society (STS), with special support from actor-network theories and sociotechnical imaginaries, this research aims at understanding the relationships, agents and symbolic configurations intermingled in the formation of an international network research on macaúba in its process of internationalization. Based on interviews with researchers, literature review and through participant observation of laboratory activities, the authors argue that the internationalization of macaúba occurred in a process of co-production of nature and society, in which its potentialities as a plant were built together with its adhesion to diverse sociotechnical imaginaries distributed throughout networks of different scales. The research was able to track macaúba's research interests in different social and historical contexts, identifying the symbolic displacements that had to be forged in order to amplify and internationalize the scientific network.

© Victor Mourão, Daniela Alves de Alves, 2021

Keywords: international networks, laboratory, sociotechnical imaginary, sociology of science, internationalization of science, macaúba, nature and society.

Acknowledgments

The research was carried out with support from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG).

Introduction: the Internationalization of Science and the Myriad of Perspectives

The internationalization of science and technology (ST) has been a topic of extreme relevance in the contemporary context. The initiatives of countries, research institutes and universities to establish bilateral or multilateral agreements for scientific and technological cooperation are increasing, with the explicit aim of exchanging, sharing and/or transferring information, technologies, processes, methods and research results. Scientific research is a privileged locus of political, diplomatic and economic activity in a context in which universities and research institutes are seen as foundations for technical and scientific development of different nations and regions.

In academic and scientific research, the construction of studies through indicators and benchmarking allows an evaluative comparison of the internationalization degree of countries, regions, universities and research groups, and they have been used to establish rankings pointing to the quality of research undertaken in these spaces. Even though such approaches succeed in highlighting fundamental characteristics of science's international division of work, the situated processes of this internationalization construction are not robustly problematized, they are frequently interpreted through a macro-logic that reduces them to a mere unfolding of structural determinants. Thus, the aim of the analysis undertaken here is to work critically and in tension on such approaches, seeking to carry out the proposition regarding the need for investigation of social and symbolic fabric of these situated processes in order to understand how the international is constituted and located, how the native and autochthonous are linked to international networks and displaced throughout these networks, which objects and knowledge are on the move and in what directions these displacements take place.

This research belongs to an area of Social Sciences which has been progressively gaining relevance to understanding the globalization of knowledge, techniques and the effects of scientific and technological development. Scientific production is seen mainly as a social and political activity and, in this sense, each discovery has an environment and a favorable context in which it germinates or conforms to in order to develop itself. According to Bruno Latour [Latour, 1987, p. 159], the construction of a sociogram (the disposition of human social relations) is correlated to construction of technogram and it is as relevant as the disposition of technological elements in a network. In this sense, we are interested in delineating the context surrounding the sociogram-technogram interface relevant to macaúba research. Additionally, we will use the conceptual proposal of the sociotechnical imaginaries which will allow us

to analyze the symbolic processes related to expectations, normativities, materialities of technoscientific practices [Jasanoff, 2015].

In previous researches, we identified some aspects of this process of internationalization in research groups on bioenergy in Minas Gerais. The results indicate, preliminarily, that these groups manage to build associate links with international organizations, enterprises and government's bureaucratic apparatus, which shows that it is rare for a research's internationalization process to be restricted to academic activities. Thus, this process of linking to the external is opposed to a certain imaginary connected to policies aimed at promoting the internationalization of science, which understands it, strictly, as a collaborative practice of knowledge production among researchers from different nations, systematically translated as co-authorship among authors from different countries [Katz, Martin, 1997] or, in another sense, as a dependent-relationship on the search for knowledge and cutting-edge innovation by researchers from Latin America as peripheral or subordinate to central countries, with a symbolic representation marked by the absence or lack [Ferreira, 2019; Kreimer, 2006]. We verified a formation of research connections mainly based on the researchers' individual initiatives: their own statement indicate that consistent internationalized research was built through contacts and personal relationships developed by the researcher in different spaces and temporalities, whereas the institutional initiatives of internationalization present obstacles in establishing themselves, which is attributed by the researchers themselves to the fragility of the Brazilian scientific system whose allocation of specific resources for international programs and / or projects is fragmented and unstable, and historically dependent on cooperation programs originated from external international investments [Gaillard, 1994]. In this article, we will not analyze the international cooperation policies in the area of science and technology, not even the institutional dynamics of the university and agencies around the programs and the results of internationalization. We are interested in presenting results of research practices carried out in a laboratory and its connection with disputed imaginaries about a particular object of study. To justify this analytical choice, it is worth remembering that the laboratory has gained prominence within the social studies of science and technology as an analytical unit since the 1970s [Mattedi, 2017].

The purpose of this text is to shed light on such aspects based on a scientific inquiry initiated in 2018 focusing on one of the laboratories under consideration. This laboratory is located in a Brazilian public university which is considered a reference in the field of agrarian sciences, not only due to the long-standing and consolidated trajectory of this research area at the institution, but also due to the prominence in its evaluation indicators for undergraduate and graduate studies. It is a space that brings together research on macaúba (a tropical plant, *Acrocomia Aculeata*) from different methods, approaches and objectives. Macaúba is a palm tree native to Brazilian semi-arid regions whose oilseeds fruits (almond and pulp) can be used as raw material for biofuel, cosmetics and food. In this laboratory, for example, the nutrition and growth of the plant, the germination and its resistance to water stress, the genetic crossing and the properties of the fruits are investigated. The researchers investigate both the plant and the fruit of macaúba. In addition to Brazil, this plant is also found in other Latin and Central American countries. The macaúba laboratory was chosen as it has stood out nationally and internationally, constituting itself as a space where graduate students and foreign researchers often spend time, and whose leading researcher has established research partnerships with companies and European universities in the last decade. In order to carry out the research, we adopted a qualitative perspective which

focuses on monitoring the routine activities of production and dissemination of knowledge to understand the processes of construction and maintenance of social spaces as well as their meanings by conducting interviews with researchers from the mentioned laboratory.

Networks Traversing the Laboratory

The construction of this research included participant observation of the dynamics of a research laboratory on macaúba and its germplasm bank, weekly presence within laboratory premises and observation of member's activities (technicians, students and researchers)¹. The physical structure and scientific instruments were also observed. The two main researchers at the laboratory were interviewed, the chief researcher, responsible for introducing research with macaúba at the referred university, and the second guiding researcher, a younger professor at the institution who also directs research on other palm trees, such as palm oil and jussara. One German researcher who stayed in the laboratory for two months collecting samples of the macaúba palm to investigate the relationship between water availability and macaúba's growth and flowering was also interviewed. In addition to participant observation, we followed the group publications on its website which gathers news and scientific articles about macaúba.

The macaúba laboratory is composed by a series of spaces that hold different activities. A substantial part of these activities are carried out within the university campus, in lab rooms that store plant samples to be subjected to scientific experiments conducted in these same rooms and in other shared lab rooms submitted to strict procedures to avoid the contamination of external agents. A series of products made from macaúba (such as oils, cosmetics, flour, cookies and others) is presented on a small table to visitors and scientific team, demonstrating the viability and versatility of its fruits. Another important scientific space is located in a neighboring city, about 40 km (25 miles) away, which holds a multiplicity of plant specimens from different regions of the country.

In these spaces, there is a large amount of materials, samples, equipment, raw materials, national and international researchers, entrepreneurs and students. It is a hybrid complex, in which heterogeneous actors are articulated in order to enable the study of the plant and its diverse potential. The knowledge produced in the laboratory assumes different meanings depending on the context to which it is directed. In the relationship with the countries of the North, there is a division of labor in which techniques and tacit knowledge on how to deal with the plant and its fruits (expertise linked to the idiosyncrasies of the plant and its environment) were accumulated in the national team, as cutting-edge technological instruments are concentrated in central countries waiting for tropical samples of macaúba. Even so, there is an expectation of double learning and exchange of complementary, but unequal experiences, which correlates such technological processes, dominated by central countries, and an oilseed with an emerging research and production chain, with original methodological processes based on local reality. Partnerships with third world countries, on the other hand, take a different direction; the laboratory assumes the leading position of knowledge and the dissemination of investigative skills and techniques that cannot be reduced to macaúba. In other words, macaúba is a fundamental point of support on the bridge

¹ The field observation was carried out more continuously by undergraduate students Ilson Soares Costa Junior and Michael Lazaro Pedroso da Silva.

built throughout this network. The fine connection between the native-peripheral-tropical-savior-of-nature fruit and the modern and technological central laboratories goes through the collective effort of purification and translation of macaúba. While Brazilian agriculture is seen by the researchers interviewed as modern and sustainable in relation to African countries, we are thought to be backward in relation to Europe or the United States, not only in terms of cutting-edge technology, but also of sustainability, something that could be offset by investment in large-scale production techniques geared towards high productivity. Researcher B² develops production systems projects in Mozambique in partnership with Embrapa and the Mozambican Agricultural Research Institute. From the perspective of B, in Mozambique, and in other African countries as well, extractive and predatory agriculture prevails.

However, if we limit ourselves to looking at the sites, we will miss a series of activities that are essential for the maintenance of the laboratory. As the network articulated by the laboratory has an open character, whose borders are porous to the outside, it is essential that we somehow manage to analytically apprehend these processes located beyond the walls (and fences) of these spaces. Latour [*Latour*, 1987, p. 159] prescribes a double-dimensionality to laboratories, one internal and other external. Whereas the former comprises internal routines, which in this case is established by researchers focused on characterizing macaúba plants and fruits, creating procedures, and hybrid maps; the latter deals with articulating its interests through publications, congresses, lectures and meetings, in an attempt to expand the elements aligned in this network and to promote its interests. These two dimensions are, at least to a certain extent, complementary: communication, dissemination and articulation actions support and are supported by routine research activities, providing different perspectives on scientific production. Therefore, the decision of a participant observation in this research not only included the description of the concrete routines of a researcher in the field carrying out activities, such as sawing the epicarps of a macaúba, crushing chestnuts, measuring the levels of beta-carotenes, but also sought to understand the broader circuit comprising what was published and talked about macaúba, how to get the widest attention on it and, therefore, on the laboratory itself.

For this reason, extra-laboratory activities are important as they are aimed at attracting persons and groups who are not immediately enmeshed in laboratory's network. We've managed to observe seminars in which macaúba, its scientific and entrepreneurial potentialities were discussed. The events were organized, on the one hand, to undergraduate students able to become interns and researchers in the laboratory and, on the other hand, to entrepreneurs, qualified as possible investors, administrators, potential partners of laboratory projects.

² Researcher B was also interviewed as part of this project. Two events were observed in which he was a speaker, a research seminar, aimed at presenting data to researchers and entrepreneurs interested in the plant, the other event of scientific dissemination whose theme was Hunger: how to face this challenge? He has a training career in the Macaúba palm tree, dedicated to improving it. He has also been working in companies related to the area as a consultant, has supervisors in the research on macaúba and is one of those responsible for conducting and thinking about the research agenda.

Sociotechnical imaginaries and the symbolic displacements of macaúba

The attention to the broader scientific production processes carried forward beyond the laboratory allows us to cover symbolic aspects that are fundamental in the case under consideration; the mobilization of values and interests of these other audiences is also a necessary condition for success of the research endeavor. To analyze this aspect, we will use the conceptual proposal of sociotechnical imaginaries. According to Sheila Jasanoff, science emerges in a process of nature-society co-production that connects the modes of knowledge and representation of the world with the modalities of action in the construction of the world; in consequence, it is analytically hollow to separate these dimensions. Thus, science is not a “transcendent mirror of reality”, but it is processed through its insertion in social, identity, normative, conventional, discursive and institutional practices and being affected by them [Jasanoff, 2004]. Such practices prevent an analytical separation between epistemic-cognitive and political-normative aspects which conform to each other. For the author, sociotechnical imaginary allows to apprehend this co-production process. These are imaginary

collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology [Jasanoff, 2015, p. 4].

Therefore, the sociotechnical imaginaries do not have the immaterial aspect that we normally attribute to the term “imaginary” in common sense; they fit into the materiality of assemblages meaning and morality that constitute social life. Thus, they constitute themselves as organized work and practices co-producing the space, the time, the objects and the subjects of the research.

Hence our questions: What are the sociotechnical imaginaries that animate the scientific work, in, out and through the macaúba labs? What is the meaningful functioning and imaginary of macaúba in its internationalization process? How does this object, simultaneously, go through a process of naturalization, purification and scientific artificialization in conjunction with such conceptions? The hint that the proposal of the sociotechnical imaginaries raises is that such questions can be answered in relation to the process of searching for desirable futures, imagined and managed in the process of co-producing social and natural reality, normativity and cognition.

When outlining a meaning in the activities undertaken in the bioenergetic research laboratory, we place ourselves in an impasse. We are facing an extensive network of distinct areas of knowledge, producing data and technoscientific facts in their laboratories that are already emerging transnationally, especially in the field of international treaties and local policies. Multilateral agreements on climate change, such as carbon emission reduction targets, have a cascading transnational effect that encourages public funding and private investments in the production of knowledge and technologies that simultaneously respond to countries' economic and environmental objectives. The dispute for green fuel, in which Brazil became a pioneer, is an example of this process. There are numerous agencies caught up in the techno-scientific facts, which are complex, hybrid and global, such as the IPCC (Intergovernmental Panel on Climate Change), the ANP (Brazilian Agency of Petroleum, Natural Gas and Biofuels), the automobile production chain, the chain production

of soy and its derivatives, among others. This network associates flows at different scales, dimensions and levels, ranging from the global to the local, from economic and scientific policies to the most everyday practices of knowledge production, which can be observed from within the micro-environment of the laboratory, as ethnographic studies of laboratory show. As suggested by Latour [Latour, 1987], we consider that the boundaries between the interior and the exterior are porous, since the networks that support the research activities in the laboratories extend outside it, channeling displacements of researchers, objects and scientific facts along the trail of “external” and transversal inscriptions to the laboratory. Wiebke Keim [Keim 2010, 2014] identifies three dimensions of the center-periphery structures: material and infrastructural dimension (scientific development / underdevelopment), existence and reproduction conditions dimension (autonomy / dependence) and international recognition and prestige dimension (central / scientific marginality). This multiple dimensional character composing the international circulation of scientific knowledge phenomenon places a strong focus on transactions that take place at the border among the various networks that make up the production of scientific knowledge. These boundary tensions between external and internal help to conceive what the social configurations involving the production of scientific knowledge are. Therefore, the symbolic categories around the objects of knowledge are in dispute and our analytical effort here is to show how localized objects of knowledge in peripheral countries are built in connection not always subordinated but linked to central interests.

From a previous bibliographic review, it is possible to identify that macaúba studies milestone links to 1980s Brazilian political environment, intrinsically related to Pro-oil program in the military period, designed to overcome petroleum foreign-dependence³. According to Fernando Távora [Távora, 2011, p. 16], successive oil crises have shown Brazilian’s dependence on fossil fuel imports, compromising supply of a fundamental resource to national economy. During the crises in the 1970s, the Pro-alcohol and Pro-oil programs were designed to generate energy autonomy in the country. In this period, fostered by Pro-oil, the research on macaúba flourished, with researcher Hebert Martins as one of its exponents [Filho, Colombo, Berton, 2012]. In such fashion, it can be seen that macaúba is linked here to energy and national aspects around mobilizing and developing production chains of indigenous raw materials which are not only capable of generating energy autonomously but also of honoring what is national. More recently, 2004, another policy (National Biodiesel Production and Use Program — PNPB) was created in order to stimulate scientific and technical researches to seek oilseed alternatives in biodiesel production and its introduction into Brazilian energy matrix, aiming at reducing diesel imports, creating jobs in rural areas and minimizing environmental impact caused by the use of fossil fuels [Padula et al., 2012]. The social aspect of such a program, created in the Lula government, was due to the promotion of economic activities by small producers, especially in the Brazilian semiarid region. The Social Fuel Seal established the conditions for industrial biodiesel producers to obtain tax benefits and financing based on proof of the acquisition of a minimum percentage of raw materials from family farming. Such a policy has not prevented soy, a culture strongly connected to large-land agricultural estates and quasi-industrial production, from becoming the main raw material for Brazilian

³ This article did not aim to capture the imaginary associated with Macaúba by the traditional peoples of the region.

biodiesel, blocking the creation of a more plural, inclusive and social market in this area [Castro, Alves, 2016].

Macaúba emerged in the analyzed laboratory as a plant linked to this process triggered by the PNPB. Its scientific activities devoted to macaúba started (and driven) by the allocation of research resources following a successful submission to a PNPB/CNPq⁴ public call in 2004 by its chief researcher A⁵ aimed at biofuels, in the areas of palm oil and macaúba. PNPB's main objective was, initially, to contribute to the production of knowledge for the advancement of energetic, social and economic potentials. Therefore, these are political processes linked to current Brazilian government's vision: on one hand, seeking to promote a social rise of the most vulnerable Brazilian people, on the other hand, without abandoning the search for energy matrix's expansion towards greater national autonomy. The inclusion of public bodies and companies (Petrobras, CNPq, ANP, public universities) in this network allowed the construction of an initial embryo of skills and research instruments at the local level of the laboratory, even allowing for a change in researcher's scientific path, who until then was dedicated to another range of agricultural plants.

In the following years, and together with a process of transformation of the national biodiesel market, which redirected Brazilian government's energy expectations, a transformation in the main research purposes linked to macaúba can be seen. Such transformations were partly due to the emergence of soybeans as the main raw material for the biofuels market nationwide, with oil as a by-product of the main economic destination, namely, bran for animal farming agribusiness [Castro, Alves, 2016]. This characteristic created a unique aspect of the Brazilian biofuels market in which soy was not produced primarily for the energy sector but ended up with other raw materials in that market. This phenomenon ended up with the limiting the space of symbolic interest in macaúba in the energy sphere.

Thus, the macaúba research network has been transformed, and the imagery associated with it has accompanied this process. Environmental issues which were present in the PNPB imagination brought to the fore global warming and deforestation concerns linked to palm oil production in Malaysia, Indonesia, Borneo and Sumatra tropical forests. Global food industry's expansion promoted a correlated increase in oil palm production and extraction, causing greater deforestation in a high temperature region. A long debate has been going on within geophysical and environmental sciences that links climate change with humanity's historical interventions in its relationship with nature, from where the term Anthropocene, popularized by the chemist Paul Crutzen, was coined. The notion of Anthropocene implies for most scientists that the advance in "Science of the Earth System" will allow an "informed and rational management of problems", related to global environmental sustainability [Veiga, 2019, p. 21]⁶.

⁴ CNPq (National Research Board) is a Brazilian agency devoted to financing national research.

⁵ A is the pioneer researcher of macaúba studies at that university, founder of an enterprise devoted to producing macaúba seedlings, a specialist in Genetics and Breeding, who coordinates the research, developing its agendas and objectives. He has a large aggregation capacity, participates in workshops and lectures on oilseeds. He was interviewed twice under this project.

⁶ This work by Veiga presents other theoretical extrapolations around the term Anthropocene, some more optimistic, others more pessimistic regarding the future of the Earth System. It also draws attention to the fact that the term has not yet been legitimized by the area of geoscience as the name for a new era, replacing the Holocene.

This critical situation has led two groups to be concerned about such a process: on the one hand, consumers looking for buying environmental-friendly products; on the other hand, companies that use palm oil (*Elaeisguineensis*) in their industrial processes. The perception of imminent global warming and the possibility of a disruption in the supply of this raw material invoked a search for alternatives. Macaúba initially built and imagined as biofuel is symbolically displaced and cultivated as a potential plant for supply environmental and economic needs of a diverse sociotechnical imaginary. In addition to the agricultural characteristics of the plant, the inquiries reported by the researchers indicate that the nutritive characteristics of macaúba's oils present better physical-chemical quality than those extracted from palm oil.

It is possible to perceive the effort and the work of inserting researchers from macaúba into a diversity of sociotechnical imaginary. On the one hand, the national aspect of macaúba is reactivated in order to place the plant in a situation where its importance is justified in the sense of offering native, local solutions to problems of the so-called global sustainability, insofar as it promises, if converted into part of the agro-industrial system, to reduce environmental costs by replacing oil palm production, another tropical plant which is central to contemporary global food chains but is also highly water-consuming and not very resistant to climate change. The international circulation of macaúba, as an object of knowledge, is also modulated by national researchers from the alignment of the foreign gaze on the plant's potential. In this sense, we highlight the report of the researcher about Brazilian colleagues who considered irrational to dedicate themselves to researching this exotic plant but immediately changed their position when German researchers demonstrated interest in macaúba. This double condition (of being presented as a solution to a global problem that goes unnoticed without a foreign eye) allows updating the national imaginary of macaúba in a globalizing context that marks our contemporaneity and highlights our social and scientific condition viewed by researchers as peripheral. A native Brazilian plant would start to be translated by the national market as potentially capable of being sold as fuel or food to the extent that it goes through the legitimation of foreign stakeholders, and the conversion of the native plant into a global plant, through the production of intense knowledge in technology and innovation rendered valid by the agro-industrial system.

In this process of transforming sociotechnical imaginary and networks of agents, research in the laboratory studied also underwent transformation. The process of characterizing the plant, the delimitation of its properties, the process of exploring the diversity of its species, now includes criteria that signal of this transformation. The co-production of society and nature, the normative and the cognitive, is continuous and transforms both dimensions.

There is a systematic effort to present macaúba as a strong player in food security⁷. This effort appears in the public speeches performed by laboratory members in events to publicize the theme and in the interviews granted to our research⁸. This imagery built not

⁷ "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization and stability. The nutritional dimension is integral to the concept of food security" [Food and Agriculture Organization of the United Nations, 2009].

⁸ An exploratory research around scientific articles published by the laboratory team showed, however, that this sociotechnical imaginary of food security is not — yet? — present in these publications. As a hypothesis for research that goes beyond our goals here, this discrepancy can be examined from the perspective of the different dynamics that involve scientific activity: on the one hand, research

only by the researchers, but also by the companies that are starting to invest in the plant in Brazil, attributes to the macaúba an imaginary linked to sustainability to the detriment of oil palm. Although little explored by its researchers in terms of meaning and scope of what is meant by the sustainable nature of the plant, sustainability is linked mainly to two points: (1) high oil productivity per planted area and (2) the two story agriculture technique, a system of production that integrate pastures for cattle with palm production while also occupying degraded areas, thus differentiating itself from the degrading monoculture technique. In addition, macaúba is a plant more adaptable to different climates and rainfall irregularities. These technical characteristics of macaúba production would place it in a position of standout in oilseeds market, for example due to the fact that it requires less rainfall and, therefore, does not need to have its production concentrated in the tropical areas of the planet, already affected by the production of oil palm monoculture. It is, therefore, a double demand that is being met: economic productivity and environmental sustainability. This discursive, imaginary, symbolic and cognitive construction of macaúba points, therefore, to different dimensions of concerns situated at different scales and levels: national biodiversity, industrial productivity, and environmental sustainability, working towards justifying the adoption of this plant as a matrix of global agro-industrial food production chains.

Conclusion: policy and climate, science and economy

The purification-translation simultaneous work [Latour, 1993] and co-production of nature and society [Jasanoff, 2004] carried out within the macaúba laboratory shapes the plant to correspond to a possible imaginary of sustainability, which in this context operates in association between two qualities: the augmented food productivity needed to feed the immense world population (seen as a solution to the issue of food security), coupled with the possibility of shifting production to areas of the planet with less risk of environmental impacts, as well as using also risk-reducing techniques, such as two story agriculture. In this perspective, the sustainability outlined by these two qualities mobilizes the moral duty, in terms of modalities of action-justification in the world. Thus, this moral work mobilizes arguments against industrial agro-food production critics, a system that destroys environment by the intensive and centralized use of raw materials and other industrial products which promotes the exhaustion of natural resources irregularities. Furthermore, this has the potential to be expanded into the unexplored areas of the planet that same depleting agricultural production system in a more resistant character to climate change. According to this perspective, the notion of “food security” is presented in a reduced and controlled manner, referring to the increase in industrial agricultural productivity and the expansion of food availability via the mass market for the growing global population [Garibaldi et al., 2018]. In that sense, the agrofood global business problems are akin to environmental and social problems: moral arguments mobilized by macaúba’s research may leverage agrobusiness’ public legitimacy while asserting its capacity to feed a growing global population and to minimize environmental degradation with its productive capacities.

processes take years and perhaps decades to consolidate in terms of scientific publications, while, on the other hand, the processes of disclosure and search for financing and justification of the purposes of these researches can adapt more rapidly to social, political and economic demands.

Therefore, the production of macaúba's sociotechnical network aligns companies with an interest in producing the plant on a large scale, companies interested in exploring the oil, European universities and policies interested in seeking new raw materials in Brazilian diversity. The production of knowledge about macaúba organizes research efforts to transform it into an internationally recognized object, thus throwing a "wild" plant, originating in a peripheral country, in the global scenario of energy and food sustainability. The environmental dimension of sustainability places the need for urgency in the domestication process of this plant, mobilizing a joint effort of discourses and practices where the "not yet known" (Researcher C⁹) from the periphery brings advantages to the knowledge produced in the center.

The struggling imaginary is that macaúba, as a raw material capable of replacing palm oil, put the food industry on a sustainable path. There is a discursive and research effort in order to identify macaúba as a rich and sustainable food, something that has already been produced in the past in relation to palm oil. At the beginning of research in Brazil, macaúba sought its insertion in the energy matrix, currently the food aspect has assumed an increasing weight, with a more markedly internationalist position, seeking to move the macaúba from the energy and national complex to the construction of the plant and its fruit as an opportunity for environmental sustainability in global food industrial processes. Thus, from a plant with scientific potential (exotic and peripheral), energetic and national, macaúba starts to be built in the imaginary as a sustainable food security solution for the global agri-food industry.

We can analyze this process of justification through an analytical perspective in which there is a reformulated Boltanskian *citè* (moral citadel), a process in which the spirit of capitalism faces criticism and demonstrates, when submitted to tests, that it is capable of solving current environmental and social problems by constructing, discursively and through visible practices of production, an image in which climate warming is not an unavoidable obstacle to industrial agri-food production, and by supporting social and political processes that place such production as the least expensive economically. Therefore, there is an overlap between two usual meanings of sustainability, one that is projected on the socioenvironmental process of climatic reproduction and biological living conditions, and another that engenders an accounting-financial sphere of maintenance of profitability conditions to mass production of food for the population at "low cost" by enterprises [Boltanski, Thévenot, 1991; Boltanski, Chiapello, 1999; Latour, 1995].

By becoming spokespersons of nature, claiming an important role for macaúba in the climate change scenario, the plant researchers cannot avoid negotiating with the "world of men", seeking to activate categories of politics and the market in order to justify its relevance in the political realm. Subjects are not separated from things, although what Bruno Latour has critically called the Modern Constitution has endeavored to separate scientific power, "charged with representing things", and political power, "charged with representing subjects" [Latour, 1993, p. 29]. In practice, the effort to link macaúba strongly to an emerging political problem of humanity (ie. food security) leads researchers to recognize the arbitrariness of the nature-culture separation and bet on nature — domesticated, purified, translated — as redemptive of the culture itself or, more specifically, of the effects of human action: anthropocene. In this way, macaúba researchers try to place themselves in a competitive advantage through the international representation of the oilseed, a position

⁹ Researcher, macaúba's lab research partner.

that is even more privileged by two characteristics of the place from which they speak: the position of excellence of the agricultural sciences in the institution where they are located and the region's tropical climate.

References

- Boltanski, L., Chiapello, È. (1999). *Le nouvel esprit du capitalisme*. Paris: Gallimard (in French).
- Boltanski, L., Thévenot, L. (1991). *De la justification: les économies de la grandeur*. Paris: Gallimard (in French).
- Castro, M.V. d., Alves, D.A. d. (2016). As controvérsias sociotécnicas sobre as especificações do biodiesel. *Sinais*, 20, 99–116 (in Portuguese).
- Ferreira, M.T. (2019). Periferia pensada em termos de falta: uma análise do campo da genética humana e médica. *Sociologias*, 21, 80–115 (in Spanish).
- Filho, J.A. d. A., Colombo, C.A., Berton, L.H.C. (2012). Macaúba: Palmeira nativa como opção bioenergética. *Pesquisa e Tecnologia*, 9 (2) (in Portuguese).
- Gaillard, J. F. (1994). North-South Research Partnership: Is Collaboration Possible between Unequal Partners. *Knowledge and Policy: The International Journal of Knowledge Transfer and Utilization*, 7 (2), 31–63.
- Garibaldi, L.A., Andersson, G., Ferrari, C.F., Pérez-Méndez, N. (2018). Seguridad alimentaria, medio ambiente y nuestros hábitos de consumo *Ecología Austral*, 28 (3), 572–580 (in Spanish).
- Jasanoff, S. (2004). *States of Knowledge: The Co-production of Science and Social Order*. New York: Routledge.
- Jasanoff, S., Kim, S.-H. (Eds.). (2015). *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: University of Chicago Press.
- Katz, J.S., Martin, B. R. (1997). What is Research Collaboration? *Research Policy*, 26 (1), 1–18. DOI: 10.1016/S0048-7333(96)00917-1.
- Keim, W. (2010). Pour un modèle centre-périphérie dans les sciences sociales. *Revue d'Anthropologie des Connaissances*, Vol. 4, 3 (3), 570–598. DOI: 10.3917/rac.011.0570.
- Keim, W. (2014). Conceptualizing Circulation of Knowledge in the Social Sciences. In *Global knowledge in the social sciences. Made in circulation* (pp. 87–113). Farnham: Ashgate.
- Kreimer, P. (2006). ¿Dependientes o Integrados? La ciencia latinoamericana y la nueva división internacional del trabajo. *Nómadas (Col)* (24), 199–212 (in Spanish).
- Latour, B. (1987). *Science in Action*. Cambridge: Harvard University Press.
- Latour, B. (1993). *We Have Never Been Modern*. Cambridge, Massachusetts: Harvard University Press.
- Latour, B. (1995). Moderniser ou écologiser? à la recherche de la “septième” cité. *Ecologie & Politique*, no. 13, 5–27 (in French).
- Mattedi, M. (2017). Laboratórios. In *Sociologia da ciência: temas, problemas e abordagens*. Blumenau: Edifurb (in Spanish).
- Padula, A.D., Santos, M.S., Ferreira, L., Borenstein, D. (2012). The Emergence of the Biodiesel Industry in Brazil: Current Figures and Future Prospects. *Energy Policy*, 44 (C), 395–405.
- Távora, F.L. (2011). História e economia dos biocombustíveis no Brasil. *Textos Para Discussão*, 89. Centro de Estudos e Consultoria do Senado (in Spanish).

Макауба как интернационализируемый объект: социотехническое воображаемое тропического растения

ВИКТОР МУРАУ

Федеральный университет Висосы,
г. Висоса, Бразилия
e-mail: vmourao@ufv.br

ДАНИЕЛА АЛВЕС ДЕ АЛВЕС

Федеральный университет Висосы,
г. Висоса, Бразилия
e-mail: danielaa.alves@ufv.br

Интернационализация науки — новая тема в социологии науки. Цель статьи — внести вклад в это направление, анализируя процесс интернационализации науки, взяв в качестве отправной точки бразильскую лабораторию, специализирующуюся на исследовании макаубы, тропического растения Южной Америки. Это исследование, основанное на литературе по социальным исследованиям науки (STS), с привлечением акторно-сетевой теории и теории социотехнического воображаемого, направлено на понимание отношений, агентов и символических конфигураций, связанных с формированием международной сети исследований интернационализации макаубы. На основе интервью с исследователями, обзора литературы и включенного наблюдения за лабораторной деятельностью авторы утверждают, что интернационализация макаубы произошла в процессе совместного творчества природы и общества, в котором его потенциал как растения был создан в связи с разнообразными социотехническими образами, распределенными среди сетей разного масштаба. В ходе исследования удалось отследить исследовательские интересы макаубы в различных социальных и исторических контекстах, выявив символические сдвиги, которые необходимо было изобрести для расширения и интернационализации научной сети.

Ключевые слова: международные сети, лаборатория, социотехническое воображаемое, социология науки, интернационализация науки, макауба, природа и общество.