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INFORMING DECISION-MAKING WITH INDIGENOUS AND LOCAL KNOWLEDGE AND SCIENCE

Research Article



Local knowledge, know-how and knowledge mobilized in a globalized world: A new approach of indigenous local ecological knowledge

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Abstract

1. More than 30 years after the 1988 Declaration of Belém, which we can consider an important outcome of socio-environmental movements, this reflexive paper proposes new ways of approaching indigenous local knowledge (ILK) related to the living environment and understanding its relevance in times of global socio-environmental crisis.
2. Drawing upon the example of an ethnodevelopment project based on guarana production by indigenous Sateré-Mawé people in the Brazilian Amazon, two important issues are addressed. First, we reflect on how a traditional management system can contribute to both biological and cultural conservation, even when that system is inserted in new global markets and spoken about through a scientific perspective. Second, we address the challenge of incorporating ILK into conservation research by formulating a set of methodological proposals.
3. We show that ILK is a dynamic, adaptive and political product of local–global interactions. This leads us to defend an analysis of ILK that would focus on its processes of creation rather than on the body of knowledge that results from them, thus helping to account for ILK's vitality and the various forms of its legitimation.
4. At the crossroads of ethnobiology, science and technology studies, and social anthropology, these research methods seek to go beyond the inventory, categorization and structural analysis of thoughts and practices to instead privilege an analysis of the interactions between local populations and resources; at the same time, they operate across different scales and integrate actors from the beginning to the end of (sometimes long) value chains.
5. Such an approach aims to make visible the modes of knowledge translation and hybridization that indigenous people might implement to maintain control over their collective identities and their relationship with a changing environment.

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biology of conservation, Brazilian Amazon, ethnodevelopment project, guarana, indigenous local knowledge, ontologies of plants, Sateré-Mawé

1 | INTRODUCTION

In 2008, indigenous Sateré-Mawé producers in Brazil published the group's first standardizing rubric, a protocol for the production of *waraná* sticks. *Waraná* is the Sateré name of guarana *Paullinia cupana* (Kunth var. *sorbilis* [Mart.] Ducke), an Amazonian climbing plant whose caffeine-rich seeds are consumed worldwide for their energizing qualities (Carneiro, 1931; Smith & Atroch, 2010). Guarana was first discovered by the Sateré-Mawé (Clement, De Cristo-Araújo, Coppens D'Eeckenbrugge, Alves Pereira, & Picanço-Rodrigues, 2010), who consist of about 13,000 people in Northern Brazil (IBGE, 2010), who went on to develop a strong cosmological connection with the plant; it is now cultivated in various parts of Brazil. The 'sticks' named in the protocol's title refer to the form in which the Sateré-Mawé traditionally conserve guarana seeds. Once they are separated from the flesh of the fruit, guarana seeds are hand-washed; slowly dehydrated on the tops of large ovens; crushed and mixed with water to form a dough; and finally rolled into 20-cm-long sticks, dried and smoked. When the Sateré-Mawé wish to consume *waraná*, they use a stone to gently grate the end of a stick into a gourd of water and drink the resulting mixture.

The 2008 protocol describes not only the process to be followed to make *waraná* sticks but also how the plant should be managed and—perhaps most importantly—*what waraná is* for the Sateré-Mawé people. Article 2, for example, tells us that *waraná* is 'the material envelope formed by the plant, the fruit, and the seed of native guarana, which is cultivated by the Sateré-Mawé for containing the spiritual principle of "Wará" (...)' It also defines *waraná* as 'the semi-domestic guarana obtained from spontaneous seedlings extracted from the primary or secondary forest (...) and transplanted to an open field, or born from seeds fallen in the field (...) [and] exposed to permanent cross-pollination with wild individuals (...)' (CPSM, 2008, p. 2, italics added). The protocol goes on to explain that the transplantation of spontaneous seedlings guarantees 'the conservation and the genetic adaptation of guarana to the natural environment' and ensures its 'genetic diversity', describing the Andirá-Marau indigenous land—the demarcated territory where the majority of the Sateré-Mawé live—as the 'ecological and cultural sanctuary of guarana' that safeguards its 'unique natural gene bank'.

These extracts demonstrate a cross-cultural and meticulously written discourse that borrows from local cosmology, indigenous local knowledge (ILK) related to the plant, and scientific knowledge about genetics and forest ecology. The document in its entirety establishes important connections between different forms and sources of knowledge, resource management practices and formalized projects of indigenous territorial protection. Indeed, the preparation of the protocol originated in the Waraná Project,¹ an ongoing ethnodevelopment project created in 1995 by a Sateré-Mawé leader in collaboration with an Italian activist and his sustainable development consultancy

(ACOIPIAMA²). Both a productive and a political effort, its focus is the establishment of a transnational fair-trade value chain for the organic, 'analog forestry'³-certified natural products produced by the Sateré-Mawé, including *waraná* seeds and sticks. From this perspective, as we will later see in greater detail, the protocol also reveals an indigenous people that has organized itself in connection with a variety of actors and frameworks, including European companies; academic, political and financial partners; and a range of certification-granting mechanisms.

The main goal of this reflexive paper, based on several months of field research completed between 2011 and 2017, is to propose new ways of approaching ILK and its relevance in times of global socio-environmental crisis. By analysing the processes of knowledge creation that lie behind the protocol, we show how a traditional management system can effectively contribute to biological and cultural conservation in a dramatically changing world.

Thirty years after the Declaration of Belém (ISE, 1988), which affirmed the indissoluble links between biological and cultural diversity and insisted on the inclusion of indigenous knowledge in development programming, references to ILK remain a source of ambiguity. While the notion of 'local knowledge' is used increasingly as a concept relating social configurations to their natural environment (Brosius, 2004; Escobar, 1998; Fisher, 2000; Pinton, 2003; West, 2005), conservationists worry that ILK is losing legitimacy, relevance or accuracy in the face of shifting socio-ecological conditions and the extension of neoliberal market value chains. Such fears often reflect an understanding of ILK as a fixed and historical—rather than living and evolving—body of knowledge.

The ethnobiological approach, which is based on the description and analysis of categories of thought and practice related to the natural environment, recognizes the dynamic and adaptive nature of indigenous cultures, traditions and knowledge systems (Berkes, Colding, & Folke, 2000; Povinelli, 2016). But such approaches, though enriching and necessary, remain incomplete and insufficient. From our point of view, ethnobiological studies generally fail to adequately consider the ongoing transformations, the issues at stake, and the difficulties confronted by social groups (whether or not they identify as indigenous or traditional) facing these socio-ecological changes. Ethnobiological methods can neglect to ask people about what happens to their relations with the living world in the face of processes of acculturation, cultural erosion or increasing competition for access to resources—and this neglect, in turn, tends to depoliticize ILK.

In this paper, we propose an approach to ILK that overcomes these limitations by taking into express account its political dimension. By 'political', we refer to the multiple interactions that take place at the global-local interface and their expressions in the field. We want to show that the dynamic and strategic character of ILK allows indigenous people to productively respond to emerging challenges at

different scales. In this regard, and in referring to 'local' knowledge beyond an exclusively indigenous dimension, we insist on the importance of anchoring knowledge in its territory of application and production.

Accounting for the dynamic, adaptive and political dimensions of ILK requires that we renew the frameworks (Gilbert & Henry, 2012) and methods classically employed. Therefore—and this is the second significant contribution this paper aims to make—we formulate a set of methodological and theoretical suggestions that can help researchers to overcome the heuristic dead ends to which conventional ethnobiological inventories can lead, especially in a context of rapid global change. We call this set of proposals 'a social anthropology of living things'.

The paper is structured in three sections. In the first section, we present the context and methods of our research by describing the Waraná Project and its centrepiece protocol of production. This will allow us to illustrate the relevance of this case study for understanding the adaptive and strategic nature of ILK. The second section draws on the case study to describe the several identified dimensions of ILK, arguing for the need to study the *processes* by which ILK is created rather than—or in addition to—the body of knowledge that results from those processes. In the third section, we set out the components of a social anthropology of living things. First, we present the benefits that a pragmatic approach to ILK can provide and suggest the fruitfulness of combining ethnobiological (here, *ethnobotanical*) methods with methods mobilized in science and technology studies. Then, we introduce the concept of 'plant ontologies', showing how such ontologies can help us to understand the processes of ILK production and the broader contribution of ILK to biocultural conservation challenges.

2 | MATERIAL, METHODS AND CONTEXT OF GUARANA PRODUCTION IN NORTHERN BRAZIL

To contextualize our study of the Waraná Project and its production protocol, we present in this section an overview of guarana production and of our research methods (Section 2.1). This allows us to situate this project within a broader range of initiatives carried out by family farmers from the Amazon region to reterritorialize guarana and valorize their knowledge in a rapidly shifting socio-economic context. Then, we describe the socio-ecological relationship between the Sateré-Mawé and the plant and explain how the deterioration of this relationship led to the creation of the Waraná Project (Section 2.2). Finally, we specify how data regarding the protocol and its creation process were gathered.

2.1 | Questioning the local transformations of Amazonian guarana production in times of globalization

This paper grows from a decade of field research on the processes of guarana valorization in the Lower Amazonas region of northern

Brazil. Besides the Sateré-Mawé, who first discovered, cultivated and probably domesticated guarana about five centuries ago in this region⁴ (Clement et al., 2010), guarana is now cultivated commercially⁵ by other populations who have gradually adapted the knowledge and know-how developed by the Sateré-Mawé (Monteiro, 1965). Most of those who cultivate guarana are *caboclo* family farmers (and, to simplify a complex identity, these are the descendants of Amazonian indigenous people and European settlers) from the Amazon region. But guarana cultivation has also expanded to other, more productive regions of Brazil, creating a competitive economic situation for traditional Amazonian producers.

2.1.1 | Socio-cultural and ecological aspects of guarana production in Brazil

One of the objectives of our research was to describe the different systems of guarana production that coexist in Brazil today, including some that might imperil the conservation of the species' biodiversity. Indeed, although the production of guarana seeds remained a regional, traditional activity through the mid-20th century, this situation changed drastically with the late-century success of national and international marketing campaigns that made soft drinks containing guarana-seed extract a hot commercial product. This success provoked a sharp increase in the demand for guarana seeds (Henman, 1982), and demand has not stopped growing since (Tricaud, Pinton, & Pereira, 2016). In response to this ever-rising demand, a number of economic actors have converged on the Lower Amazonas since the 1960s to promote the 'modernization' and intensification of local guarana production (Congretel & Pinton, 2016). Among them are soft-drink industry multinationals and the Brazilian Agricultural Research Corporation (EMBRAPA⁶), a state-owned research corporation.

Over the course of the last 40 years, EMBRAPA has worked to develop and promote 20 improved cultivars of guarana with desirable characteristics such as good productivity of seeds, resistance to various diseases and high caffeine content. Such varieties also satisfy the requirements stipulated for their distribution and marketing in Brazil (which mandate, e.g. that the cultivars available be clonal cultivars). These requirements are related to Brazil's 1999 decision to join the UPOV (International Union for the Protection of New Varieties of Plants) system.⁷ Along with its stewardship of genetic resources, EMBRAPA works in partnership with a number of other actors (e.g. the soft drink industry, banks, public technical support organizations) to promote—and even to impose (see Congretel, 2017; Congretel & Pinton, 2016)—production management practices that favour larger fields, monocultures, a high use of inputs and time-consuming activities such as pruning. Notably, EMBRAPA-promoted management practices were developed with little to no reference to local knowledge of the plant. In addition, they are based on representations that differ drastically from the conceptions and expectations of local guarana producers, most of whom prize the strength and autonomy of their

guarana trees rather than their high productivity or caffeine-rich content (Congretel & Pinton, 2016).

Another important issue at stake is how to maintain the genetic diversity of the species while promoting the use of a limited number of clonal cultivars. The semi-domestication practices and gene exchange between wild and domestic species characteristic of the swidden cultivation systems⁸ traditionally used to grow guarana (Congretel, 2017; Henman, 1982) strengthen agrobiodiversity and can thus prove valuable guarantors in commercial and subsistence agriculture alike (Smith & Schultes, 1990). In this regard, the different practices developed by the Sateré-Mawé and insisted upon in the production protocol are particularly interesting, especially since the contrasting EMBRAPA-promoted management practices disregard most recent findings about the resilience of swidden cultivation systems.

Swidden practices have often been criticized by conservationists because they contribute to deforestation. But since forms of swidden agroforestry preserve some naturally recruiting wild tree species, require low inputs and allow for secondary forest regeneration, they are generally considered to be sustainable, environmentally friendly forms of agriculture that favour the conservation of the Amazonian forest (Lima, Skutsch, & Costa, 2011; Nepstad, Stickler, Filho, & Merry, 2008; Porro et al., 2012). ILK of the ecological characteristics, interactions and trajectories of plants can assist in secondary forest restoration efforts (Reyes-García et al., 2019). Given this situation and the negative consequences of the abandonment of swidden agroforestry on Amazonian forest ecosystems, better understanding how to work with and support communities—such as the Sateré-Mawé—that wish to maintain or revitalize swidden agroforestry, then, will be a valuable skill.

2.1.2 | Studying the trajectory of innovative local socio-ecological projects

About 4,000 tonnes of guarana seeds are produced each year in Brazil—the only country to grow guarana—and almost all are produced by small family farms (Pinton & Congretel, 2016). About 75% of the harvest is now produced in the coastal parts of the Bahia region, and most of the rest in the Lower Amazonas. There, a small part of the production is consumed or sold locally, but the great majority is destined for industry. At the same time, we have noticed several initiatives that aim to sidestep this conventional value chain. Led by groups of traditional producers, they aim to add market value to their production with appeals to its geographical origins and the socio-environmental conditions of its production, and they work to connect local producers with niche markets around the world.

Because these initiatives mobilize a variety of legal and economic tools, multiple forms and sources of knowledge, and a very diverse cohort of actors as they experiment novel paths for the development of the Amazon, these projects constitute interesting attempts to build ‘new possible worlds’ in which local producers try to reconcile economic, cultural and environmental issues at the same time that they maintain control over their own development. From 2011 to 2017, we

conducted a socio-anthropological survey of three of these projects, studying what their protagonists think and do with the plant and, conversely, how the plant engages them and influences their trajectories. The three initiatives we examined, all situated in the Lower Amazonas, were the Waraná Project; a farmers’ association working to obtain a geographical indication (which it obtained in 2018) for their guarana seeds; and a cooperative producing organic guarana.

Throughout the duration of our research, we carried out fieldwork with the protagonists of these projects (including guarana producers, consultants, development agencies, customers in Brazil and France, and financial and academic partners) as well as with actors invested in the modernization of local agricultural systems, including breeders and geneticists from EMBRAPA, agricultural technicians and representatives of the soft drink industry. Fieldwork mostly took the form of semi-structured interviews, participant observation, and participation in meetings and events.

Fieldwork among the Sateré-Mawé was made possible through authorizations from the Sateré-Mawé General Tribal Council (CGTSM), the National Foundation for Indigenous People (FUNAI), local *tuxauas*, and each interviewee (from whom prior informed consent was obtained and recorded). The socio-anthropological research approach was issued all mandatory authorizations by the Brazilian Council for Research Ethics (CONEP). The research has been developed largely in the context of a PhD project carried out between 2013 and 2017 at AgroParisTech. For our work on the Waraná Project, we spent several months immersed in different villages of the Andirá-Marau (AM) indigenous land,⁹ where we conducted interviews and participant observation with indigenous producers taking part (or not) in the Project and with local authorities (*tuxauas*). We also conducted interviews with the administrators of the project from the Sateré-Mawé Producers’ Council (the CPSM, presented below), attended meetings and daily work sessions at the headquarters in Parintins (AM), and embarked on two expeditions organized by the CPSM to buy seeds from producers and communicate about the project. We also carried out ethnobotanical surveys in the swiddens and forest patches where guarana grows and organized focus groups and participative mapping workshops. This combination of methods and approaches—a lawyer was also involved in fieldwork—allowed us to describe and characterize the many and diverse forms assumed by the specific and historical but ever-changing relationship between the Sateré-Mawé involved in the Waraná Project and the guarana plant.

2.2 | The Waraná Project: Connecting socio-cultural and ecological issues across scales

The Sateré-Mawé indigenous people belong to the *Tupi-Guarani* ethno-linguistic group, speaking the Sateré language as mother tongue (though the majority also speak Portuguese). Most live in small communities scattered across the Andirá-Marau indigenous land, situated on the border that separates the states of Amazonas and Pará, about 600 km east of Manaus. This forested area, spanning

7,886 square km and accessible only by boat, was officially demarcated by the Brazilian government in 1986, following a series of violent conflicts that erupted when different actors, including oil and gas companies, attempted to exploit some of the community's territorial resources (Lorenz, 1992). If those events have weakened the Sateré-Mawé politically and socially, they have also generated opportunities for the community to organize itself and experience the power of global connections as it endeavours to solve local challenges (Figueroa, 1997; Wolf, 2012).

2.2.1 | Not any guarana is *waraná*: From local cosmology to plant management practices

For over five centuries, the Sateré-Mawé have developed strong material, cosmological and epistemological connections with guarana. In relation to their founding myth (Figueroa, 1997), the Sateré-Mawé consider themselves the 'sons of guarana'—or rather of *waraná*. In addition to understanding the plant as the origin of their people, they also consider it their main source of knowledge and their main *tuxaua*, a respected authority and counsellor who fosters good thoughts and wise decisions through the consumption of the seeds. In the Sateré language, the term *waraná* reflects the epistemic authority of the plant: it is the 'beginning (-na) of all knowledge (*wará*-)' or 'explanation'. Sateré-Mawé people do not consume guarana seeds only for their physiological virtues, then: taken at social occasions, the *waraná*'hy ('water of guarana', guarana sticks grated and diluted in a water-filled gourd that circulates from mouth to mouth) is shared to ensure the circulation of *wará* ('thoughts' or 'knowledge'), generate 'good speech', and guide learning and decision-making processes (Congretel, 2017; Figueroa, 1997). However, though this ritual constitutes a founding principle of knowledge and guides the community's reflections and decisions, its profound signification has eroded in recent decades with the diffusion of the national educational system and its competing knowledge claims. Revitalizing the epistemic authority of *waraná* is one of the issues addressed in the protocol.

In relation to the cosmological status of the plant, for the Sateré-Mawé, not any guarana is *waraná*. Local management of the resource and production practices play important roles in this regard. For the Sateré-Mawé, *wará* is contained only in the seeds of 'true guarana' (*waraná sese*) or 'mothers', vines that grow spontaneously in the forest (*ga'apy*), and in the seedlings that germinate spontaneously at their feet, or 'sons'. Consequently, the Sateré-Mawé never sow guarana seeds but transplant 'sons' from the forest into small clearings near the villages, where they are grown alongside other useful species such as fruit trees, tubers, etc. Maintaining a direct lineage between forest-dwelling 'mothers' and transplanted 'sons' ensures that *wará* is retained in the seeds and—not a point of minor importance—that the Sateré-Mawé maintain their identity as 'sons of *waraná*' through the consumption of those seeds. Planting clonal seedlings of improved cultivars is, in this sense, inconceivable: these have no lineage with the forest mothers and therefore contain no *wará* at all.

The 2008 protocol makes the transplantation of forest seedlings the only production practice authorized, presenting the forest 'mothers' as 'wild individuals' and the 'sons' transplanted to the swiddens as 'semi-domesticated'. Before further analysing this discourse and its motivations through a social anthropological lens, it is important to note that, according to geneticists, guarana is probably an entirely domesticated species (Atroch et al., 2012; Clement et al., 2010): in other words, there is no *wild* guarana. According to the authors mentioned, the species of guarana currently known and cultivated results from a fortuitous and unique genetic crossing.¹⁰ We discuss the implications of this affirmation later (in Section 3.3.2); what is important to observe here is that the protocol's description of the transplantation practice was conceived of not only as a tool to give commercial value to *waraná* but also to present the related knowledge and know-how (*savoir-faire*) reconfigured, rethought and mobilized by the producers engaged in the Waraná Project.

2.2.2 | Genesis and purposes of the Waraná Project

Founded in 1995, the Waraná Project takes as its objective the creation of a local economy capable of backing Sateré-Mawé claims for cultural and political autonomy and for securing their territorial rights (Barthel & Erhardt, 2008). Based on the organic production and fair trade of guarana seeds and other local natural products, the economy generated would serve to improve infrastructures in the indigenous area, build local education and health systems based on traditional knowledge and epistemology, and foster a cultural revival. Indeed, among the main concerns of the project's leaders are the Sateré-Mawé's increasing dependence on the State for income and the erosion of their culture (Palma Torres, 2010). The project also aims to prove that the group's land is productive and should therefore be respected.

By 2017, about a hundred families were involved in the Waraná Project. It is administered and managed by a 'head' group of six people, most of whom are guarana producers, who lead the Consortium of Sateré-Mawé Producers (CPSM), and supported still by the consultant who co-initiated the project. The CPSM, a collective autonomous entity created in 2008, assembles all the producers involved in the project and functions according to democratic principles.

The 'Protocol for the production of *waraná* sticks' was also created in 2008; its genesis, which involved numerous actors (managers of the CPSM, producers, consultant and others) and developed through a participative process of knowledge production and selection, is presented in Section 3. We gathered our data regarding this process, during which we were not present, through interviews with the actors involved. Data regarding the result of this consultative process—that is, the protocol document itself—come from our translation and analysis of the document. The protocol consists of nine articles, all written in both the Portuguese and Sateré languages. A reverse translation from Sateré to Portuguese has allowed us to assess the differences between the two versions

and to develop an understanding of how 'scientific' elements were translated.

While the protocol's vocabulary is partly scientific and derives from scientific ecological knowledge, its primary motive is to emphasize the Sateré-Mawé epistemology—in other words, how they come to know things through the plant and how they use this knowledge to intervene on their situation and find their place in a globalized world. In this regard, the protocol (and the management system it describes and broader ethnodevelopment project in which it is inserted) offers a highly relevant case study for considering the role that ILK can play in a context of global socio-environmental crisis.

3 | RECONSIDERING ILK AS A POLITICAL AND ADAPTATIVE COUPLING OF THE LOCAL AND THE GLOBAL

In the wake of the socio-environmentalist movements of the 1990s, the relationship between cultural and biological diversity has been frequently addressed through the concept of *traditional ecological knowledge* or TEK (Berkes, Folke, & Gadgil, 1994; Inglis, 1993; Johannes, 1989). TEK refers to 'a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment' (Berkes, 1993, p. 3).

The term thus simultaneously attests to the ancient origins of these forms of knowledge and indicates their situated basis in local natural environments, raising questions about the relationships between knowledges produced by local populations about local natural history and those that emerge from within scientific ecology (Roué, 2012). At the same time, however, the term *TEK* risks 'translating' and reducing these forms of traditional knowledge under the rubric of scientific ecology; and, in describing these knowledges as 'traditional', it risks suggesting situations of exclusivity, identity and historical depth that become increasingly slippery (Pinton & Grenand, 2007). In addition, this term tends to depoliticize the recognition of these forms of knowledge by presenting them as part of a completed historical process. Our choice to speak of 'local' rather than 'traditional' knowledge, specifying their indigenous character but not the specific ecological domain, then, seeks to avoid these pitfalls.

In this second section, we argue for an enlarged framing of ILK that takes into account political and strategic dimensions. Drawing from an analysis of the conditions and processes of knowledge production and selection which led to the validated version of the 2008 protocol, we show that political and strategic dimensions indeed contribute significantly to ILK's relevance and accuracy in contemporary, shifting socio-ecological conditions. In doing so, we emphasize the need for renewed approaches to ILK that attend carefully to the processes through which ILK is informed, created, transmitted and used rather than focusing only on its contents and cognitive organization.

3.1 | ILK as a mediation with the world

Anthropological studies have shown that most people holding localized knowledges are now implicated in processes of globalization, whether or not they wish to be (Escobar, 2001). We argue here that, in order to continue *existing*, indigenous and local populations need to defend and adapt 'a' local knowledge—conjoined with its related practices and discourses—to the ever-evolving overlaps of scales that define globalization; this adaptation, furthermore, must be underpinned by strategic political choices.

3.1.1 | The issue of finding a place in a globalized world

Although the Sateré-Mawé consider themselves to be the descendants of guarana, they are not unaware that guarana, in addition to its traditional cultivation and mythological character, also takes on other forms of identity: it is a nationalized genetic resource; a primary resource for the soda industry; a protected set of improved cultivars promoted by EMBRAPA; and even a 'super-food' consumed in diverse forms throughout the world. Consequently, guarana is the object of claims and strategies of appropriation concerning not only its botanical and scientific history but also ones about the history of the peoples and territories where it is found. Keeping in mind that the Sateré-Mawé belong to an agronomical, commercial and juridical universe that is both globalized and competitive is essential to understand how they reconfigure their knowledge and know-how and the ways they use it in different globalized contexts.

In this evolving context, the Sateré-Mawé (re)consider and present their production of guarana in a way that links their representations with the places that they wish to occupy, roles they want to have, ways they want to be seen in a globalized world and global forces that they must contend with. For example, given the way they manage their guarana, it is impossible for the Sateré-Mawé to have it recognized as a single cultivar and hence protect it as intellectual property (Filoche & Pinton, 2014). Neither is it feasible for them to adopt the improved cultivars promoted by EMBRAPA, since these do not correspond to their own representations of what 'good' guarana is and lack the attributes that confer on guarana its cosmological role as 'guide' of the Sateré-Mawé people (Congretel, 2017). Their development project thus pursues other paths, other forms of valorization of the plant and other strategies for relating these to their socio-political goals. One such path lies in linking their knowledge and practice regarding guarana to the global public debate regarding the sustainability of resources.

3.1.2 | Linking ILK to debates about resource sustainability

The opening of markets and the strengthening of environmental concerns have elevated the matter of resource sustainability worldwide.

As a result, the relationships between societies and their natural environments are transformed as these are drawn into relation with global public debates (Thomas & Boisvert, 2015). The Sateré-Mawé involved in the Waraná Project are aware of global trends in sustainability and conservation policies concerning tropical forests and understand how indigenous groups are viewed and positioned relative to those trends (Conklin & Graham, 1995).

Social groups or local communities may be tempted to reimagine their relations with the living things that surround them—plants, animals, soils, forest environment, etc.—according to the representations of themselves that they wish to present to global society (Carneiro da Cunha, 2010). In other words, they may attempt to find new ways to perform or represent their interactions with their environments so that outsiders more easily understand them as good environmental stewards. This, in turn, can allow local communities to retain control over their mode of cultivation and continue traditional practices of gathering wild plants from sustainable natural forest populations.

It is partly with this goal that the Sateré-Mawé engaged in the Waraná Project claim, through their protocol and communication via various media (social networks, website, public events), that their production practices are sustainable, both in terms of biodiversity conservation and in the fair working conditions experienced by the producers. Since 2012, these efforts have been validated with the award of several certifications and labels that aim to make the group's *waraná* attractive to a niche clientele operating mainly in organic and fair trade markets in the global North. For example, Sateré-Mawé *waraná* has been granted a certification as 'analog forestry'¹¹ and status as Slow Food 'Presidium'. This status, named after the Italian word for 'sentry', is awarded to products from a 'quality production threatened with extinction' (Baldereschi, Ciociola, Giannini, Milano, & Ponzio, 2015). The production concerned must 'protect a single region and an ecosystem' and contribute to 'maintaining traditional processing methods [and] safeguarding native breeds and varieties of local plants'.¹² In other words, Presidia products are sentries meant to defend biocultural diversity.

This latter certification is worth some elaboration, since analog forestry is itself an excellent example of how traditional and scientific knowledge have been successfully integrated. Analog forestry is a holistic form of forestry that seeks to minimize external inputs such as agrochemical products and fossil fuels and to maintain forests' ecological functions to ensure their resilience and productivity. The Forest Garden Product (FGP) certification was created in the early 2000s and is now recognized by the International Federation of Organic Agriculture Movements (IFOAM Organics International, 2020). It consists of a set of norms guaranteeing that products are sourced from an organic and diversified environment and produced in accordance with accepted social criteria. These norms formalize principles found in many 'forest societies', drawing on the strengths of the traditional paradigm of forest home gardens, patches of cultivated land dominated by trees and perennial shrubs and assuming a forest-like system appearance (Senanayake, 2000). An analysis of FGP certification criteria shows that they are broad and flexible enough to accommodate a wide range of forest production systems

(IAFN, 2014) that differently—but successfully—facilitate a 'natural process of seral succession' and maintain the 'fertility and biological activity of the soil'.

3.1.3 | Combining issues to build networks

Despite the place-based nature of ILK, the involvement of local populations in a globalized and connected world requires that they find allies with whom to construct and consolidate their projects. As Sateré-Mawé leaders struggled to valorize guarana on the international stage without losing control of its production conditions, it proved important to link their knowledge and know-how with the local bioclimatic conditions and with the scientific bases for conservation. Together, these aligned the political dimensions of their project and determined the sorts of partnerships they established.

The certifications attributed to the products derived from *waraná* connect the Sateré-Mawé producers to a large network of consumers and, more broadly, to actors promoting agroforestry, environmentally friendly agriculture and biocultural diversity. Among these are mixed companies, private and public development agencies and foundations, governmental actors and the academic world with whom the producers can interact. Most of these actors were involved in the writing of the 2008 protocol, sharing ideas that joined together different experiences of the plant, objectives and knowledge registers so as to consolidate the partnership between network members at the same time that it addressed the producers' main goals.

3.2 | Processes of ILK transformation

3.2.1 | Reshaping ILK through participation

Another important element of the political character of local knowledge resides in the emphasis on the participation of local populations as a touchstone of development (Olivier de Sardan, 2001; Pinton & Grenand, 2007). While the Waraná Project was initially placed under the control of the General Council of the Sateré-Mawé tribe (CGTSM), whose members include the tribal elders, an appeal to participatory processes led to the creation of the CPSM in 2008, more than 10 years after the birth of the project. Since then, all decisions concerning the management of resources, the production or commercialization of guarana, and the production of other agroforestry products such as *urucum Bixa orellana* and *andiroba Carapa guianensis* are voted on by the assembly of all members (Congretel, 2017). The construction of the protocol was no exception, emerging according to the democratic principles that regulate the functioning of the CPSM.

The knowledge described in the protocol is the fruit of a process of discussion and 'participative selection' about what constitutes 'good' guarana (*waraná*) and how this should be produced. Most of this process took place during a 3-day assembly that brought together about 70 guarana producers involved in the Waraná Project (mostly elders

of the community), the head-directors of the CPSM, Sateré-Mawé teachers, the Italian consultant (ACOPiAMA) and a group of Brazilian students funded by the Amazonas State Research Support Foundation (FAPEAM) who had interviewed several dozen guarana producers across the indigenous area and helped to compile a draft protocol.

The draft protocol served as a basis for the assembly's discussions, during which certain elements of product definition and production practice were easily validated, others bitterly discussed and others finally rejected. The main challenge was finding acceptable compromises between the demands formulated by the certifying organizations, which were based on ecological and social criteria, and those of the producers. Drawing on their individual and collective understanding of the past as well as on their visions for the future, producers' demands combined the desire to revitalize practices guaranteeing the plant its central role in Sateré-Mawé society with the desire to improve difficult working conditions. For example, traditional Sateré-Mawé guarana cultivation practices require tedious labours to maintain the swidden plots, such as the building of *jiraus*, traditional wooden stakes that support the plant's branches and prevent certain diseases. The difficulty of this practice had led many producers to abandon it, and it had to be debated whether the group, in its collectivity, wanted to revitalize it or not. Another example lies in the suggestion to ban the use of plastic tools (such as buckets) and rely instead on tools made with local materials; that suggestion was ultimately rejected by the producers. In the end, the debates and writing process resulted in the definition of production practices that were both traditional and ecological and that made sense to the producers without privileging or yielding on any of the dimensions.

When the discussions concluded, the final protocol was written (in Portuguese) by the Italian consultant with the assistance of ecologists from the Federal University of Amazonas; it remained under the oversight of the CPSM. The protocol was then translated into Sateré, using circumlocutions to construe concepts that do not exist in the Sateré language, and distributed to producers. It also became the subject of many outreach actions in the different Sateré-Mawé communities, aiming to make producers aware of the multiple commercial, political and cultural issues at stake in respecting the protocol that they had themselves played a major role in defining.

The participative process invoked in the definition of this protocol shows us that knowledge is something that is transmitted, selected and circulating, and that the processes of knowledge selection correspond to the adoption of particular strategic alliances and political positioning that emerge within a given global context. This contrasts markedly with an understanding of knowledge conservation as a form of heritage, which maintains a position of indifference as to whether or how knowledge is used, updated, or taught.

3.2.2 | Reshaping ILK through the hybridization of knowledge registers

The *circulation* of ILK transforms its contents through processes of selection and adaptation—but this is not the only way in which

ILK is shaped and reshaped. It is important to recognize also that ILK is *open*, including to other forms of rationality such as science. New inputs and influences must be approached with great sensitivity when they engage ILK, due to its unique interactions with the natural world, making it a situated or contextualized knowledge (Altieri, 2004). In the case of sustainability, the range of actors engaged in the construction of a supply chain or project diversifies the sources of knowledge being used and the world-visions associated with them. In this case, then, the implementation of certifications serves as an instrument that brings these various sources and forms of knowledge together and makes different rationalities meet.

In the development of the protocol, it is possible to identify not only processes of knowledge innovation and readjustment but also the mixing (*métissage*) of different forms of knowledge. What seems important for us to explore here is the way in which confrontations are managed, what translations are carried out (Callon, Lascoumes, & Barthe, 2001—see also Section 4.3) and what is constructed as a 'negotiated commons' across the supply chain. It is important to note, too, that the processes of integrating different forms of knowledge and worldviews across a supply chain can complicate and refuse simple binary oppositions such as those between tradition and modernity or between the *emic* perspective and the *etic*. The *emic* perspective comprehends knowledge and representations as they are interiorized, lived and formulated by the people being studied themselves; the *etic* perspective refers to scientific methods and classifications and assumes an objectified 'from the outside' view (Berthe-Friedberg, 1991).

Discussions between all the actors involved in the design of the protocol forced different perspectives on what 'good' guarana is (and the related 'good' ways to cultivate and process it) to meet and hybridize as the final version of the protocol took form. The knowledge presented in the document does not merely juxtapose the *emic* perspectives of each different actor (producer, certifier, commercial partner and so on) on those matters but intertwines them. The statement defining *waraná* as consisting of 'wild' vines and 'semi-domesticated shrubs' related by gene flows through cross-pollination (Art. 3) is a good example. It results from a translation of the Sateré-Mawé's own cultural understanding (*emic* perspective) of *what waraná is* (mothers and sons) in scientific terms, as if viewing their own culture from the outside (i.e. assuming what would be an *etic* perspective of the Sateré-Mawé but an *emic* perspective of the scientists). Other statements use concepts such as agroecology, permaculture, genetic diversity, etc. (the *emic* perspective of the scientist) to explain how the Sateré-Mawé's own ideas about what good guarana is (the *emic* perspective of the Sateré-Mawé) relate to conservation and management outcomes.

As mentioned earlier (Section 2.2.1), some affirmations found in the protocol regarding the status of the spontaneous guarana seedlings found in the forest or the gene flows maintained between the forest 'mothers' and the transplanted 'sons' might raise questions among ecologists. From an ecological perspective, transplanting self-recruiting seedlings into swidden cultivation probably maintains gene flows between the transplanted populations and the forest

populations, thus ensuring a reasonable genetic diversity within the swiddens. Nevertheless, further analysis of these gene flows remains necessary to affirm that cross-pollination between these populations can effectively occur, since the distances between the spontaneous populations in the forest and the swiddens are often considerable (several kilometres). Our point here, however, is to underline the capacity of ILK to integrate and adapt to other forms and sources of knowledge.

Beyond the hybrid of forms of knowledge visible in the protocol itself, the Sateré-Mawé involved in the Waraná Project strategically use ecological facts and language to express, present or legitimate their own practices and values. We frequently observed how scientific concepts such as biodiversity, agroforestry or in situ conservation percolated in the daily discourses of producers, even reaching their Facebook posts. This discursive penetration signals the process of knowledge mixing at work, one very different from the acculturating processes that would replace traditional knowledge with generic scientific knowledge. The Sateré-Mawé use scientific concepts (i.e. they assume an *etic* perspective) to translate or frame their ILK (their *emic* perspective): this is how they legitimize it to their external counterparts.

Symmetrically, this same pluralistic approach to knowledge is sometimes drawn upon by scientists, too. For example, a team of geneticists and agronomists drew on an interpretation of the Sateré-Mawé's foundational myth to clarify their research on the origins and domestication of guarana. Clement et al. (2010) suggest that the Sateré-Mawé myth relating the birth of guarana—and of the Sateré-Mawé people itself (see Pereira, 1954)—narrates in a barely metaphorical way the initial domestication of the plant by a Sateré-Mawé woman. She noticed the particularities of the plant (i.e. its larger fruits, which are due, in scientific terms, to polyploidy), and, by planting the seed, began its cultivation. This 'genetic' re-reading of the myth, which was paired with scientific research and knowledge production about the plant's genome, led the researchers to two main conclusions. First, the species of guarana that is cultivated today is an entirely domesticated species arising from a fortuitous and unique genetic crossing. And, second, the Sateré-Mawé themselves carried out this process of domestication.

3.3 | From reshaping (ILK) to reclaiming (rights and traditions)

In this sub-section, we briefly present the socio-political and cultural issues that the knowledge hybridization achieved during the protocol preparation processes addressed.

From the producers' perspective, the certifications obtained are valuable in multiple ways. In addition to valorising sustainable practices on the basis of product traceability, the certifications—and the transformations of ILK they motivated—are also thought of and experienced by the producers as an opportunity to defend the integrity of their territory and to internally redefine the place of the plant in their own collective organization.

3.3.1 | Reclaiming the land

The demarcated Indigenous Territories remain a fragile legal construction in Brazil. While guaranteeing their indigenous inhabitants use of the land and of local resources, they face multiple pressures; among other challenges, the subsoil and its resources (such as minerals, petroleum, etc.) remain the property of the Brazilian state, and 'projects of general interest' (such as hydroelectric dams) can be realized upon them, independent of indigenous wishes (Baines, 2001; Brum, 2015). Since the impeachment of Dilma Rousseff in 2016 and Jair Bolsonaro's accession to power in 2018, the existence and integrity of Indigenous Territories have been threatened by constitutional and institutional changes invoked in a context of general deregulation (e.g. the dismantling of the National Foundation for Indigenous Peoples [FUNAI]; Letourneau, 2019). As Obadias Batista Garcia, the most prominent leader of the Waraná Project, put it 6 years ago, 'demarcation does not mean territory (...). We need to produce to occupy the land'.

In this perspective, the qualification procedures underlying processes of certification emphasize the productive character of the territory and the specificity of the resources from which its production originates, and, in so doing, gives value to the most remote parts of the land. The 'wild' *waraná* gathered in the forest and transplanted into swidden agricultural fields become 'sentries' of the Andirá-Marau indigenous land, and the ecological continuities between the forest and the swidden fields (*roças*) acquire value for being characteristic of sustainable agro-forestry systems.

3.3.2 | Reclaiming traditional practices

Among the Sateré-Mawé, certifications and labels have also prompted collective decisions to revitalize practices that had fallen into disuse, such as the building of *jiraus*, the use of smokers for conserving and imparting a characteristic flavour to the guarana sticks, and the intentional combination of various plant species within guarana plantations (Congretel, 2017). Co-locating species remained a common practice until about two generations ago, when guarana shrubs were often mixed with orange or calabash trees, for example; but this traditional practice had slowly disappeared. Following the principles of analog forestry and, more broadly, principles of ecological and economic resilience, participants in the Waraná Project are now encouraged by the protocol to plant guarana together with other 'useful species'—such as *açaí* palm trees *Euterpe oleracea*, rosewood *Aniba roseodora*, *cupuaçu* *Theobroma grandiflorum*, *andiroba* or *urucum*—whose fruits or barks can be consumed, used or marketed.

While these practices help to restore to guarana its central place as a source of knowledge and decision-making support (Figuroa, 1997), they also serve many objectives more: they help to assure the sustainability of production by guaranteeing good management of the forest and diversity in the swidden fields; to differentiate the production by the Sateré-Mawé from that of their competitors and to renew the bonds of the Sateré-Mawé with the 'epistemology of *ward*'.

In other words, all these practices help, by way of their interactions with guarana, to reinstall Sateré-Mawé ILK with deep significance.

Before continuing, it is important to note that the processes of knowledge production, hybridization and selection described here and captured in the protocol form part of a medium-term strategy. The codification invoked by the protocol is not intended to fix this knowledge as stable over time. It rather reflects the state of empirical and scientific knowledge at the time of its writing, as well as the position of Sateré-Mawé guarana producers in socio-political and environmental contexts likely to change more or less quickly—especially in Brazil, which, as we have seen, is in a period of especially rapid change. It is important to note, in this light, that the protocol could be reopened for discussion and revised. When we were last in the field, discussions were being held between the CPSM, ACOPIAMA and scientific partners from the National Institute for Amazonian Research (INPA) to better understand the gene flows between forest ‘mothers’ and transplanted ‘sons’ and to debate opportunities to create a norm that would encourage producers to diversify the places from which they collect seedlings. A mid-term study of the genetic diversity of guarana plantations was planned. What is more, ILK is *also* a product of changing interactions between humans and non-humans, a dynamic that we examine in the next subsection.

3.4 | Considering the reciprocal interactions between humans and non-humans

Finally, our argument in favour of a dynamic analysis of ILK is supported by more recent work on the role of reciprocal interactions between humans and non-humans in the production of knowledge. Since the beginning of the 21st century, accounts of the material and sensory dimensions of interactions between social actors and other living things—in this case, we refer primarily to plants—appear as promising approaches for understanding the diverse forms of knowledge-making (Rose et al., 2012). The thrust of such accounts is that it is necessary to recognize the agency of living things—understood broadly as all non-human beings—in their interactions with humans; in other words, researchers must attend to other beings’ capacity to act, and to make others do things, which may, in turn, transform those beings (Demeulenaere, 2017; Myers, 2015; Tsing, 2015). Focusing on the *categories* used to *think about* living things is not enough to clarify these interactions.

As explained before, for the Sateré-Mawé, the *waraná* is a *tuxaua*. Thus beyond its energizing effects, the plant intervenes actively in people’s social lives. Through its characteristics and attributes—that is, because the seeds contain *wará* and do so only if the seedling was born from a forest ‘mother’—it directs production practices. In this way, the plant is not simply a passive object of management and consumption. It can also be seen as actively *doing something* within or to Sateré-Mawé society and to the global world beyond: by agreeing on how to manage and cultivate guarana, the Sateré-Mawé conserve the species, the forest and other species. At the same time, the guarana conserved in this way permits the Sateré-Mawé, via designated

rituals, to live as a society and to make collective decisions, including decisions to respect forage-based cultivation practices and to continue to develop and transmit the ILK associated with these practices (through the Waraná Project, for example). The plant is thus not passive but understood as *actively contributing to and making possible* social rituals and processes, including ones with conservation outcomes. According to Obadias Batista Garcia, the main leader of the Waraná Project, the project itself embodies the prophecy found in the founding myth of the Sateré-Mawé, according to which *waraná* would 1 day save their people.

Throughout this second section, we have seen how the interactions that the Sateré-Mawé maintain with the wider world (embodied in public policies, conventions, alliances and market transactions) and the resources they use to occupy the political and commercial arenas opened by globalization, act to transform their ecological knowledge, practices and discourses. The particular case of the Waraná Project shows the multidimensional and multifunctional character of local knowledge, including its ecological and political roles. This leads us to affirm once more that anthropologists must no longer simply inventory local phenomena but rather examine local–global interactions and come to understand their consequences and outcomes (Tsing, 2005). How have we proceeded methodologically to characterize such interactions? This is the matter we address in Section 4.

4 | FOR A SOCIAL ANTHROPOLOGY OF LIVING PLANTS: THEORETICAL AND METHODOLOGICAL PROPOSITIONS

Two complementary and interwoven methodological approaches for understanding the interactive nature of local knowledge production follow from our enlarged framing of ILK. The first (Section 4.1), sociology’s pragmatic approach, emphasizes the plurality of actors and scales and the links that are created among them. The second (Section 4.2), which consists of combining approaches from ethnobiology and science and technology studies (STS), proves helpful for illuminating how elements of knowledge produced in diverse contexts can be usefully translated or combined. At the crossroads of these two methodological entry points, we formulate an original proposal that consists of characterising knowledge creation through the description of ontologies—here, *plant* ontologies—to be understood as performative discourses about what *is* and *ought to be* (Section 4.3). Together, these methodological and theoretical proposals constitute what we call a ‘social anthropology of living things’.

4.1 | The pragmatic approach

The pragmatic approach, first developed by French sociologists in the 1980s, starts with an understanding of the experience of actors. Its methods emphasize the observation of the micro-social phenomena evolved in small social groups (i.e. a nuanced, qualitative observation of the groups’ interactions) that aims to understand how

they participate in 'macro-social' phenomena (such as the organization of global value chains; Barthe et al., 2013; Chateauraynaud & Debaz, 2017). Using this approach means analysing, through localized or multi-sited case studies, how collectives, groups and structures are formed (Barthe et al., 2013). Another important aspect of the pragmatic approach is that it does not pretend to explain the situations observed by resorting to ways of thinking or conceptual frameworks of which the actors are not themselves aware. It rather consists of trying to understand *on their own terms* the discourses and justifications actors produce about their own practices (Boltanski & Thevenot, 1991). In other words, actors' claims about their situations, beliefs, practices and so on, are taken seriously. Thus, the claim of the Sateré-Mawé that the *waraná* is a *tuxaua* is treated in the same way as the claim that *waraná* is a family of semi-domestic rootstocks and wild lianas interacting via gene flows.

Following a pragmatic approach has significant implications for the way that inquiries are conducted, data are collected and social orders are explored. Our approach, inductive (Guillemette, 2006) and multi-sited (Marcus, 1995), was based on the accumulation and progressive interpretation of data that allowed for the emergence of new questions, new key actors and new orientations for the study as the research evolved. In this respect, the pragmatic approach may bring into play what Dodier and Baszanger (1997) call 'combinatorial ethnographies', ethnographies that consist of noticing certain social operations (doing science, evaluating, caring, killing, etc.) observed in different contexts. In other words, rather than a controlled comparison between two objects of similar status, this approach focuses on the heterogeneity of places, objects and projects. It proves especially fruitful for helping to grasp the transformations, convergences and processes of legitimation or marginalization at play.

In the case of our study, adopting a pragmatic approach and using combinatorial ethnographies led us to observe how the plant interacts not only with indigenous communities but also with local peasants, national development agencies and implicated multinational companies (such as Coca-Cola). The goal was to characterize the innovative social and territorial dynamics at play around the plant in the Lower Amazonas. Instead of simply comparing how guarana is produced within the studied projects and what knowledge about the plant predominates—which would have taken for granted what guarana *is* to the actors invested in these projects—we observed and described ethnographically the joint trajectories of the projects and the plant along with the circulations and interactions between them and the knowledge production and transformation involved. Thus, we were able to observe that the guarana produced and experienced by the actors of the different projects *is not the same plant*. This is what the notion of plant ontology, presented below, intends to account for.

4.2 | Crossing ethnobiology with science and technology studies

Following a pragmatic approach to local knowledge and know-how relating to plants implies considering how these forms of knowledge

are based upon certain capacities and powers specific to the plant in question. But how can we concretely consider the production of these forms of knowledge prior to the production of the discourses designed to make them visible and circulating? We propose to briefly review what ethnobotany (as a branch of ethnobiology dedicated to human-plant relations) can bring to this question and then to show how the descriptive and agnostic approach to human–non-human interactions provided by STS can efficiently extend the contributions of ethnobotany.

The combination of ethnobotanical and STS approaches allows us to understand the processes by which ILK is reformulated at the local–global interface. At the same time, it is important to integrate the technical and ecological aspects that feed into these processes and the ways in which networks of actors connect with one another to carry out this reformulation, and we take care to incorporate these considerations in our combined approach.

4.2.1 | What is revealed by ethnobotanical studies

Variants of the ethnobiological approach (Barrau, 1976; Conklin, 1954; Hunn, 2000), as it has been conceived of since the 1950s on both sides of the Atlantic, are well known to those who study the so-called 'traditional' societies. Such approaches aim to inventory the patrimony of knowledge and know-how related to natural entities and resources by focusing 'primarily on the way in which (these societies) describe, name, class, interpret, etc., natural objects' (Metailie & Roussel, 1998). The principal merit of this approach is that it focuses on the differences between Western and non-Western ways of thinking, a focus important in contemporary anthropology.

Ethnobotany, defined in a broad sense as the 'dynamic, evolving, and historical [study of] the relations of a human group with its plant environment' (Haudricourt, 1956), is based on the ethnography of social facts relative to plants (Lieutaghi, 2003). From its roots—in progressive tropical agronomy, on the one hand (Portères, 1961), and American ethnoscience and anthropology (Bahuchet & Lizet, 2003), on the other—ethnobotany has inherited a double aim. For some, it is the privileged approach for learning more about plants themselves, a strategy with the utilitarian aim of imagining future applications. For others, its objective is anthropological (Lieutaghi, 2008). In both cases, the method consists of carrying out an ethnography of the knowledge, practices and local uses or cosmologies involving plants.

One of the fundamental contributions of ethnobotany is to provide an insight into the categories used locally to think about plants, along with what these modes of thinking reveal about the place, roles and status of plants within the set of beings that populate the studied groups' worlds. For example, ethnobotanical approaches have allowed us to understand how guarana seedlings change status when they are collected in the forest and then replanted in agricultural swiddens by the Sateré-Mawé: they pass from the category '*hentyri*' ('things that grow by themselves') to

the category '*mikoi*' ('things planted intentionally'). This change of status based in the plant's semi-domestication then becomes the basis for discourses used in the protocol to highlight the contribution of Sateré-Mawé guarana management practices to the maintenance of 'genetic diversity'.

The principal obstacle that classic ethnobiological studies must surmount is their risk of presenting a particular relationship with nature, or a particular body of ILK, as an undisputed and unchanging fact. For us, the appeal of an ethnobotanical method is that it resides less in taking an inventory of knowledge and categories and more in understanding in the processes that make them relevant to discourses destined for the 'outside world' (Carneiro da Cunha, 2010). From this perspective, and based on the observation that local knowledge constantly circulates, transforms and is open to multiple forms of rationality, we have sought to identify the shifts, correspondences or translations used, and reconfiguration strategies that characterize ILK in its evolving forms.

If ethnobotany is well equipped for creating inventories, it is less well equipped to answer questions about social transformations (such as, e.g. understanding how and why historically marginalized actors do or do not take advantage of particular tools and discourses or form alliances with other actors). To continue the previous example, it proves more interesting for the members of the Waraná Project to emphasize the genetic diversity created or maintained by their practice (using the notion of 'semi-domestication' to translate it into externally acceptable language) than to justify their argument on the basis that they are the community responsible for the domestication of guarana.¹³ To overcome this problem, we believe it is necessary to go beyond making inventories of local knowledge and its categorization and to situate them more robustly in their evolving environmental and political contexts so as to understand the *dynamics* of knowledge alteration and re-elaboration. Only by understanding these dynamics can we understand how ILK contributes to conservation and management in a changing world.

In this perspective, combining ethnobotany with methods from science and technology studies may be fruitful. With a composite approach, it becomes possible to characterize the cognitive, technical, sensory, interactive, temporal and strategic experiences of people in relation to the plant.

4.2.2 | The contribution of STS

Developed by Anglo-American researchers (Bloor, 1983; Collins, 1985; Jasanoff, Markle, Petersen, & Pinch, 1995) and present in France since the 1980s, science and technology studies approach science as a practice that is historical, social and technical. Its basis lies in making a close ethnographic description of its subjects, human and non-human, and of their interactions in the processes of 'making' science and technology. STS can be divided into several different lines of work, and, over the past several decades, it has produced a number of impactful

theories. The actor-network theory (ANT), which we focus on here, is one of them. Developed mainly by M. Callon, B. Latour, J. Law and M. Akrich, ANT emphasizes the multiplicity and heterogeneity of agents implicated in doing science. It gives particular importance to the role that objects play in the production, interpretation and circulation of the data that 'makes' scientific knowledge and disseminates this knowledge within the wider society (Callon, 1984; Latour, 1989; Law, 1987).

Though ANT intends to describe 'science as it is being made' by foregrounding aspects of methodology that scientists themselves rarely include in their scientific publications, the approach can be applied productively in the study of ILK by focusing on the frequently ignored aspects of its development. Fieldwork takes the form of observing the multiple interactions—between social actors, between humans and other beings (plants in our case) or between multiple other beings themselves (plants, technical objects, etc.)—that contribute to the production of different forms of knowledge. We can then describe the *translations* that operate in the 'creation of knowledge' through these interactions. In STS, the idea of translation designates the displacement of an entity (an object, phenomenon or technique) from one environment (spatio-temporal, linguistic, disciplinary, etc.) to another in response to a particular problem (Callon, 1984). Translation should thus be understood as a process through which elements that are a priori incommensurable (such as *plant, space, chemical input, productivity figure or parasite*) are brought into relation. This state of relations is always susceptible to change and is never entirely stabilized. The protocol of production written by the Sateré-Mawé is from this point of view exemplary, as we will see.

Some authors have criticized ANT, faulting it for an 'undifferentiated conception of social spaces' (Bonneuil & Thomas, 2009, p. 13). According to these critics, ANT gives too little importance to the context and the social positions of actors, leading to a situation in which 'the sociohistoric specificities of each account tend to be toned down' (Aggeri & Hatchuel, 2003, p. 117). Our methodological proposition allows us to avoid this pitfall. Using 'combinatorial ethnographies' to join the ANT approach with ethnobiological and micro-sociological surveys—which include the collection of life stories, project stories and argumentations, as we did with the actors involved in the Waraná Project—a holistic set of interactions that contribute to knowledge formation between the Sateré-Mawé and other entities can be taken into account. At the same time, this combination of approaches prevents us from neglecting the particularities of each actor or group of actors, be they cosmological, spiritual, political or historical ones (see Congretel, 2017).

4.3 | Describing the ontologies of plants

Our proposal to approach plant-related ILK by describing the ontologies of plants arises from the two methodological approaches presented and embodies the need to take into account the *agency* of non-humans—here, in the production of knowledge. Ecologists

think of species as agentic, functional entities within dynamic ecosystems or socio-ecosystems, yet it is not always clear how to understand or represent their ability to *do things*—and in particular to *make people do things*. Neither it is clear how to evaluate the dynamic interactions between species, the environment and humans. We want to emphasize that knowledge derived from a plant–human interaction can also be influenced by what ecologists call the developmental or functional traits of plants (in other words, by the ‘other’ powers held by plants). For example, the structure of guarana’s genome makes it behave a certain way in a certain environmental condition, and this contributes to the production of knowledge related to its cultivation. Another example is the *wará* contained in *waraná* seeds, which brings thoughts and knowledge to those who consume it.

The way in which we understand and mobilize the notion of ontology is mostly inspired by researches in STS (Law & Lien, 2013; Mol, 1999) and biological philosophy (Dupre, 2012). In its most literal sense, ontology is ‘a discourse on what is’ (Pellizzoni, 2015)—in the case of guarana, a discourse on what ‘good guarana’ is and ought to be. Our understanding of ontology goes beyond this to consider ontology as a *performative* discourse, a way of talking about guarana that guides the practices of those who use it, practices which in turn modify or (re-)‘create’ guarana. Thus, the guarana with which the Sateré-Mawé interact—*waraná*—is not the same as the one that is manipulated in laboratories. Nor is it the same as the one grown by *caboclo* smallholders. In other words, we want to avoid the danger of merely studying *others’* representations of what we ‘know the world to be’ and instead to recognize and describe other worlds revolving around common objects—here, a plant (Demeulenaere, 2017; Henare, Holbraad, & Wastell, 2007).

To characterize these ontologies is thus to characterize the set of discourses *about* and practices *with* living things. Our aim is to reveal, by analysing the relations of different social groups to the same ‘living object’, a pluralism of ways in which ‘what is’ and ‘what ought to be’ that emerges. This approach can also clarify the tensions between groups or groups’ strategic capacity to pass from one ontology to another according to the context in which they express themselves.

In the protocol, the definitions and instructions that appear are based on scientific knowledge and vocabulary but retain their associations with traditional knowledge and values (mythology). Drawing on what the project members have validated as their traditional ontology of guarana, and on the practices of production that they wish to conserve or reintroduce, the protocol performs a translation—in the STS sense—into ecological terms, thus making visible an ‘ecological ontology’ of *waraná*. This translation allows the actors in the project to operate within the field of environmentalist discourse and to discuss ‘in equal registers of knowledge’ with their ecologist partners—and also with the promoters of agricultural modernization whom the Sateré-Mawé resist. The chart below illustrates this point by comparing some characteristics of the two *waraná* ontologies mobilized by the project members, which we refer to here as ‘traditional

TABLE 1 Comparison of the characteristics of two different ontologies of guarana: traditional *waraná* and ecological *waraná* (translation)

Ontology	Traditional <i>waraná</i>	Ecological <i>waraná</i> (translated)
Representatives	Mothers and sons	‘Wild vines’ and ‘semi-domesticated’ shrubs
Reproduction dynamics	Matrilineal lineage ^a	Random ‘cross-pollination’
Properties	Source of <i>wará</i> and social cohesion	Source of genetic diversity
Habitat	<i>ga’apy</i> (forest) + <i>waraná’yypia</i> (plantations)	‘Primary or secondary forest’ + ‘open fields’ (clearings at forest margins)
Territory occupied	Sateré-Mawé’s ‘ancestral territory’	‘Sateré-Mawé guarana ecological and cultural sanctuary’

^aThe Sateré-Mawé consider that sons of guarana descend from their mother but have ‘no father’.

waraná’ and ‘ecological *waraná*’, the translation of traditional into ecological terms. Both ontologies can be opposed to a third that we have identified as ‘improved guarana’ (Table 1).

If man’s relation to nature is mediated by a complex set of representations (Dugast, 2003), characterizing these ontologies helps us understand what they tell us about the positioning of the project members, their ambitions and their relations to others and to the globalized world. Thus, rather than proposing a counter-narrative based on their cosmology or their identity as ‘children of *waraná*’, the Sateré-Mawé propose arguments of a scientific nature that emphasize the ecological and sustainable character of their practices. This translation, reflecting the alignment of their discourse, practices and objectives, legitimates their traditional practices but also their occupation of their territory, which becomes a unique ‘reserve’ of biodiversity.

5 | CONCLUSIONS

The renewal of research on indigenous and local knowledge following the 1992 Convention on Biological Diversity (or CBD), the general criticisms of the productivist model of conventional agriculture, and the many different trajectories of agriculture today have led to a diversity of knowledge that calls into question the monopoly of science (Agrawal, 1995; Compagnone, Lamine, & Dupre, 2018; Ingram, 2008; Kloppenburg Jr., 1991). The integration of these ‘knowledges’ into environmentalist discourse has enabled a recognition of ‘situated knowledges’—that is, a plurality of localized, evolving forms of knowledge—each guided by interactions with the natural environment; such knowledges are in distinct contrast to the ‘ungrounded’ knowledge of science and its claims of universality. The approach proposed

in this paper allows us to follow the trajectories and transformations between these different knowledges, and our analysis of the knowledge reconfiguration processes underlying the Waraná Project emphasizes the need to consider ILK's functions, sources of inspiration and modes of acquisition to better understand its relevance.

The XVI Congress of the International Society of Ethnobiology, held in Belém, Brazil, in August 2018, made its objective a stock-taking of 30 years of public policies and social mobilizations that had aimed to take indigenous and local knowledge into account in conservation decision-making processes. However, few changes are evident on the ground, and the knowledge of indigenous populations is often immediately discarded as non-actionable for its distance from western standards of conservation. If ILK is not yet broadly seen as contributing to conservation actions, we suggest that this is because ILK is too often misunderstood by researchers and managers as a historical body of knowledge about strictly local phenomena (e.g. as an inventory of species names and culturally specific uses). Clearly, such a body of knowledge, though it can easily be made to look like facts or data, would not be something useful for a changing world in which the local is linked to the global, and where multiple forms of knowledge and cultural contexts vie for influence in lengthy value chains. Our methodology allows us to see how ILK is transformed locally and to appreciate some strategies that it uses to resolve conservation problems.

The case of the Sateré-Mawé is exemplary in this sense, insofar as they have been able to find solid support outside their community and have benefited from leaders determined to defend their culture, their practices and to reinforce their capabilities (Sen, 2010). Their goal is to have Sateré-Mawé ILK recognized by the external world as meaningful, and the successful strategy they have used lies in the creation of equivalences and comparisons between their ILK and scientific knowledge. This has implied the formation of strong partnerships in the field and mediations with ecologists and conservationists. To understand these 'translations', we moved on different scales and in the different places where knowledge is being developed, from indigenous territory to the globalized public space of ecological crisis, without neglecting regional and national spaces. The networking of actors involved in the Waraná Project made it possible to link all these together.

The Sateré-Mawé thus respond to the question famously formulated by Latour (2017): how is it possible to anchor locally to inhabit the world? This scalar issue adds complexity and heterogeneity to the observed processes; in the case of Brazil, for example, the federal institutions responsible for processing the certification files submitted by the CPSM can considerably slow down the procedures and put applicants in difficulty.

Our propositions are not new in that they have already been used, here and there, in the literature. They are not *stricto sensu* specific to 'traditional knowledge' or to ILK and the problematics that concern them (such as status, rights and situations). Nevertheless, they do open the scope of research more generally to the creation of singular, local, situated knowledge, and towards an understanding of how local, participatory processes have brought global ecological discourse into dialogue with ILK. Practicing a social anthropology

of living beings, focused on plant ontologies, is a way to understand the plurality of worlds engaged in the production of knowledge, and to understand how the dynamic encounter between these worlds can benefit the conservation of both biological and cultural diversity.

The production of local knowledge may bring together a multitude of micro-worlds at the dynamic interface of the local and the global (Chateauraynaud & Debaz, 2017; Tsing, 2015). Working with ILK in this context is a challenge. The challenge is political in the sense of understanding the diversity of local and/or territorial responses to global social and ecological crises, as they contribute to the political reconfiguration of the world. And it is scientific as it demands a complex methodological arsenal associating anthropological approaches with a pragmatic sociology.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

M.C. did fieldwork with additional fieldwork by F.P. The two authors worked on the framing and analysed the data. They contributed together to the writing of the manuscript. They contributed critically to the drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT

We guaranteed anonymity and confidentiality to our interviewees, as per our Ethics Approvals granted by the Federal University of Amazonas Committee for Ethics in Research (CEP-UFAM), by Brazil's National Commission for Research Ethics (CONEP-authorization n°1.357.690) and by Brazil's Foundation of Indigenous People (FUNAI). The data contained in the Protocol analysed in the manuscript can be found online, as indicated in the References.

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ENDNOTES

- ¹ The formal name of the Waraná Project is the Sateré-Mawé 'Integrated Ethnodevelopment Project'.
- ² ACOPIAMA: Associação de Consultoria e Pesquisas Indianistas da Amazônia (Amazonian Consulting and Indigenous Research Association).
- ³ The concept of analog forestry is presented with more detail in Section 3.1.2.
- ⁴ The grounds for this affirmation are discussed below, in Section 3.3.2.
- ⁵ When cultivated, guarana grows in the form of a shrub. The fruits are hand-picked during a few weeks at the end of the year and processed, mostly by hand, to separate the seeds from the flesh.
- ⁶ EMBRAPA: *Empresa brasileira de pesquisa agropecuária*.
- ⁷ See Filoche and Pinton (2014). UPOV was created in 1961 to encourage research and innovation with a view to creating more productive and predictable plant varieties by offering breeders the possibility to have their variety innovations registered and protected and opening opportunities to derive income from them. To register a new plant variety, the breeder must prove that it is different from others, consistent and stable from generation to generation (see Trometter et al., 2007).
- ⁸ For more details about swidden cultivation systems, see Miller and Nair (2006).
- ⁹ All authorisations are available on request.
- ¹⁰ We come back to the process of knowledge hybridization and production behind this affirmation in Section 3.2.2.
- ¹¹ See the International Analog Forestry Network, IAFN (<http://www.analogforestry.org/>).
- ¹² Slow Food Foundation for Biodiversity (2020), online.
- ¹³ Note that this latter claim has been acknowledged by geneticists; however, it remains a claim that fails to serve Sateré-Waré ambitions for autonomy and territorial defence. (see Filoche & Pinton, 2014).

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