
Fostering Transitions Towards Sustainability? The Politics of Bioeconomy Development in Argentina, Uruguay, and Brazil

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The concept of bioeconomy is increasingly gaining attention in South America as a potential strategy to foster sustainability transitions. As bioeconomy development is intertwined with often contested questions of natural resource governance, it is important that the promotion of bioeconomy takes place in an inclusive manner. In three case studies from Argentina, Uruguay and Brazil we examine who takes up the concept, what interests are reflected in this and the implications for socio-environmental concerns. This points to two interrelated aspects which demonstrate variations in inclusiveness: the constellation of actors who drive bioeconomy visions, and the scope of issues covered.

Keywords: bioeconomy, inclusiveness, natural resources, South America, sustainability.

Initially promoted by the high-income countries of the Organisation for Economic Co-operation and Development (OECD) and taken up in the European Union and the United States, the concept of bioeconomy is increasingly gaining attention in

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South America also. Several countries in the region are in the process of translating the concept into policy by designing specific bioeconomy strategies. The bioeconomy concept builds on the idea of greater use of bio-based resources and includes many different strands. Key elements are the replacement of fossil-based raw materials with bio-based alternatives, fostering more efficient use of biomass, or developing biodegradable materials such as bioplastics or organic fibres, increasing the economic value of forestry and agriculture and promoting innovation in biotechnology. Policy documents and proponents of bioeconomy often present it as a way to support a transition towards sustainability. However, previous studies on bioeconomy governance have highlighted that sustainability benefits are not automatic (Dietz et al., 2018; Biber-Freudenberger et al., 2020). In fact, as we examine in more depth below, the concept of bioeconomy remains very broad and can be interpreted and prioritised in different ways with very different outcomes with respect to sustainability. Moreover, any potential sustainability transition is a highly political process involving multiple stakeholders with different and potentially competing interests (Köhler et al., 2019).

In South America, the Economic Commission for Latin America and the Caribbean (ECLAC) is one of the main actors that have taken up the concept of bioeconomy and promote this at the regional level as a way to address sustainability concerns. ECLAC reports outline several main areas of bioeconomy development in the region, including valuation of biodiversity and ecosystem services; bioenergy and biomaterials; eco-intensification of agriculture; biotechnology; and improving the efficiency of agri-food chains (Aramendis, Rodríguez and Krieger Merico, 2018; Rodríguez, Mondaini and Hitschfeld, 2018). It is important to note that none of these are new economic sectors. Rather, the bioeconomy concept is being used to promote and further develop particular aspects of natural resource use that have existed for a while and have also been frequently contested. For example, the exponential expansion of industrial agriculture using biotechnology over the last two decades is one of the most important bioeconomy sectors in the region, but it is also one of the most contested and polarising socio-environmental issues in the Southern Cone. In fact, the terms ‘eco-intensification’ or ‘sustainable intensification’, frequently used in bioeconomy policy documents, are rejected by many environmentalists who regard them as an oxymoron (Mahon et al., 2017). Bioeconomy development in South America is therefore intertwined with often contested questions of natural resource governance. Consequently, it is particularly important that the promotion of bioeconomy takes place in an inclusive manner (see also Bastos Lima and Siegel, 2020).

The aim of this article is therefore to examine to what extent and in which ways the concept of bioeconomy may foster or hinder an inclusive sustainability transition in South America, with a particular focus on the Southern Cone in the current context of contested natural resource governance. In the following section, we examine the history of the concept of bioeconomy and how it has been adapted to South American contexts. We then present three case studies to show how the bioeconomy concept has been taken up in a prominent sector in each of the three countries, notably biofuels, biotechnology and agricultural intensification in Argentina; forestry, biomass and the pulp industry in Uruguay; and valuation of biodiversity in Brazil. We examine who takes up the bioeconomy concept, what interests are reflected in this and what the implications are for socio-environmental concerns. An analysis of the three case studies points to two interrelated aspects which demonstrate variations in inclusiveness; first the constellation of actors that drive bioeconomy visions; and second the scope of issues covered. Our analysis of South America therefore has broader theoretical relevance for

the literature on bioeconomy governance, which has not looked at inclusiveness in much detail so far.

A Concept in the Making: Bioeconomy in South America

The term 'bioeconomy' is very broad and encompasses both a theoretical idea and a policy strategy. On the one hand, bioeconomy describes an 'economic system in which biological resources (e.g., plants) form the basis of production and production processes' (Birch, 2016: 1). A central element is the replacement of fossil-based raw materials with bio-based resources. The concept of bioeconomy has also been used to develop a particular vision or imaginary of the future (Goven and Pavone, 2015; Birch, 2016; Tittor, 2021) where climate change is addressed through the development of bioeconomic sectors and technological innovation. This vision has been translated into policy strategies often building on the biotechnology strategies that many governments had developed around the turn of the century. Initially, the OECD played an important role in the shift from biotechnology to bioeconomy and in promoting the concept of bioeconomy as a policy strategy through its report *The Bioeconomy to 2030* published in 2009 (Hilgartner, 2007; Goven and Pavone, 2015). Policy documents promoting bioeconomy often present sustainability as an inherent element. However, the development of bioeconomic sectors does not necessarily lead to more sustainable outcomes. Without adequate safeguards and sufficient attention to social and environmental concerns bioeconomic development can also undermine sustainable development (Pfau et al., 2014; Dietz et al., 2018; Biber-Freudenberger et al., 2020). Promoting environmentally responsible, equitable and inclusive bioeconomic development therefore remains a major governance challenge (Bastos Lima, 2018; Biber-Freudenberger et al., 2018).

In South America, Argentina and Brazil have been described as 'key players within the global bioeconomy' (Delvenne and Hendrickx, 2013: 75) and Argentina has sought to present itself as a leader on bioeconomy in the region (Tittor, 2021) and promoted the concept together with ECLAC and the Interamerican Institute for Cooperation in Agriculture (IICA) as well as European organisations. The bi-regional project 'Towards a Latin American and Caribbean Knowledge Based Bio-Economy in partnership with Europe', which ran from 2011–2013 and was funded by the European Commission's 7th Framework Programme, was central in building a regional network of experts working on that topic and led to the publication of several reports outlining areas for bioeconomy development in the region (Aramendis, Rodríguez, and Krieger Merico, 2018: 25; Rodríguez, Mondaini, and Hitschfeld, 2018: 45–46). These first regional initiatives established a novel agenda of research and policy on bioeconomy as a potential strategy for sustainable development in Latin America.

In the social sciences, there are few studies that explicitly examine the concept of bioeconomy in South America and in the bioeconomy literature there is still a focus on industrialised countries. In Europe and North America, bioeconomy has become a subject of political struggles by different actors with different priorities. Bioeconomy policy frameworks in Canada have been described as fragmented because of the contestations over different bioeconomy policy visions (Birch, 2016), while in agro-food research programmes in Europe rival stakeholders with divergent agendas have taken up the concept. In this process the dominant life sciences vision for agricultural innovation was challenged by an agro-ecological vision which was increasingly promoted in some agricultural research programmes, but remained in a marginal position (Levidow, Birch,

and Papaioannou, 2012). This demonstrates the breadth of the concept of bioeconomy, which also means that to some extent it is open to interpretation.

Existing studies examining bioeconomy in South America have focussed to a large extent on the most prominent bioeconomy sectors, notably biotechnology and agribusiness in Argentina (Arancibia, 2013; Delvenne, 2017; Tittor, 2021) or biofuels in Brazil (Backhouse and Lorenzen, 2021; Bastos Lima, 2021: 89–122). A key concern noted by these studies is that the large-scale intensive agricultural production in these South American bioeconomic sectors perpetuates existing inequalities in terms of income, job opportunities, regional development, concentration of political power, and access to land, technology and knowledge, while aggravating environmental problems such as soil degradation, loss of biodiversity and water availability and quality. Yet, the first regional networks, information exchanges and projects on bioeconomy in Latin America have paid little attention to the challenges of applying the bioeconomy concept in South American countries with major social and economic inequalities that are also reflected in access to food, water and land. For example, the conclusions of an ECLAC report from 2018 (Rodríguez, Mondaini, and Hitschfeld, 2018: 64–66) highlight the need for regulatory frameworks, including those for biodiversity protection, and also mention reduction of pesticide use, employment generation and food security as challenges. However, these concerns are not considered in much depth and they are not linked to civil society perspectives, while inequality is not mentioned.

This lack of attention to socio-environmental inequalities and ongoing conflicts over natural resource governance in emerging regional policy networks on bioeconomy in South America is an important concern. It is therefore crucial to highlight that in order to merit being called ‘sustainable’, bioeconomy development in South America has to be inclusive and take into account different perspectives including the socio-environmental concerns of citizens and civil society.

Case Study Design

To examine to what extent and in which ways the concept of bioeconomy may foster or hinder an inclusive sustainability transition in South America we focus on three different bioeconomy sectors in three countries in the Southern Cone, Argentina, Brazil and Uruguay, which are all in the process of developing their bioeconomy strategies. The three countries share some similarities in terms of availability and characteristics of natural resources, position in the global economy as commodity exporters and membership of regional organisations. However, as existing regional initiatives have not resulted in a joint policy framework on bioeconomy, there is still space for governments and non-state actors to define, prioritise and implement the concept of bioeconomy in different ways. It is therefore important to examine in more depth how bioeconomy agendas are being adopted in different South American countries and diverse sectors in the current changing political and economic context.

For each country we started by examining central bioeconomy policy strategy documents and tracing who wrote them and in which context to understand who takes up the concept of bioeconomy and what interests are reflected in this. To understand in which ways the concept of bioeconomy may foster or hinder an inclusive sustainability transition, we then examined critiques of bioeconomy development coming from a variety of state and non-state actors in the context of domestic and international politics. For this

analysis we also drew on other sources, notably other policy documents, NGO reports, media articles and earlier research articles.

Argentina: Biodiesel, Biotechnology and Agricultural Intensification

In Argentina, the private sector, in cooperation with regional organisations like ECLAC and IICA and the Ministry of Agroindustry, took the lead in promoting the development of a series of bioeconomy strategy documents. The Buenos Aires Grain Exchange and a small group of academics with backgrounds in the natural sciences and agricultural economics led the political and academic debate and translated bioeconomy into a beneficial strategy for the industrialisation of agriculture. The first Argentinean bioeconomy strategy documents were released during the Macri presidency (2015–2019) (Trigo et al., 2015a; Bisang and Trigo, 2017) and were based to a large extent on two documents prepared for the Buenos Aires Grain Exchange (Wierny et al., 2015; Trigo et al., 2015b), demonstrating close collaboration between the private sector and the Ministry of Agroindustry. According to the vision set out by this network, bioeconomy in Argentina is based on the already established agricultural products, and especially soybean and its by-products, and the use of new agricultural technologies (Trigo et al., 2015a). Bioeconomy is also presented as a way of crossing the perceived divide between agriculture and industry (Delvenne, 2017).

Bioeconomy relates to the expansion of the agricultural sector since the 1990s in multiple ways. Argentine biodiesel is based mainly on soy products and the country has now become the world's largest soy-based biodiesel exporter (Baraibar Norberg, 2020: 217). In 2006, during Nestor Kirchner's government (2003–2007) the Biofuel Law was passed to promote its demand. Currently, at least 10–12 percent of fuel consumption in Argentina must be biofuel. This growth opened the door for the development of new technologies resulting in a consolidated biorefinery sector and other bio-based agricultural supplies. In addition, biotechnology plays an important role as Argentina is now the second largest producer of genetically modified (GM) organisms, after the United States, and practically all of the country's soy production uses genetically modified soybeans engineered to resist the broad-spectrum herbicide glyphosate (Trigo et al., 2015b). Moreover, precision agriculture is being promoted as part of bioeconomy in Argentina. The objective is to increase profits and competitiveness through larger harvests while lowering production costs by controlling the dosage levels of agrochemicals, and potentially limiting the excess of run-offs to the nearby aquatic systems and reducing the environmental impact related to agriculture (Aramendis, Rodríguez, and Krieger Merico, 2018: 44).

However, the impacts of some of these technologies are heavily disputed. The GM-based production of soybean in particular has been subject to profound criticism and it has created conflicting interests among actors. On the one hand, taxes on soy were translated into subsidies and cash transfer programmes and played a key role in a larger process of wealth redistribution to poor and working-class Argentines (Córdoba et al., 2018). Conflicts over such bioeconomy revenues confronted political parties and social actors in an ongoing dispute between the public and the private sector on taxation and redistributive policies to address economic and social inequalities (Hora, 2020). On the other hand, criticism focuses on the concentration of power and capital in agricultural corporations (Gras and Hernández, 2014; Cáceres and Gras, 2020), the uncontrolled use of glyphosate for agricultural processes, and the displacement and

impoverishment of rural and indigenous populations (Leguizamón, 2014; Brent, 2015; Lapegna, 2016). At the same time, the sector's reliance on technological innovation was used as an argument to justify lax regulatory frameworks benefiting agricultural corporations over rural populations. As large-scale aerial spraying of agro-chemicals triggered a major health concern in soybean producing areas, rural communities organised themselves in different collective action initiatives, notably the Madres de Ituzaingó (Stop the Spraying Campaign) and a group of local scientists, experts and NGOs, to change the regulatory frameworks (Arancibia, 2013). In addition, deforestation for agricultural uses has been widely criticised by NGOs such as Greenpeace, Fundación Ambiente y Recursos Naturales and Vida Silvestre (Aranda, 2015: 16). The expansion of the agricultural frontier pushed livestock to native woods and new lands and displaced indigenous people and small rural farmers (Lapegna, 2013; Leguizamón, 2014). Yet, these concerns are barely addressed by the main bioeconomy network in Argentina, which has no representation of small peasants or indigenous communities and practically no women. Proponents of bioeconomy in Argentina have not engaged in meaningful dialogue with scientists from other disciplines or activists from grassroots environmental movements and show very little concern for the socio-environmental concerns expressed by citizens in affected rural areas (Tittor, 2021).

With the arrival of the new government in 2019, bioeconomy remained part of the policy agenda. So far no new policy strategy has been released, but aside from the dominant bioeconomy network, policymakers also instrumentally use the concept to try to re-territorialise economic activities by promoting regional bioeconomies in different provinces of Argentina (Delvenne, 2017) mainly related to the agri-food and the forestry sector. In some cases, these sectors are engaged in circular economy activities, the transformation of waste into bioenergy and the application of biotechnology to transform available regional bio-mass. Some examples are the peanut sector in Cordoba province, turning its waste into bioenergy; the Yerba Mate in Misiones, applying biotechnology to develop new varieties of the plant; or the processing of seaweeds in the coasts of Patagonia (Lengyel and Zanazzi, 2020). These initiatives may hold potential for fostering inclusive sustainable development by strengthening regional development, the inclusion of rural and indigenous populations, and creation of jobs and infrastructure, but at the moment this still takes place in the margins. While such regional bioeconomy initiatives have received some state funding in different provinces, those initiatives are not sufficiently well-funded or large-scale to challenge the mainstream agribusiness vision of bioeconomy.

Uruguay: Forestry, Biomass, Bioenergy and the Pulp Industry

In Uruguay, the state and public policies have played a central role in promoting bioeconomy while the private sector and foreign investors have been driving the development of certain bioeconomic sectors. Bioeconomy, together with digitalisation, is one of the pillars of Uruguay's long-term development strategy launched by the previous Frente Amplio centre-left to left coalition government in 2019 (Oficina de Planeamiento y Presupuesto, 2019a). The development of a national bioeconomy strategy is also continuing under the current centre-right coalition government of Lacalle Pou. The strategy has been developed through inter-institutional cooperation between different ministries and governments agencies. In addition, it built on three workshops, with several stakeholders from the public and private sector, and with the technical support of the UN Food and

Agriculture Organization, ECLAC, IICA and the German cooperation agency GIZ (Pitaluga, 2020). In the development of the bioeconomy strategy, there has thus been an effort to take different perspectives within the state as well as different nonstate actors into account.

In addition to agriculture, in Uruguay the forestry sector is an important other sector for bioeconomy development and the focus of this case study. It is one of the prioritised sectors in the bioeconomy strategy and linked to the pulp industry. The pulp mills process the residual sub-products from their industrial process to meet their demand of energy. One element of bioeconomy development in Uruguay is the replacement of fossil fuels by forestry biomass that is left over from the industrial process of pulp production, mainly black liquor, bark and other residues and primary sludge (Ministerio de Industria Energía y Minería, n.d.). Modern pulp mills, like the two mills that have been operating in Uruguay for the last fifteen years, therefore rely to a large extent on their own energy supply and only require fossil fuels to reduce lime mud to burnt lime, during upsets (start-up and shut-down), and sometimes for safety reasons (Kuparinen, Vakkilainen, and Tynjälä, 2019: 1214). In addition, the mills can feed any excess energy into the national electricity grid.

This type of bioeconomy development has benefitted from state support and government policies in different areas for several decades. The Forestry Law approved in 1987 declared the forestry sector a national interest and created a favourable investment setting through state subsidies and tax exemptions. As a result, large-scale plantations of non-endemic eucalyptus trees expanded significantly. This availability of raw materials made Uruguay an attractive location for the pulp industry and in 2007 a large-scale first pulp mill built by a Finnish company went into operation. A second large mill was inaugurated in 2014 and plans for an even larger third plant are ongoing. The Uruguayan pulp and paper industry has been driven by large-scale foreign investments. These were attracted by so-called *zonas francas*, which have been granted to different sectors in Uruguay, including the pulp mills. These tax regimes exempt the pulp mills from customs and national taxes, with the exception of social security contributions (República Oriental del Uruguay and UPM, 2017; Siegel, 2021).

In addition to the active promotion of the pulp industry by successive governments on both sides of the political spectrum and the considerable inflow of foreign direct investment, another key factor that supported the substitution of fossil-based energy resources by forest biomass was Uruguay's energy policy 2005–2030. This policy was developed by the Frente Amplio coalition government, which was in power until 2020. It was the first time that a long-term energy policy was approved, and it was based on the consensus of all the political parties and with the involvement of the major public stakeholders of the sector (Oficina de Planeamiento y Presupuesto, 2019b). One of the main goals was to diversify the energy matrix, to reduce costs and dependence on oil, and to promote local energy resources, particularly renewable ones (Ministerio de Industria Energía y Minería, 2005: 5). The use of biomass has contributed significantly to the diversification of the country's energy matrix using renewable energies. Between 1990 and 2007, biomass had a relatively constant share of about 20 percent, but it increased considerably from 2007, the year the first pulp mill went into operation. In 2018 biomass became the most important element in the energy matrix, accounting for about 41 percent (Ministerio de Industria Energía y Minería, 2018).

Bioeconomy development in Uruguay strengthens sustainability by promoting renewable energy and using waste products from the pulp industry and there are efforts to take into account different perspectives and stakeholders in policy strategies. Nevertheless,

there are also concerns, and criticisms from some civil society organisations and from one of the political parties, which integrates the current government coalition, regarding potential negative environmental impacts resulting from the considerable expansion of the pulp industry. The expansion of eucalyptus monocultures already raised civil society concerns before the first pulp mill started operating (Ortiz et al., 2005). The pulp industry in conjunction with the expansion of intensive agriculture in the same time period has led to important changes in land use. For example, between 2000 and 2011, natural grasslands lost 10 percent of their area while agriculture and forestry expanded significantly (Ministerio de Ganadería Agricultura y Pesca, 2019: 44). The Uruguayan state seeks to mitigate such negative impacts through a number of policies, including the Forest Law already mentioned, a National Strategy on Native Forests (Ministerio de Ganadería Agricultura y Pesca, 2018) and a National Strategy for the conservation and sustainable use of Biological Diversity (Ministerio de Vivienda Ordenamiento Territorial y Medio Ambiente and Ministerio de Relaciones Exteriores, 2016). There are also concerns regarding the third planned mill with respect to the impact of residual waters from the industrial plant, which may further deteriorate the water quality of the Rio Negro, which is already suffering from eutrophication due to fertiliser use from other agricultural crops in the area (Beretta-Blanco and Carrasco-Letelier, 2020).

Moreover, there are questions as to how much Uruguay does or should benefit from bioeconomy development of foreign companies. For example, the Uruguayan government committed to buy the excess energy produced by the third pulp mill for a period of twenty years, but Uruguayan newspapers have reported that there are some concerns over the high prices paid by Uruguay to the company (Noguez, 2017). Uruguayan researchers also note that the forestry biomass that is currently used for energy could also be used for other products with more added value (Semanao Búsqueda, 2021). Finland for example has already launched new bioproducts such as bio composites, paper mulches and biofuels. For the third pulp mill Uruguay signed a contract with the Finnish company UPM, which includes the development and financing of a Wood – Forestry Technological Centre and a Bioeconomy Technological Centre. UPM has undertaken to make annual payments of 1.5 million US dollars for a period of twenty years to fund these developments (República Oriental del Uruguay and UPM, 2017). It remains to be seen whether this funding can really strengthen the development of bioeconomy at a higher and more profitable level of the value chain.

Brazil: Biodiversity Valuation and Ecosystem Services

In Brazil, the bioeconomy agenda is quite fragmented across different institutions. The concept of bioeconomy has become an arena of contestation between different actors, with different interests and visions of development. Historically, the development of biofuels was a prominent feature of the Brazilian bioeconomy and interest coalitions formed to defend this (Flexor et al., 2011; Morilla, 2019). More recently, the Brazilian National Confederation of Industry has promoted bioeconomy as an industrialisation project that could bring back competitiveness to the Brazilian economy and foster economic growth (CNI, 2020). Some sections of agribusiness also use the concept of bioeconomy as a marketing strategy (Mejias, 2019), to create a positive image of the sustainability of Brazilian modern agriculture, in an attempt to reverse the negative impact caused by government policies under Bolsonaro in international markets. However, in this section we focus on a different vision of bioeconomy, which is based on knowledge of nature,

payments for ecosystem services and innovation based on biodiversity. This is reflected in one of the key strategy documents for the bioeconomy in Brazil, the National Strategy for Science, Technology and Innovation which was launched in 2016 (MCTIC, 2016). It differs from a vision of bioeconomy focussing solely on biotechnology and biofuels, but has received little attention in previous studies on bioeconomy in Brazil.

This approach to bioeconomy has been promoted by some civil society organisations such as the Instituto Escolhas and the World Resources Institute Brazil and some smaller groups in the public bureaucracy, innovative business actors and academic circles, which have taken up the concept of bioeconomy as an alternative to the expansion of agricultural production as the main driver of bioeconomy development (Becker and Stenner, 2008; Bound, 2008; MCTIC, 2016; MCTIC/CGEE, 2018; Abramovay, 2019; Valli and Bolzani, 2019; CNI, 2020). In the Brazilian context of conflicts regarding the expansion of biomass production in biomes like the Amazon and the Cerrado, the possibility to develop innovative products and business models based on biodiversity applied research (Valli and Bolzani, 2019) is increasingly gaining attention as an alternative development project and a way of preserving threatened biomes (Abramovay, 2019).

One of the first initiatives in this respect came from the Brazilian geographer Bertha Becker (Becker and Stenner, 2008), who proposed the concept of a natural knowledge economy as a development vision for the Amazon. It is based on three key elements: (a) avoiding the destruction of the Amazon region, where we find the largest biodiversity in the world; (b) recognising the strategic role of traditional populations and indigenous communities and their contribution to preserving this area; (c) promoting a transition from an economy of nature destruction to an economy where innovation and knowledge are used to reap the economic benefits of nature preservation (Abramovay, 2019). From 2006 onwards, the collaborative work between Becker and the Centre of Management and Strategic Studies, which is linked to the Ministry of Science and Technology, led to the inclusion of this perspective in Brazilian development policies (Bound, 2008; CGEE, 2009). This approach was in line with other initiatives to protect the Amazon and fight deforestation under the Lula government (2003–2010) (Boucher, Roquemore, and Fitzhugh, 2013). In 2011, the Partido dos Trabalhadores government presented a new industrial policy, the Plano Brasil Maior, where the development of competences in the natural knowledge economy became a guideline (Queiroz-Stein, 2016). This provided a basis for the strategy for the bioeconomy in Brazil that was later consolidated in the National Strategy for Science, Technology and Innovation (MCTIC, 2016).

The key element of this vision of bioeconomy is that nature preservation is potentially an important part of the Brazilian bioeconomy mobilising intensive knowledge in activities like payments for ecosystem services; eco-tourism; environmental management services; environmental audit and certification; food and feed; reforestation, and recovering degraded areas. Scientific research on chemical and biological diversity holds potential for developing new pharmaceutical, cosmetics and nutritional natural products including food or food supplements (Valli and Bolzani, 2019). An important milestone in relation to this was the approval of the Biodiversity Law in 2015, which regulated the access to the genetic heritage, the role of traditional knowledge about Brazil's biodiversity and the sharing of benefits created by the economic activities based on biodiversity (da Silva and de Oliveira, 2018). Proponents argue that this approach to bioeconomy may also be more viable in economic terms than agricultural expansion (Abramovay, 2019), while potentially benefiting indigenous communities by providing income from their extensive traditional knowledge on forest management and products.

As in the other two case studies, many of the elements are not new and have been contested previously, but they are taken up now under the broad concept of bioeconomy. In particular, payments for ecosystem services have already encountered significant criticism. This ranges from the rejection of the commodification of nature to concerns about how to implement it in practice and what the implications may be for marginalised groups, especially indigenous communities. Previous studies demonstrate that payments for ecosystem services are complex political processes involving many different actors at the local, national and international level who may frame payments for ecosystem services in quite different ways (Aguilar-Støen, Toni, and Hirsch, 2016; Hausknost, Grima, and Singh, 2017). An important example of payments for ecosystem services is the UN programme on Reducing Emissions from Deforestation and Forest Degradation. Different indigenous organisations have viewed this programme quite differently. While some indigenous organisations are critical of carbon markets, there are also some examples of indigenous communities in Brazil that have been successful in taking up carbon projects on their own terms and to their own benefit (Aguilar-Støen, Toni, and Hirsch, 2016: 225–226).

Overall, in Brazil a major question is how these different visions of bioeconomy will play out in the current political scenario. As his speeches clearly demonstrate, President Bolsonaro is explicitly critical of socio-environmental concerns and speaks out in favour of practices that enhance deforestation, such as mining in indigenous lands and the expansion of livestock in the Amazon and Pantanal (Caetano, 2021). Likewise, the former environment minister, Ricardo Salles, promoted deregulation and flexibility in environmental legislation, a stance that received significant criticism from civil society organisations (Vale et al., 2021). Budget cuts and political interventions in environmental control agencies have resulted in increasing deforestation and environmental disasters. Bioeconomy is therefore an increasingly contested field within the tumultuous Brazilian economic and political scene. Whether the development of bioeconomy will foster an inclusive sustainability transition in Brazil depends on which actors and interests will ultimately dominate in defining Brazil's approach to bioeconomy and the implications this will have in particular for marginalised groups. An important question is to what extent indigenous communities themselves consider the concept of bioeconomy as a helpful tool.

Conclusion

In this final section, we return to our question regarding to what extent and in which ways the concept of bioeconomy fosters or hinders an inclusive sustainability transition in South America. An analysis of how the concept of bioeconomy has been taken up by different actors in different sectors in the three countries points to two aspects which are important in this respect.

First, although the expansion of industrial agriculture is important and has encountered civil society opposition across the region, the constellation of state and nonstate actors that have taken up the concept of bioeconomy and the way bioeconomy strategies are developed differs. In Argentina there is one influential bioeconomy network revolving around a relatively small group of men with similar professional backgrounds and strong links to agribusiness. At the margins of this, other visions of bioeconomy are starting to be formulated by a slightly different group of people in the government, but without challenging the dominant network. In Uruguay, the constellation of actors

is a bit broader and more diverse. Here, the state plays a central role in formulating the bioeconomy strategy by building on cooperation between different ministries and state agencies as well as initiatives to include different nonstate actors. In Brazil, the constellation of actors looks more fragmented than in the other two countries. In addition to the influential agribusiness network, other coalitions of actors have formed and formulated alternative visions of bioeconomy. These differences are important because they influence who is able to shape visions of bioeconomy and according to what interests. Concentrated and exclusive networks indicate barriers to inclusiveness while more open networks involving a broader range of actors hold better chances of representing different perspectives.

Second, there are also important differences in the scope of concerns taken up in different visions of bioeconomy. This is another important indicator for inclusiveness. Bioeconomy visions that reflect a broader range of concerns are more inclusive than those that focus on a very narrow selection and leave out, or sideline, other questions. In this respect, it is concerning that the agribusiness-dominated bioeconomy network in Argentina has not engaged with the strong civil society opposition to GM-based agriculture. While some environmental concerns, in particular climate change, are mentioned in policy documents, the solutions proposed are largely technological, focusing on increasing efficiency through innovation in agricultural production, but leaving out the serious socio-environmental concerns directly affecting communities in rural areas. In this case, there is a strong risk that agricultural production methods that have long been criticised due to their social and environmental consequences are now being relabelled as 'bioeconomy' with the connotations of sustainability that this term may bring, but with little or no changes to actual practices. At the same time, the political debate regarding redistribution through taxes on soy exports continues and this may support economic inclusion. Moreover, it remains to be seen whether the nascent networks seeking to promote regional economies are able to consolidate a different bioeconomy vision. In Brazil, there are similar concerns regarding the dominance of agribusiness networks. Nevertheless, the scope of socio-environmental concerns covered by the fragmented constellation of actors is broader and in some visions of bioeconomy there are also attempts to bring in other perspectives and solutions for development in the Amazon and other parts of Brazil. It will be important to follow how this plays out in the rapidly changing political landscape of Brazil.

Implications of bioeconomic development for socio-environmental concerns are quite different in Uruguay compared to Argentina or Brazil. Severe and violent conflicts over access to land are absent in Uruguay and generally levels of inequality are much lower while the quality of democracy is stronger (Siegel and Bastos Lima, 2020: 4). The scope of environmental issues considered in public policies generally is fairly broad and seeks to address a range of harmful impacts. While there are also some civil society concerns regarding bioeconomic sectors, these are caused less by immediate impacts on the lives of citizens, but reflect also broader questions over how the benefits are, or should be, distributed between the state, and private companies and foreign investors, for example in relation to the tax exemptions granted to large transnational companies or the extent to which these investments generate employment in the country.

Overall, in South America, as in other parts of the world, bioeconomy is still a concept in the making and there are different visions of bioeconomy. However, in many South American countries, this process of defining bioeconomy takes place in a context of relatively high levels of inequality. Inequality is not only economic, but also has a political dimension and not all actors have equal resources and possibilities to promote their

perspectives and interests in emergent visions of bioeconomy. The availability of natural resources or technical knowledge on their own is not sufficient for achieving inclusive sustainability transitions through bioeconomy development and it is crucial to look at domestic politics together with existing policies and political institutions. As the political and economic landscape is changing across the region, it will be important to follow how different visions of bioeconomy continue to play out and what the implications are in particular for groups with less political influence. Ultimately, bioeconomy development will only foster inclusive sustainability transitions in the region if it is able to offer improvements compared to previous approaches to natural resource governance and address longstanding socio-environmental concerns of citizens and conflicts over access to land or water.

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