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The socio-ecological bioeconomy in Argentina: towards a typology

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ABSTRACT

Three main bioeconomy models have been distinguished at the international level: the biotechnological, the biomass and the socio-ecological approach. While the first two have been widely studied, research into the third model is still sparse in Argentina. Furthermore, this approach is hardly noticed or even invisible in the public debate. The article focuses on describing the organization and functioning the socio-ecological bioeconomic model. Based on a sample of 34 enterprises of all Argentinean regions, their innovations and contributions to the sustainability of their value chains and of the territory are analyzed. A typology of enterprises is presented, taking into account their sustainability narratives and the type of linkage they create with the market. Results show that the socio-ecological bioeconomy model focuses on an integrated vision of territorial and rural development. Market orientation is a key factor differentiating actors of this approach, leading to different sustainable narratives and development perspectives.

1. Introduction

The bioeconomy is now recognized as a production logic capable of contributing to the 2030 Agenda for sustainable development (Bisang et al., 2015). We understand the bioeconomy as the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy (Haarich, 2017; Wreford et al., 2019). It includes agriculture, forestry, fisheries, food and pulp and fiber production, as well as sectors of the chemical, energy, health and medicine industries.

Three main types of bioeconomic activities have been identified at the international level. One is the biotechnological type which has been described by several authors (Bugge et al., 2016; Dürr and Sili, 2022b; Levidow, 2015; Priefer et al., 2017. It includes companies that place emphasis on the generation and application of modern biotechnological knowledge, supported by a strong relationship with scientific and technological organizations, and knowledge sustained to a large extent by the development of international patents. A second bioeconomy type can be referred to as the biomass model. These are generally companies that integrate the primary or industrial sector and make use of large volumes of biomass or waste from other production processes. It is generally oriented towards energy and food production. Given that proven technologies are already available for the development of these products, scientific and technological innovation is more oriented towards improving the efficiency of production processes. This model is more anchored to the territory due to the difficulty of mobilizing large volumes of biomass (Bugge et al., 2016 ; Vivien et al., 2019; Dürr and Sili, 2022b).

Different authors presented a third model which can be broadly termed as the socio-ecological approach. This model is characterized by using less biomass, having a more local character, and using technologies that guarantee the sustainability of resources and environmental protection, while at the same time generating organic, quality products. Therefore, not only internationally recognized technologies are used, but also technologies that are more adapted to the conditions of the territories themselves (Bugge et al. 2016; Levidow, 2015; Priefer and Meyer, 2019). Innovation in this model is understood in a broad sense, as technical, productive and social innovation, and not only as technological or productive innovation as is often the case in the other two bio-economic models.

In Latin America, and in Argentina in particular, great importance has been given to the first two bioeconomy models, based on the idea that large-scale agriculture and its value chains should be boosted as a strategy to guarantee food supply and generate foreign currency through exports. However, beyond these two models, the third bioeconomic model emerges, motivated not only by the search for better business, but also by a greater concern for the environment, habitat and rural development (Dürr and Sili, 2022b), by the need to protect the environment,

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for a more efficient use of natural resources; and finally by the emergence of new consumption patterns.

Case studies of the three approaches with different methods and objectives have been carried out at international level. However, most of the studies linked to the bioeconomy in Argentina and other Latin American countries have focused on the bio-technological and biomass models (Bisang et al., 2015; Jaramillo, Henry, and Trigo, 2019). The alternative, socio-ecological bioeconomy model is much less studied in the Argentinean context.

Faced with this lack of in-depth studies and the possible implications that this sector of the bioeconomy may have for rural development and sustainability in Argentina and beyond, the research questions we are interested in answering are the following:

- What are the elements that characterize the socio-ecological bioeconomy approach?
- What type of innovation processes take place in companies?
- What contribution to sustainable development do companies see themselves making?
- What types of enterprises can be distinguished within the approach?

This research describes and analyses the functioning of the socio-ecological bioeconomy approach, and advance in the search for a typology of enterprises of this model. For the construction of the typology, the specific contributions of enterprises to sustainability, and the level of their market linkages will be considered. Thus, the contribution of this research is not only to explain the characteristics of a type of bioeconomy that is little explored, but also to create a typology for the socio-ecological bioeconomic approach, something that, to our knowledge, has not yet been done in the literature.

2. Conceptual framework

2.1. The socio-ecological bioeconomy

This approach to bioeconomic activities has been described by different authors in slightly different ways. For Bugge (2016) the most important aspects of this sector are sustainability, biodiversity, conservation of ecosystems, and avoiding soil degradation. For this approach the development of integrated production systems and high-quality products with territorial identity are key elements. This type is based on the search for sustainable agro-ecological practices, re-use and recycling of waste, and efficiency in land use. Research and innovation activities are related to transdisciplinary sustainability issues. For Hausknost et al. (2017) this bio-economy approach can based on the narrative of agro-ecological innovations for intensification and efficiency gains, combining in agro-ecological practices with growth-orientation, but also with socio-economic sufficiency. Visions of organic entrepreneurship, agro-ecological innovation, small-scale farming practices and the benefits of being less dependent on external inputs dominate.

For Priefer et al. (2017) this type of bioeconomy emphasizes the multifunctionality of agriculture, ecological agriculture, natural cycles and reduced resource consumption. To this end, the authors suggest the need for the promotion of social innovations, the use of local knowledge, the strengthening of rural areas, the creation of regional value chains, a more localized food and energy supply based on small-scale units, greater participation by civil society, and inter- and transdisciplinary research. Levidow et al. (2015) point in the same direction. They describe agro-ecological systems that minimize the use of external inputs, emphasize product identity with territorial characteristics that can be recognized by consumers and therefore add local value, and is based on small-scale farming units and knowledge of agro-ecological methods. Dürr and Sili (2022b, 2022a) characterize a so-called bio-embedded bioeconomy by the use of small amounts of biomass but of local origin, low levels of biotechnology use, and small to very small enterprises.

2.2. Types of sustainable and rural entrepreneurship

The concept of sustainable entrepreneurship is related to companies that not only strive for economic success, but also pursue social and environmental goals. Shepherd & Patzelt (2011) define it as *"…focused on the preservation of nature, life support, and community in the pursuit of perceived opportunities to bring into existence future products, processes, and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy, and society."* However, different views on how the three sustainability dimensions are covered by sustainable entrepreneurship can be distinguished: as a concept of intersection between the economy, society, and the environment, where all dimensions have an equal value; as a concept of embeddedness, where the natural and social environment limits entrepreneurship; or as a concept of integration, where entrepreneurs recognize their responsibility to jointly follow economic, social and environmental goals (Farny and Binder 2021).

Different typologies of sustainable entrepreneurship have been developed, based on the degree of the company's more environmental or economic motivation, or whether only two or three points of the triple bottom line are covered by companies (Levinsohn, 2013). For example, Schaltegger and Wagner (2011) use a matrix with the degree of environmental or social responsibility orientation of a company on the one side and its market aspirations and position on the other. So-called "alternative actors", "bioneers" as well as "ecopreneurs" focus in their business on environmental aspects, but the first are active in alternative markets, the second in niche eco-markets where customers have high environmental awareness and purchasing power, and the third rather serves the mass market. "Ecopreneurs" have a less fully developed sustainability performance goal, paying less attention to social issues, while "sustainable entrepreneurs" see all sustainability issues as central to their core business and want to serve a mass market, so that their economic success is strongly linked to their sustainability performance (Schaltegger and Wagner, 2011).

Müller and Korsgaard (2018) developed a typology of rural entrepreneurs based on their spatial context, in particular, how embedded rural companies are in their locality and whether they connect this with non-local places, e.g. by operating on (inter-)national markets, i.e. forming a "bridge" between local resources and non-local buyers. Embedded companies that use local resources and link these to outside markets can be an opportunity for the local economy to develop dynamically. Other rural entrepreneurs might be highly embedded, using local resources, but not "bridging" them to outside customers, but serving only local markets. This sort of "lifestyle entrepreneurs" with no ambition to go beyond the local marketplace nevertheless can form important economic activities in communities with limited resources (Müller and Korsgaard, 2018). Enterprises that serve local markets can build local circuits, and connect producers and consumers more directly, thereby shortening value chains, making them more sustainable. "Connecting" producers and their clients on the local level instead of "bridging" local resources to outside demand therefore could make an important difference in the ability to contribute to rural sustainable development.

Bosworth (2012) develops a typology of rural businesses that combines the categories of 'operating in a rural area', 'serving a rural population' and 'selling a rural product'. However, these do not all have to apply at the same time to qualify a business as 'rural', but at least meet two of the criteria. Rural businesses are usually embedded in the rural environment and, in addition to the products or services, generate other positive non-market contributions such as environmental protection or the preservation of traditional skills and abilities. These positive externalities should be rewarded by policies in order to promote rural development. However, the author also points out the danger that small rural enterprises can often be less innovative and less growth-oriented. Selling to external customers can represent an opportunity for the rural economy, while exclusive dependence on local customers, whose

preferences may change, can lead to business decline.

With these typologies in mind, it might be interesting to note how companies see their contribution to local socio-economic development and environmental sustainability, and if they rather serve the territorial or extra-territorial markets, which indicates whether bridging or connecting is taking place. We start from the idea that the socio-ecological bioeconomy consists of companies with a strong local base with positive contributions to sustainability, and that the different ways in which they are linked to the local and the non-local economy is key to understanding them. Therefore, our aim was creating a typology that could demonstrate different patterns of variation in the narratives and market orientation of enterprises. This could show to what extent a stronger orientation towards socio-economic development goes hand in hand with an orientation towards extra-local markets, or, conversely, to what extent a stronger orientation towards ecological sustainability goes hand in hand with a stronger presence in local markets. It could also reveal how different levels of bridging and connecting are linked to different types of entrepreneurial activities (Kuckertz et al., 2020). Finally, it might also be that different types have different needs for their business, and that this requires differentiated policies to support them (Bosworth 2012).

3. Methods

3.1. Selection of cases and sample structure

Since there are no lists of socio-ecological bioeconomy companies in Argentina, such companies had to be identified by researchers who know their locality well. Therefore, a team of 15 enumerators was created. They were chosen on the basis of their knowledge and experience of rural issues in their regions, their experience in data collection and their ability to carry out field work. The number of experts were distributed as follows: Pampa (5), Northeast (2), Patagonia (3), Cuyo (2), Northwest (3).

Each of the enumerators carried out an initial purposive survey of bio-economic enterprises in their region of influence, resulting in a list of 120 enterprises. This list was then filtered to include only companies that were thought to be part of the socio-ecological approach. From this first filtering it was possible to obtain a list of 51 bioeconomy companies.

A pre-test of the questionnaire was made with five companies. Once the survey form had been verified and improved, each interviewer prepared a schedule of visits. 51 interviews were carried out in person between January and March 2023. The survey was carried out in paper format, and all answers uploaded and sent to the research team using Google forms. The interview questionnaire was developed in Spanish. The survey modality was directive and personal. Respondents were the owners of the companies or their top management. The more important survey topics included:

- Type of bio-economic activities carried out
- Type and quantity of biomass used
- Commercialisation of products
- Main customers
- Main innovations carried out
- Reasons for innovation
- With whom innovations are built
- Sustainability of innovations in the value chain
- Factors that favour the development of the company
- Needs for improvements in the future

Once all the surveys were downloaded into an Excel database, the quality and the consistency of the information was checked.

A first step was to filter again companies which properly belong to the first two bioeconomic models, and not to the socio-ecological bioeconomy approach. We used two exclusion criteria derived from the conceptualization of the different models proposed by Bugge et al. (2016), Hausknost et al. (2017), Priefer et al. (2017), and Dürr & Sili (2022b). The first criterion relates to high components of innovation and scientific and technological development, coupled with low use of biomass, which was considered a key characteristic of the bio-technological approach. The second critical factor taken into account was the high use of biomass (>1000 tons per year) by companies, which were then considered as belonging to the biomass approach. These criteria made it necessary to remove 17 companies from the survey base in order to concentrate on an alternative approach, characterized by companies with low to medium use of biomass and with technologies adapted to local conditions. Table 1 shows the distribution of these 34 companies according to their location and sector. The map in Appendix A shows the location of the 34 enterprises in Argentina.

3.2. Data analysis

All the information obtained was categorized into different dimensions and variables, so as to allow for analysis. Additionally, the information on the factors that enabled the development of the enterprises themselves was categorized, giving rise to the different variables. With all the information organized and systematized according to the categories proposed, frequency tables were drawn up to enable an initial characterization of all the producers surveyed.

Complementary to the quantitative descriptive analysis of companies, a content analysis of the information actors provided on the following topics was carried out:

- Motivations of companies to innovate;
- Contribution of enterprises to the environmental sustainability of their own business, of their suppliers and customers, i.e., of their value chains, and
- Contribution of enterprises to sustainable development of the territory.

Once these broad groups of content analysis were defined, the survey was processed to facilitate the categorization of the information and qualitative pre-analysis in the AtlasTi software. The construction of categories of analysis was carried out ad hoc according to the reading of the material, grouping the fragments by thematic affinity, coinciding references and related concepts. The categories obtained were contrasted to check the validity of their consistency. The resulting thematic categories were worked on, giving greater relevance to those most frequent in the number of related comments, and explaining the main narratives identified, and rescuing textual quotations as examples to exemplify.

4. Results

4.1. General characteristics

The sample of 34 bioeconomic enterprises consists of small and very small enterprises, 41 % of them with up to four employees, and of young companies where the majority (71 %) are <15 years old, and 32 % are start-ups with <5 years, see Table 2. Thirty seven per cent of these enterprises are owned or managed by women.

In general, the companies are mainly oriented (47 %) to the

Table 1
Structure of the sample.

Region	No.	Sector	No.
Pampa	14	Food	12
Northeast	9	Biomaterials	11
Patagonia	5	Agricultural inputs	6
Cuyo	4	Pharmaceuticals and cosmetics	4
Northwest	2	Bioenergy	1

Table 2
Variables for the characterization of bio-economic enterprises.

Variables		N°	%
Age	between 5 and 15 years	13	38.2
	<5 years	11	32.4
	>15 years	10	29.4
Employees	1 to 4 employees	14	41.2
	5 to 9 employees	10	29.4
	10 to 29 employees	8	23.5
	30 to 49 employees	2	5.9
Sector*	Biomaterials	16	47.1
	Food	13	38.2
	Agro-specific Inputs	8	23.5
	Pharmaceuticals and Cosmetics	6	17.6
	Bioenergy	1	2.9
Biomass origin*	Plant products	22	64.7
	Animal products	6	17.6
	Forestry waste	6	17.6
	Plant waste	6	17.6
	Animal waste	5	14.7
	Forest products	5	14.7
	Micro-organisms	4	11.8
	Industrial waste	2	5.9
Biomass volume	1 - 100 t	28	82.4
	100 – 1000 t	6	17.6
Customers*	Final consumers	17	50.0
	Retail traders	9	26.5
	Food companies	9	26.5
	Agricultural companies	8	23.5
	State	4	11.8
	Construction and materials companies	2	5.9
Markets**	National		44.2
	Local		35.3
	Provincial		17.2
	International		1.8
	Latin America		1.5

Source: based on producer survey;.
* multiple choice answers.
** unweighted average.

production of biomaterials such as bamboo bicycles, water-soluble bags, industrial waxes, biodegradable pots, various wood-based products, compostable utensils, among others. The second most important sector (38 %) is food production, such as olive oils, gluten-free foods, different types of meat, whole meal flours, hops pellets, or differentiated milks. The third most important sector is agricultural inputs, especially bio-fertilizers, organic amendments, biological fungicides, or micro-organisms for agriculture. Pharmaceuticals and cosmetics follow in fourth place. Yet, there are differences according to gender. Women's activities are much more centered on cosmetics and pharmaceuticals (47 %), and less on food (26 %), biomaterials (16 %) and agricultural inputs (10 %).

Most (82 %) companies use very little biomass, i.e. <100 tons per year, generally from plant products or plant and forestry waste. The biomass used of vegetable origin are usually fresh fruits, herbs and flowers, bamboo cane, cereals and oilseeds, eucalyptus or pine wood, aromatic herbs, mushrooms, hops, flours of different types, oils of different origins, among others. Vegetable or forestry residues used are straw, wood chips, pruning and grass cuttings, rice husks, wood in general, citrus waste, conifer resin, used vegetable oil, and nut shells. To a lesser extent, animal products or animal production residues are also used, such as fish skin, shrimp waste, chicken or goat guano, buttermilk, honey, beeswax, among many others. The main clients of these companies are the final consumers, which shows the small scale and local character of these companies, followed by the retail trade and food companies. The destination of the products is mostly the national (44 %) and local (35 %) market. However, there are also differences according to gender, as the products generated by women are especially oriented towards the end consumer, that is to say centered on local markets or on sales to retailers).

4.2. Factors enabling the development of enterprises

Based on the question 'What were the three factors that favoured the development of your business?' an analysis of the various enabling factors were carried out. The first factor considered key to the development of the bioeconomic enterprises is the availability of knowledge and technical capacities, as all these enterprises were able to emerge due to the effort made by the entrepreneurs in training and learning new processes and products, see Table 3. Next, the geographical conditions, i.e. the characteristics of the rural territory and its endowment of resources, infrastructure and labor, allowed the company to develop. Thus, the companies state that the territory has strong potential and resources (good soils, biological products in abundance, good environmental conditions, and proximity to markets). Market demand and changes in the population's consumption patterns, with more demand for healthy and organic products is another important factor. Moreover, some enterprises have emerged thanks to the availability of technical assistance, especially in the start-up of initiatives, and infrastructure in their own territories (electricity and paved roads specially).

Family and local relationships are another factor. The presence of the family and other producers who provide technical support, labor, financing, local marketing, links for the provision of inputs or local biomass, contacts with service providers and with local extension and promotion organizations are, among others, key issues that make it possible for the enterprises to be sustained. In other words, the presence of an environment of knowledge and strong social relations is key to the persistence of this group of enterprises. Other factors are the search for new forms of production and consumption, which is often associated with migration from the city to the countryside where these new productive initiatives can be undertaken.

In sum, the greatest percentage of factors that have contributed to the emergence and consolidation of these enterprises have been territorial factors (geographic conditions, availability of resources, local and family network, etc.), which shows the level of embeddedness of these initiatives in rural territories. There are no significant differences between men and women according to the type of factors encountered. Moreover, even if some of these factors might also apply to other bioeconomic enterprises, there are some specific answers such as the search for new ways of living, changes in consumption patterns, or environmental awareness, which are strongly related to the socio-ecological bioeconomy.

4.3. Generation of innovations

On the one hand, companies focus on generating process innovations, i.e. they are looking for new, more sustainable forms of production, with greater energy and input savings, using new

Table 3
Factors that contributed to the emergence and consolidation of enterprises*.

Factors	N°	%
Knowledge and technical capacity	12	35.3
Geographical conditions	10	29.4
Market demand	9	26.5
Existence of family and local networks	7	20.6
Search for new ways of living, production and consumption	6	17.6
Changes in consumption patterns	6	17.6
Access to financing	5	14.7
Linkages with other sectors	5	14.7
Search for better production techniques and tools	5	14.7
Environmental awareness	4	11.8
Generation of organic or quality products	4	11.8
Favourable legislation	4	11.8
Availability of technical assistance, innovations and infrastructure	4	11.8
Facilitation of logistics	3	8.8

Source: based on producer survey.
* multiple choice answers.

technological knowledge and production management, see Table 4. On the other hand, they focus on product innovation, i.e. creating new products for the local market, either through their own inventions or by imitating products presented in other markets.

The first motives that drive innovations are conventional ones, namely to improve processes and competitiveness, and to satisfy existing demand. The arguments put forward are the need to optimize processes to reduce costs and improve product quality. Next comes care for the environment, i.e. the search for environmentally friendly processes, for greater harmony between human beings and nature, the need to reduce pollution, recycle waste, and generate responsible consumption. Another strong motive is to achieve company growth. The generation of value-added products is associated with improving the quality of products by satisfying the needs of consumers. In sum, although environmental aspects are mentioned by 38 % of companies, economic motives strongly dominate the motives to innovate.

Innovation is built in many different ways, but mainly with the technical teams of the companies and by the entrepreneurs themselves, through their own knowledge or thanks to access to technical information from organizations of the scientific and technological system, especially local universities and public R&D institutes such as INTA, INTI and CONICET. It is also key for the entrepreneurs to build information exchange networks, to share ideas or to see other technological and productive experiences, either in the same region or in other regions where there are similar companies.

Given the difficulty of access to public and private finance, most of the companies rely on their own sources for investment (71 %). Only 23 % could finance their innovations through funding from science and technology organizations or other public support (credits and subsidies) linked to productive development. Financing from the private sector is very limited (9 %).

4.4. Contributions to the sustainability of the value chain

With regard to the contribution to sustainability of suppliers, enterprises expressed three main types (see Fig. 1):

1. Recycling and reusing waste from suppliers (41 % of all mentions). Entrepreneurs indicate that: *"There are large sawmills that even pay us to take the material they discard"*. The link with some suppliers is functional as their waste is the raw material for these companies.
2. The incorporation of sustainable suppliers in production processes (34 %). Entrepreneurs express the search for more sustainable suppliers: *"We are committed to the development of small suppliers, for example, of bamboo, who consciously work towards sustainability, applying sustainable working methods on small plots of land"*.
3. The expansion of the market for sustainable products and services (15 %). Entrepreneurs indicate that through their demand they are contributing to building and developing a market for suppliers of sustainable goods and services: *"They increase the dynamics and the sales market for sustainable products and suppliers*". In addition to producing biodegradable products, they value for example that their suppliers *"help in the process of reusing waste water and improving the environment"*.

Regarding the contributions to the companies' own sustainability, enterprises mainly do this:

1. By having environmentally friendly attitudes and behavior (32 %). This idea is associated with comments such as: *"Sustainability is at the core of our existence"*. This narrative is linked to other narratives such as defending biodiversity or reducing the carbon footprint.
2. By obtaining greater economic benefits and cost reductions (29 %). In this respect, there are references such as: "Economically, it allows me to save and reduce the cost of production and sales", or: "Energy savings in processes and products make the company totally sustainable".
3. By the implementation of recycling and input reuse processes (22 %). Three lines stand out: a) those that show a clear and explicit search for sustainability, which crosses all the processes of the company, expressed in statements such as: *"I use all organic material, the water consumption is recycled and the energy by solar panels"*; b) those that refer to recycling and reuse processes as a way of reusing waste that would otherwise be discarded. Some references that show this contribution type are: *"A waste that would otherwise be discarded, burnt, is used and replaces other products that are not recommended for construction, polluting and not at all sustainable"*; c) another line of reflection on recycling and reuse can also be seen as a way to reduce costs, as observed in some narratives: *"In the ecological or recyclable part… although it is a large investment, often over time it helps to lower costs"*.

Finally, six major contributions to the sustainability of clients could be identified:

1. The generation of sustainable products (42 %), such as: "We contribute to people eating healthily and getting sick less".
2. Environmental education (14 %). The generation of a new culture and environmental awareness appears as a fundamental part of many companies' projects. Thus, they not only sell products, but also educate about the importance of caring for the environment: "Education regarding the care of the agro-ecosystem, telling them that bees need to be able to work, which is closely related to avoiding pollution, maintaining the biodiversity of the ecosystem".
3. The impulse to generate sustainable processes in its customers (14 %).
4. The promotion of recycling processes (12 %). This is present in the relationship with customers, as entrepreneurs transmit this practice, thus encouraging consumers to take it on board.
5. The generation of collaborative processes and networks (10 %). This generates an environment of shared learning and new sustainable practices, both for entrepreneurs and customers: "It is a nice interaction, there is a social and environmental web of mutual experience and collaboration towards sustainability."

Table 4
Motivations and types of innovation*.

		N°	%
Motivations to innovate	To improve processes and competitiveness	16	47.1
	To satisfy demand	14	41.2
	To offer ecological solutions	13	38.2
	To grow the business	10	29.4
	To improve quality	7	20.6
	To use available resources (R&D, raw materials, capital)	5	14.7
	To add value	4	11.8
Type of innovation	New processes	19	55.9
	New products	18	52.9
	New technology	16	47.1
	Generation of skills and knowledge	10	29.4
	Equipment and infrastructure	8	23.5
Who generates the innovations	With its own team	24	70.6
	Knowledge exchange with other companies or actors	10	29.4
	With help of the scientific and technological system	10	29.4
	With private technical assistance	4	11.8
Who finances the innovations	With own financing	24	70.6
	With public funding	8	23.5
	With private financing	3	8.8

Source: based on producer survey.
* multiple choice answers.

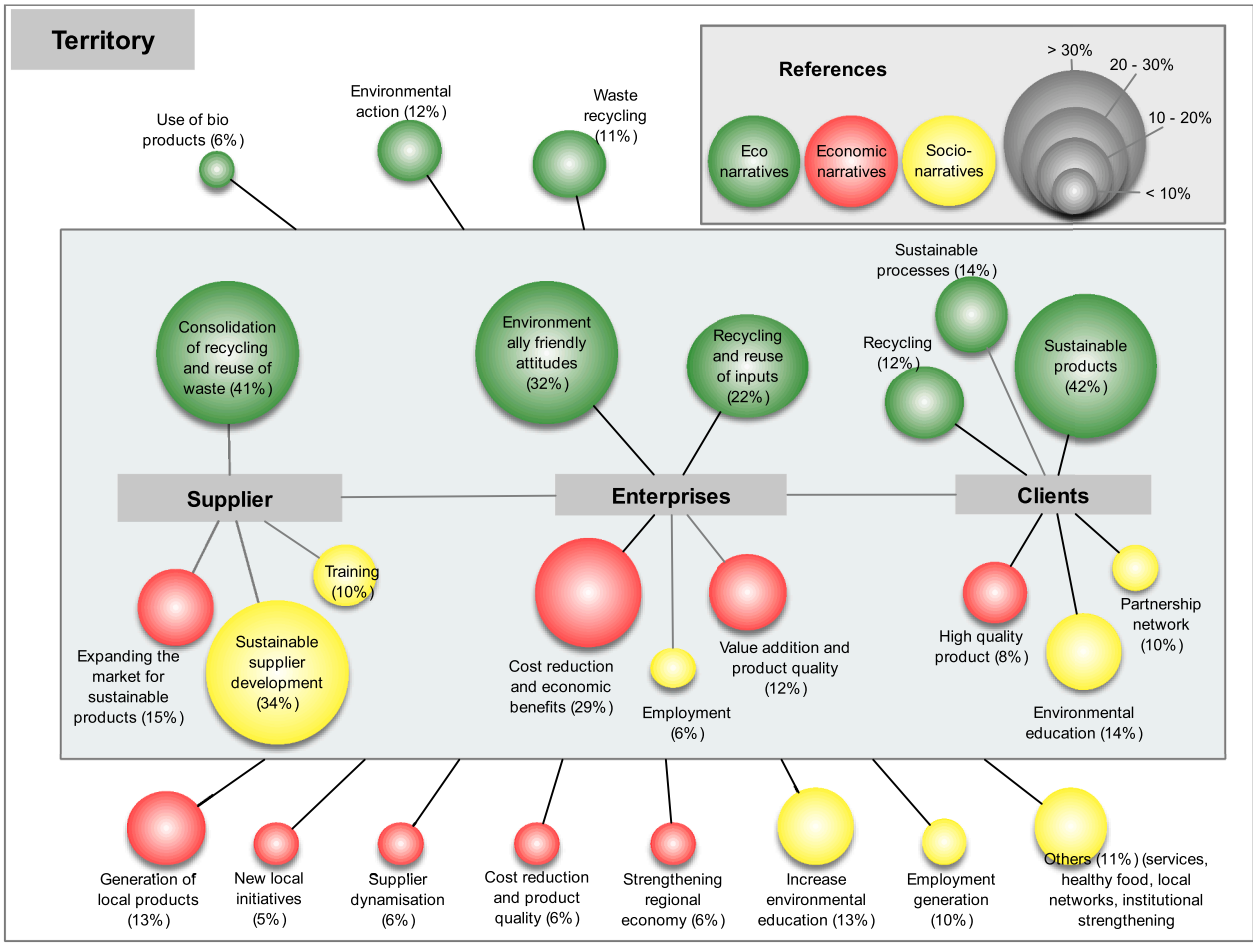

Fig. 1. Contributions of bioeconomic enterprises to the sustainability of their value chain and of the territory, in % of total mentions.

6. The improvement of product quality (8 %) which is associated with products that are environmentally friendly: "By improving the product we help our clients to improve their products".

4.5. Contributions to sustainable territorial development

The contributions to sustainability at the territorial level include both environmental and socio-economic:

1. The generation of employment (10 %): *"We provide direct and indirect employment."* This narrative is directly associated with the contribution made to strengthening the regional economy (6 %). The comments are linked to how the companies contribute to developing products that were not previously available in the region, adding local value: *"Working together locally to develop the craft beer industry."* This narrative is also linked to the generation of locally produced products (13 %): *"Recognition of local production"*.
2. The positive impact that environmental education has generated (13 %). The following comment stand out: *"Through the cooperative we provide opportunities for young people and we provide training in environmental issues"*. Thus, environmental awareness is deeply rooted in some companies, and they take on a training and educational role, knowing that what they generate is awareness and a broadening of environmental ideas in the population and other companies.
3. The positive impact of environmental actions (12 %), for example: "All I seek is to produce in the most environmentally friendly way, reducing the generation of waste, using natural elements for the process."
4. The dynamization of suppliers (6 %), as one entrepreneur comments: *"We are about to set up this laboratory and link up with people who do field trials with long-term links"*. The companies generate synergies that favor the whole chain and help each other to grow.
5. The development of waste recycling also appears as an activity with an impact on the territories (11 %), for example: "Customers have already made a habit of coming, bringing me their bottles, refilling them, so all those parts of constantly buying are eliminated". Entrepreneurs state that they reuse waste, oil, wood and fish waste, or even sewage water: "With the recovery of "mud" I don't generate even 20 % of the waste that we generated 20 years ago."
6. Cost reduction and improved product quality (6 %) are commented, for example: *"Services that halve the installation of air conditioners and thus reduce energy use"*. Linked to recycling actions is the use of agroecological, biodegradable and compostable products (6 %): *"Offering bio-degradable and compostable products that replace conventional plastics."*

5. Towards a typology of the socio-ecological bioeconomy model

All of the 34 companies report on their ecological contribution to sustainability, and almost all mention both social (30 out of 34) and economic (31) aspects. This means that in their narratives, these companies make a comprehensive contribution to the triple bottom line of social, ecological and economic goals (Belz and Binder, 2017). However, different patterns can be seen: some companies focus more on their environmental contribution, while others stress more their socio-economic contributions to sustainability.

As for their market outlet, half of the enterprises sell 50 % or more to the (inter)national market, the other half >50 % to local (and provincial) markets. Following the logic of typologies of sustainable entrepreneurship (Levinsohn, 2013), we construct our typology of the socio-ecological bioeconomy on two axis: one represents the importance of ecological versus socio-economic sustainability narratives, the other the sales market, taking the two dimensions described in Section 1.2.

For the following graphic we distinguish on the horizontal axis the companies that generate at least 50 % of their sales at the (inter-) national level ("bridging") from those that sell >50 % on the local markets ("connecting"), and on the vertical axis the companies that mention more often ecological contributions (50 % and more) in their narratives from those that stress mainly (>50 %) socio-economic ones.

This results in the following quadrants:

1. *"Eco-outward oriented"* (4) refers to companies with a strong ecological narrative that are present on the national and international market; it consists of ventures such as agro-ecological producers of vine and olive oil, bio fertilizers, and wooden glasses frames.
2. *"Eco-inward oriented"* (8) ventures are only present on the local market and are primarily ecologically motivated. They comprise enterprises which make agricultural inputs such as earthworm humus or bio fertilizers, produce agro-ecological food such as integral wheat flour, or make natural cosmetics, and cleaning products for local clients.
3. *"Socio-inward oriented"* (9) enterprises are based on the local market, and emphasize more their contribution to socio-economic development than to ecological aspects of sustainability. Enterprises include producers of agro-inputs such as bio fertilizers and bio- insecticides, producers of biomaterials for construction, and natural cosmetics and natural food.
4. *"Socio-outward oriented"* (13) bioeconomic companies place emphasis on their socio-economic contribution to development and are present on the national market and even abroad. These include enterprises from the special food sector such as ginger and turmeric, propolis, gluten free toast and hop pellets, but also enterprises which produce biomaterials such as bamboo bikes, fish leather tanning, wooden chips and decks.

It has to be mentioned that the pre-fix "socio" combines the social and the economic sustainability narratives of the ventures; it does not mean non-profit, social entrepreneurship in contrast to profit-oriented business, a distinction proposed for a typology of green entrepreneurship by Nikolaou et al. (2018). It has to be emphasized again that the ecological aspect is important for all companies, albeit to different degrees. This means that all of the 34 enterprises see themselves as contributing to ecological as well as socio-economic points, i.e. they represent sustainable entrepreneurship. It also needs to be noted that the market outlet is rather a continuum, so that half of the enterprises (17) sell both on the local and the national market; only eight companies exclusively sell locally, and nine only nationally. This means that "bridging" of local resources to outside markets and "connecting" local producers and clients are not mutually exclusive but are combined in half of the cases, even if there are not many enterprises that serve relatively equally both markets.

Even if the limited number of cases does not allow to make systematic comparisons, two points should be mentioned in relation to Fig. 2: First, it can be seen that the more outward-oriented companies tend make stronger socio-economic (13 out of 17) than ecological contributions (4), while the narratives of the inward-oriented enterprises are more balanced between predominant ecological (8) versus socio-economic (9) contributions. However, there is no significant relationship between market positioning and the ecological dimension (r = 0.060, p=.734). Second, the contributions of the outward-oriented enterprises are more widely spread (SD: 21.0) than those of the inward-oriented (SD: 13.5). This is especially true for the companies that sell 100 % on the (inter-) national market, and whose share of ecological narratives ranges from 13 % to 100 % (SD: 25.6).

Taking into account these differences, the question is: what else differentiates the inward-looking from the outward-looking companies, or, put it differently: will the inward-oriented become outward-oriented in the future? Is it feasible or even desirable that this will happen? First, 47 % of the inward-oriented enterprises are start-ups, i.e. they are a less than five years old, which is true for only 18 % of the outward-looking ones. This means that in the future, some of these start-ups might try to develop their outlets also on the national level. Second, 53 % of the inward-oriented enterprises have less than five employees (in contrast to 29 % of the outward-oriented). It is questionable if such small ventures have the capacity to conquer the national market. Third, the product lines of the inward-oriented ventures are geared to local demand and rely less on customers with high purchasing power in certain market niches, in contrast to some outward-oriented companies which need a wider market outlet, for example, to sell bamboo bicycles. However, this does not mean that certain now locally sold products could not enter the national market.

Fourth, the expressed needs of the different types of enterprises for

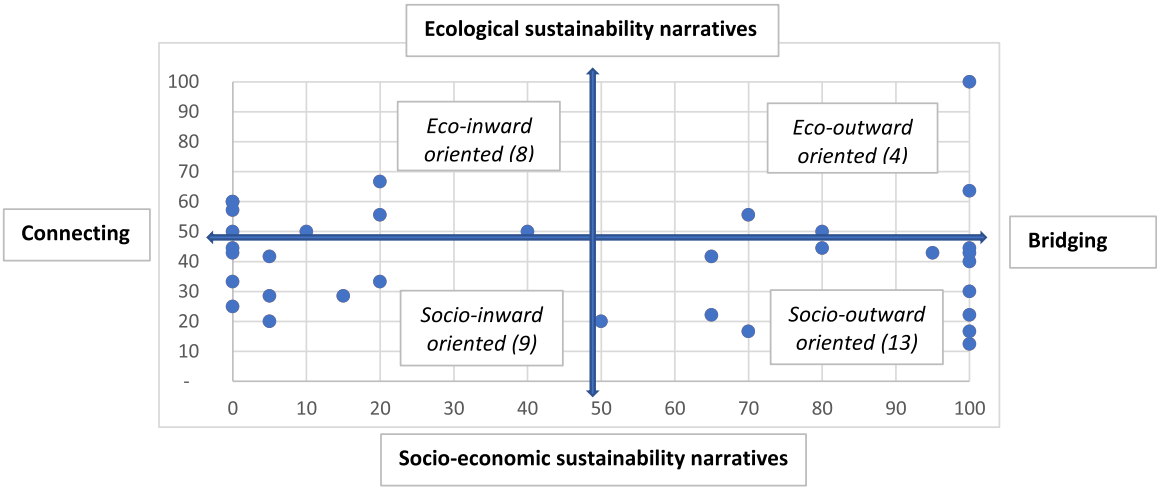

Fig. 2. Different types of bio-embedded enterprises depending on their participation on the national market (horizontal axis) and the share of ecological narratives versus socio-economic narratives (vertical axis).

their future development are also diverse. Table 5 shows that the inward-looking enterprises emphasize more legislative and policy aspects, while the outward-oriented enterprises accentuate more labor and market aspects. Similarly, the two eco-oriented types stress more the need for adequate environmental and labor legislation and proactive policies than the socio-oriented types, which put more emphasis on market expansion, innovations and better trained staff. In short, it seems that the inward-looking ventures are more dependent on external factors they cannot influence easily, and therefore might be somehow "caught" in their local market niche.

Source: based on producer survey

6. Discussion

The socio-ecological bioeconomy model in Argentina can be well described by certain basic characteristics. The results of this study, and also taking into account other studies carried out in Argentina (Dürr and Sili, 2022a, 2022b; Dürr et al. 2024), and in accordance with international literature, we can assign companies to the socio-ecological bioeconomy model. They are rather small-sized companies that use small amounts of biomass of local origin to produce on a small-scale, mainly biomaterials and food. Their production model is based on the minimum use of external inputs, small-scale, often organic farming practices and small-scale biotechnology. The key is the search for sustainable agro-ecological practices, re-use and recycling of waste, high quality products, territorial identity and transdisciplinary research. In line with Bugge et al. (2016), there is a strong concern among these producers for sustainability, biodiversity, recycling of products, and conservation of ecosystems. As rural entrepreneurs, they create positive externalities to their territories (Bosworth 2012).

Territory and localized innovation are a key factor in the socio-ecological bioeconomy model. Innovation is motivated by environmental care combined with the search for productive and economic improvement in general, and a great anchoring to the territory. Innovations are also based on available knowledge and existing patents, they are created at the local level, based on productive experiences and local knowledge (Levidow et al., 2013). Even if the enterprises face many conventional factors (such as the existence of technical assistance, financing, etc.) for their development, they are favoured by some specific factors such as the existence of local networks, the search for new ways of living, changes in consumption patterns, and environmental awareness. Thus, innovation for these entrepreneurs requires areas of interaction where knowledge, ideas and information are exchanged, i.e. a territory of concrete proximity where the actors can establish cooperation and exchange links. Innovation is no longer limited to strictly technological and economic processes, but includes the defense of the environment, the preservation of landscapes and the enhancement of heritage (de Boon et al., 2022). In short, territory and the search for new lifestyles and consumption patterns are important additional factors for the development of these innovations.

Table 5
Needs for further development, in % of enterprises.

	Average Eco n = 12	Average Socio n = 22	Average Inward n = 17	Average Outward n = 17	Total Average n = 34
Environmental awareness in society	17	14	12	18	15
Develop new products and expand markets	17	32	24	29	26
Financing	42	36	41	35	38
Innovate and improve processes	33	41	41	35	38
Environmental and labor legislation	42	18	35	18	26
Larger supplier market	–	5	–	6	3
More trained and committed staff	8	23	12	24	18
Proactive and stable public policies	58	41	59	35	47

The socio-ecological bioeconomy model promotes sustainability of value chains. Bioeconomic initiatives make a contribution to the sustainability of their suppliers and their customers, i.e., to the value chain in which they are inserted in different ways (Wohlfahrt et al. 2019). In doing so, these initiatives are in a position to contribute to creating sustainable value chains in the territories, articulating sustainable suppliers with sustainable clients (Moretti et al., 2023).

Several elements should be highlighted.

- There is a focus on producing sustainable goods and services.
- There is a commitment to building a new culture of environmental care.
- There is a significant predisposition to recycle and reuse waste from suppliers, and to hire suppliers that are more sustainable, thus aiming to generate sustainable products.
- There is a significant intention to promote and build sustainable production chains, through greater environmental education and awareness among all parties, but also by influencing or conditioning (based on the demands for types of products) other parts of the chain.

The sustainability of their own enterprises is achieved through a combination of environmentally friendly and economically efficient practices. In other words, sustainability is seen as an environmental as well as an economic issue. Yet, profit does not seem to be the only goal for these companies (Bosworth 2012). Moreover, the social dimension is very prominent in their value chains. In short, the companies have a holistic vision of the sustainability of their value chains, providing sustainable products and services by connecting with suppliers and serving sustainability-oriented customers, and by creating networks and fostering environmental awareness.

The socio-ecological bioeconomy model focuses on an integrated vision of territorial development. The contribution of the bioeconomic activities to territorial and rural development is diverse, and is reflected in the narratives of building new forms of production and consumption, sustainability, ties with the territory, and a new form of relationship with nature. In this way, the holistic view of the production process, which combines the ecological, social and economic dimensions in a balanced way and is linked to the territorial basis, represents a representative factor of the socio-ecological model (Farny and Binder, 2021). However, many of the contributions to territorial development, such as employment creation, generation of local products with value added, or recycling and environmental education, strongly relate to value chain sustainability. The social participation of these companies or the level of involvement in the community was not specifically mentioned as a contribution to territorial development. This deserves further research. This also applies to the special way that women play in strengthening the embeddedness of the value chains. The type of activities carried out by them have a focus on the production of cosmetics and pharmaceuticals, and are more oriented towards local direct sales. It seems that female entrepreneurs have a strong local customer base that they know and mobilise for the commercialisation of their products.

Market orientation is a key factor differentiating actors of the socio-ecological bioeconomy. Although some companies sell to both the local and national markets, the distinction between those producers who "connect" with their customers at the local level and those who

build a "bridge" to extraterritorial consumers seems important. These two options can make a different contribution to sustainable rural development. The idea that sectors that sell their products outside the local sphere contribute to regional development has long been discussed under the export hypothesis. This claims that in order to promote rural economic development, it is necessary to promote companies that sell their products outside their territory (Kilkenny and Partridge, 2009). In turn, the development of local markets can support the use of local resources to satisfy local demand, thereby generating employment and income. Even if the question of which of the two approaches can contribute more to sustainable rural development cannot be clarified here, with regard to the socio-ecological bioeconomy another question arises: Is external orientation always desirable considering that connecting local producers and consumers means shortening of supply chains, reducing the need for transport, contributing to direct contacts of and trust between producers and consumers, use of local knowledge to find local solutions, enhanced local identities, more circularity and less waste, as described by some authors (Hausknost et al., 2017; Priefer et al., 2017). Besides, the local orientation might also be a choice of lifestyle the owners deliberately have chosen, with no intention to expand (Müller and Korsgaard, 2018). The stronger eco-orientation and weaker socio-economic orientation of the inward-looking enterprises seems to point in the same direction. "Visionary" small enterprises take a more nature-centered and less growth-oriented perspective in their business operations (Kearins et al., 2010). On the one hand, it has been argued that sustainability start-ups are interested in market growth, but on the other hand, that there is often a tendency to limit this growth in order not to undermine sustainability standards, but rather to keep them high. It may also be that start-ups want to remain in their niche so as not to attract excessive interest and therefore competition from incumbent companies (Hockerts and Wüstenhagen, 2010).

The typologies of sustainable entrepreneurship are a suitable instrument for understanding the socio-ecological bioeconomic model. For a comparison of the typology presented here with others, it must first be noted that it represents only a sub-categorization of the socio-ecological bioeconomy model, which alone differs from other bioeconomy approaches, as explained above. There are some similarities with typologies of sustainable entrepreneurs, but they must be viewed against this background. For example, the eco-inward-oriented entrepreneurs could have some points of overlap with the alternative green start-ups of Bergset & Fichter (2015), e.g. the local perspective, the closed cycle of production and consumption, and a rather weak growth strategy. The eco-outward-oriented ones could partly correspond to the visionary green start-ups, which take a more global than local perspective and also a more mass market perspective, but with strong visions of sustainability. The socio-outward-oriented entrepreneurs certainly have something to do with the ecopreneurs of Schaltegger & Wagner (2011) as they are more economically and market-oriented. Despite these partial similarities, it must be emphasized again that the typology developed here refers to small to medium-sized, strongly locally integrated and sustainability-oriented companies of the alternative, socio-ecological bioeconomy model.

7. Conclusions

This paper describes the functioning of the socio-ecological model. In many Latin American countries the bioeconomy is still very focused on the processing of large volumes of biomass or on biotechnological progress, while the socio-ecological model is rather invisibilized. Therefore, this analysis is one of the first to better understand the basic characteristics and activities of this type of bioeconomy.

The proposed typology of socio-ecological bioeconomic enterprises based on their sustainability narratives and market orientation might be useful for further conceptualization of the interrelationships of these two categories. It also offers a scheme to better distinguish the needs of different types of small-scale bioeconomic enterprises. For further research, it will be interesting to explore deeper if a stronger ecological orientation of enterprises has implications for their growth perspective, for example, if there is less motivation and/or less opportunities to expand their business to outside markets. Moreover, further investigation might clarify if more outward market orientation actually goes hand in hand with less eco-orientation, as some authors claim (Bergset and Fichter, 2015; Schaltegger and Wagner, 2011), and as this research has also shown.

The results obtained from this research come from experiences of dispersed bio-economic initiatives in different Argentinean rural territories. In the future, more in-depth results on the contribution to sustainability and territorial development could be obtained from the analysis of bio-economic clusters located in a specific territory. In the same vein, further research could focus on measuring, through quantitative indicators, the level of contribution of bioeconomy initiatives to territorial development. This would make it possible to identify which sectors, productive modalities or bioeconomic models have a greater impact in terms of sustainability, employment and value generation in the territory, which could guide policies to support the sector (Refsgaard et al., 2021).

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

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CRediT authorship contribution statement

Marcelo Sili: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Jochen Dürr:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jochen Durr reports financial support was provided by Ministry of Culture and Science of the German State of North Rhine-Westphalia. Jochen Durr reports financial support was provided by German Federal Ministry of Food and Agriculture. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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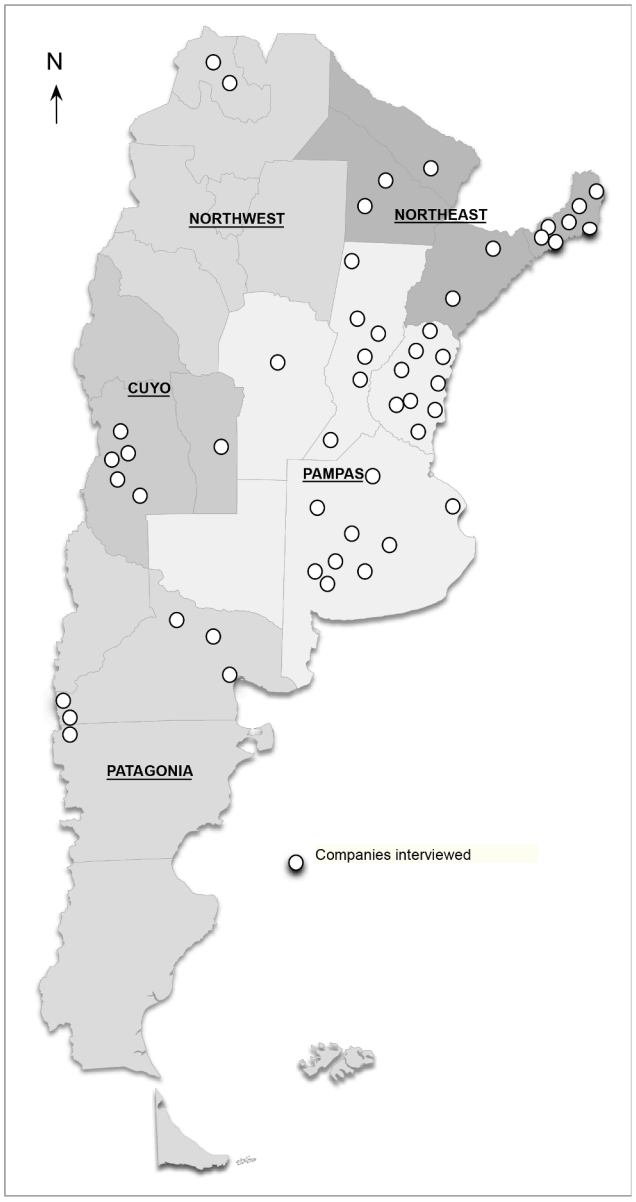
Appendix A. Map of interviewed companies in Argentina



Data availability

The data that has been used is confidential.

References

Belz, F.M., Binder, J.K., 2017. Sustainable entrepreneurship: a convergent process model. Bus. Strategy Environ. 26 (1), 1–17. https://doi.org/10.1002/bse.1887.

Bergset, L., Fichter, K., 2015. Green start-ups – a new typology for sustainable entrepreneurship and innovation research. J. Innov. Manag. 3 (3), 118–144. https://doi.org/10.24840/2183-0606_003.003_0009.

Bisang, R., Anlló, G., Fuchs, M., Lachman, J., & Monasterios, S. (2015). Bioeconomía. Cambio estructural, nuevos desafíos y respuestas globales: una ventana de oportunidad para las producciones basadas en Recursos Naturales Renovables. Retrieved from http://www.ucar.gob.ar/images/publicaciones/Documento-Bioeconomia.pdf.

Bosworth, G., 2012. Characterising rural businesses: tales from the paperman. J. Rural. Stud. 28 (4), 499–506. https://doi.org/10.1016/j.jrurstud.2012.07.002.

Bugge, M.M., Hansen, T., Klitkou, A., 2016. What is the bioeconomy? A review of the literature. Sustainability 8 (7). https://doi.org/10.3390/su8070691.

de Boon, A., Sandström, C., Rose, D.C., 2022. Governing agricultural innovation: a comprehensive framework to underpin sustainable transitions. J. Rural. Stud. 89 (July), 407–422. https://doi.org/10.1016/j.jrurstud.2021.07.019.

Dürr, J., Sili, M., 2022a. Bioeconomic entrepreneurship and key factors of development: lessons from Argentina. Sustainability 14 (4). https://doi.org/10.3390/su14042447.

Dürr, J., Sili, M., 2022b. New or traditional approaches in Argentina's bioeconomy? Biomass and biotechnology use, local embeddedness, and sustainability outcomes of bioeconomic ventures. Sustainability 14 (21). https://doi.org/10.3390/su142114491.

Dürr, J., Sili, M., Mac Clay, P., Sellare, J., 2024. Bioeconomic innovations breeding more sustainable innovations: a value chain perspective from Argentina. Bus. Strategy. Environ. (June 2023), 1–19. https://doi.org/10.1002/bse.3845.

Farny, S., Binder, J., 2021. Sustainable entrepreneurship. World Encyclopedia of Entrepreneurship. https://doi.org/10.4337/9781839104145.00076.

Haarich, S., 2017. Bioeconomy Development in EU Regions – Final Report. Retrieved from. https://ec.europa.eu/research/bioeconomy/pdf/publications/bioeconomy_development_in_eu_regions.pdf.

Hausknost, D., Schriefl, E., Lauk, C., Kalt, G., 2017. A transition to which bioeconomy? An exploration of diverging techno-political choices. Sustainability 9 (4). https://doi.org/10.3390/su9040669.

Hockerts, K., Wüstenhagen, R., 2010. Greening Goliaths versus emerging Davids - theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. J. Bus. Ventur. 25 (5), 481–492. https://doi.org/10.1016/j.jbusvent.2009.07.005.

Jaramillo, E.H.De, Henry, G., Trigo, E., 2019. In: de Jaramillo, E.H., Henry, G., Trigo, E. (Eds.), La Bioeconomía. Editoria Pontificia Universidad Javeriana, Bogotá.

Kearins, K., Collins, E., Tregidga, H., 2010. Beyond corporate environmental management to a consideration of nature in visionary small enterprise. Bus. Soc. 49. https://doi.org/10.1177/0007650310368988.

Kilkenny, M., Partridge, M.D., 2009. Export sectors and rural development. Am. J. Agric. Econ. 91 (4), 910–929. https://doi.org/10.1111/j.1467-8276.2009.01320.x.

Kuckertz, A., Berger, E.S.C., Brändle, L., 2020. Entrepreneurship and the sustainable bioeconomy transformation. Environ. Innov. Soc. Transit. 37 (November 2019), 332–344. https://doi.org/10.1016/j.eist.2020.10.003.

Levidow, L., 2015. European transitions towards a corporate-environmental food regime: agroecological incorporation or contestation? J. Rural. Stud. 40, 76–89. https://doi.org/10.1016/j.jrurstud.2015.06.001.

Levidow, L., Birch, K., Papaioannou, T., 2013. Divergent paradigms of European Agro-food innovation: the knowledge-based Bio-economy (KBBE) as an R&D agenda. Sci. Technol. Human Values 38 (1), 94–125. https://doi.org/10.1177/0162243912438143.

Levinsohn, D., 2013. Disembedded and beheaded? - A critical review of the emerging field of sustainability entrepreneurship. Int. J. Entrepren. Small Bus. 19 (2), 190–211. https://doi.org/10.1504/IJESB.2013.054963.

Moretti, M., Belliggiano, A., Grando, S., Felici, F., Scotti, I., Ievoli, C., Brunori, G., 2023. Characterizing value chains' contribution to resilient and sustainable development in European mountain areas. J. Rural. Stud. 100 (September 2022), 103022. https://doi.org/10.1016/j.jrurstud.2023.103022.

Müller, S., Korsgaard, S., 2018. Resources and bridging: the role of spatial context in rural entrepreneurship. Entrepren. Reg. Devel. 30 (1–2), 224–255. https://doi.org/10.1080/08985626.2017.1402092.

Nikolaou, I.E., Tasopoulou, K., Tsagarakis, K., 2018. A typology of Green entrepreneurs based on institutional and resource-based views. J. Entrepren. 27 (1), 111–132. https://doi.org/10.1177/0971355717738601.

Priefer, C., Jörissen, J., Frör, O., 2017. Pathways to shape the bioeconomy. Resources 6 (1), 1–23. https://doi.org/10.3390/resources6010010.

Priefer, C., Meyer, R., 2019. One concept, many opinions: how scientists in Germany think about the concept of bioeconomy. Sustainability 11 (15), 1–21. https://doi.org/10.3390/su11154253.

Refsgaard, K., Kull, M., Slätmo, E., Meijer, M.W., 2021. Bioeconomy – a driver for regional development in the Nordic countries. N. Biotechnol. 60, 130–137. https://doi.org/10.1016/j.nbt.2020.10.001.

Schaltegger, S., Wagner, M., 2011. Sustainable entrepreneurship and sustainability innovation: categories and interactions. Bus. Strategy Environ. 20 (4), 222–237. https://doi.org/10.1002/bse.682.

Shepherd, D.A., Patzelt, H., 2011. The new field of sustainable entrepreneurship: studying entrepreneurial action linking "what is to Be sustained" with "what is to Be developed. Entrepreneurship 35 (1), 137–163. https://doi.org/10.1111/j.1540-6520.2010.00426.x.

Vivien, F., Nieddu, M., Befort, N., Debref, R., Giampietro, M., 2019. The hijacking of the bioeconomy. Ecol. Econ. 159, 189–197.

Wohlfahrt, J., Ferchaud, F., Gabrielle, B., Godard, C., Kurek, B., Loyce, C., Therond, O., 2019. Characteristics of bioeconomy systems and sustainability issues at the territorial scale. A review. J. Clean. Prod. 232, 898–909. https://doi.org/10.1016/j.jclepro.2019.05.385.

Wreford, A., Bayne, K., Edwards, P., Renwick, A., 2019. Enabling a transformation to a bioeconomy in New Zealand. Environ. Innov. Soc. Transit. 31 (October), 184–199. https://doi.org/10.1016/j.eist.2018.11.005.