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A BIOECONOMY-BASED DEVELOPMENT MODEL FOR ARGENTINA: APPROACHES, DRIVERS AND INNOVATIONS FOR SUSTAINABILITY

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Key Messages

- Diverse bioeconomy approaches play a role in Argentina, including the **biomass-based, biotechnological, and a socio-ecological approach,** though the latter is still absent in the public debate.
- **The socio-ecological approach is sustainability-oriented and locally embedded**, but entrepreneurs also connect local resource systems to (inter)national markets.
- Most business actors emphasize the importance of environmental protection and the sustainable use of natural resources.
- **Innovative entrepreneurs and innovation networks** are decisive factors for the development of the bioeconomy in Argentina.
- **More dialogue and information exchange** among public and private actors is needed to identify bottlenecks to the development of bioeconomic businesses.
- **Territorial innovation dynamics and their contribution to rural development** in the diverse regions of Argentina are still not sufficiently understood.

Background

Argentina has a large biomass base and a well-developed **Research and Development** (R&D) sector — conditions that make it a prime candidate for a bioeconomy-led development model. Such a model could overcome the historical opposition between agricultural and industrial development, and between large companies and family farming, with a view to achieving more balanced territorial development (Trigo et al., 2016). Yet its current bioeconomy is dominated by **large-scale monocultures**, with mixed sustainability outcomes.

Research based on four case studies in Argentina

Four case studies of various ZEF research projects (see Fig. 2 in the Annex) examined how Argentine companies pursue different bioeconomic approaches (Bugge et al., 2016), which factors drive or block their growth, what innovations they introduce, and what their impacts are (see Fig. 1).

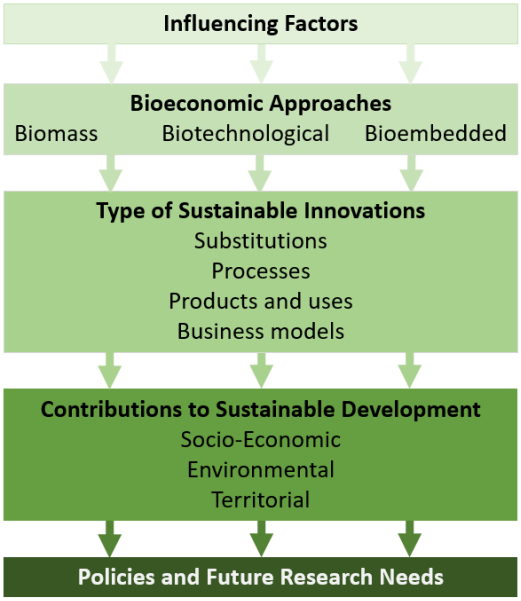

Figure 1
Framework for analysis of case studies

Three Types of Bioeconomic Approaches

The three approaches reflect Argentina's production history: **large biomass resources, an agricultural tradition, and solid scientific and technological networks**.

1 Biomass approach: Companies use large volumes of biomass from surrounding areas, historically centered on primary and food production (soybean, corn, meat, sugar). They have moved up the value chain by leveraging existing infrastructure and strong links to R&D organizations.

2 Biotechnological approach: Companies generate specialized products for agriculture (seeds, fertilizers, biostimulants) and for pharmaceutical or cosmetic industries. They are

characterized by cutting-edge biotechnological knowledge, international patents, and close scientific partnerships.

3 Socio-ecological approach: Companies produce food and bioproducts with a strong focus on natural resource protection and local identity. They use small amounts of locally sourced biomass or recycle waste, follow agro-ecological principles, and serve niche markets. Their success depends on solid ties to territory, community, and local government. We term this third approach the **socio-ecological bio-embedded approach**.

Zooming in on the Socio-Ecological Bio-embedded Approach

The socio-ecological bio-embedded approach is locally rooted and places greater weight on social, cultural, and environmental considerations than the other two approaches.

Importantly, many bio-embedded businesses sell nationally and internationally — bridging local resources to extra-local demand (Müller & Korsgaard, 2018).

Typology based on market orientation and sustainability

A **typology** based on market orientation and sustainability narratives (Levinsohn, 2013) yields four types of bio-embedded companies:

1. **Eco-outward** — ecologically driven, serving national and international markets (eco-wine, olive oil, bio-fertilizers)
2. **Eco-inward** — ecologically driven, serving local markets (agricultural inputs, bio-food, natural cosmetics)
3. **Socio-inward** — socio-economically driven, serving local markets (agro-inputs, biomaterials, natural cosmetics)
4. **Socio-outward** — socio-economically driven, serving wider markets (specialty foods, biomaterial products such as bicycles and construction materials)

Inward-oriented firms are mostly smaller start-ups. To reach wider markets they need proactive public policy, finance, and appropriate environmental regulation. Their stronger eco-orientation also means they may deliberately prioritize sustainability over growth (Bergset & Fichter, 2015) — a feature that current policy frameworks rarely accommodate.

Key Factors for Bioeconomic Development

The single most important driver across all business types is **access to new knowledge and technology**, whether generated in-house or through R&D partnerships. Entrepreneurs' skills and those of their workforce are central to this.

Other key factors include raw material supply, as reliable access to biomass is crucial for volume-dependent companies; infrastructure, such as roads, high-voltage electricity, and internet connectivity, which varies greatly depending on the region and distance from cities; market access, which either greatly enables or severely restricts bioeconomic activity; and macroeconomic stability, as exchange rate fluctuations and high inflation rates are the most frequently cited obstacles for all types of businesses.

The Role of Entrepreneurship

Argentine bioeconomy entrepreneurs operate in an unusually demanding environment: macroeconomic instability, political uncertainty, and international competition. That bioeconomic innovation is happening at all reflects the high level of training, adaptability, and network-building capacity of business leaders and their teams (Rosário et al. 2022). Leadership commitment to sustainability is a decisive factor. Entrepreneurs who invest in new activities, seek out R&D collaborations, and absorb calculated risks are driving the bioeconomy forward, often without the stable framework conditions that make such risk-taking easier elsewhere.

Innovations for a Sustainable Bioeconomy

Four innovation types (Dietz et al., 2018; Bröring et al., 2020) are present across companies:

1. **Fossil fuel substitution** — biofuels replacing conventional energy sources
2. **Process innovation** — more efficient production or entirely new biological transformations (e.g. gene editing for plant breeding)
3. **Novel bio-based products** — new functions and industrial applications from biological materials
4. **New business models** — circular systems, waste valorization, sustainable supply chains

Beyond these, companies pursue a range of incremental innovations: energy recovery from residues, improved conversion efficiencies, new crop varieties, water and waste recovery, and reforestation. Innovation is cumulative — prior eco-innovations create the conditions and confidence for further ones (Horbach, 2008).

Contributions to Sustainable Development

Most companies see their primary contribution in generating new knowledge and jobs. But sustainability performance varies sharply by approach. **Biomass-intensive** pathways connected to large-scale soy and maize with GM crops deliver high yields and economic growth but carry ecological and social risks. Companies in this space are increasingly innovative and internationally competitive, and are gradually improving their environmental performance. The **socio-ecological approach** delivers more balanced outcomes. **Bio-embedded businesses** report positive contributions across economic, social, and environmental dimensions: recycling waste, educating customers and suppliers, generating local income and jobs, and producing ecologically sound products with local added value. **Across the sample, 62–81% of biomass companies and 53–63% of biotechnology companies also prioritise environmental protection, suggesting that awareness of sustainability is widespread, even if practices vary.** The weakest area across all approaches is territorial impact. Regional job creation, infrastructure improvement, and rural development gains are real but poorly documented. Closing this knowledge gap is essential for designing effective place-based policy.

Conclusions, Recommendations, Research Priorities

The case studies show that a bioeconomy-led development model is viable in Argentina, but only if the right conditions are in place. Innovation is happening; entrepreneurs are delivering it against the odds. What is missing is a **coherent policy framework to support, scale, and steer this transformation**.

We see six priorities for transformation:

1. **Establish a national body to coordinate the bioeconomy.** Fragmented public and private sector stakeholders need a formal roundtable to align their strategies, identify bottlenecks and develop joint proposals.
2. **Provide macroeconomic and regulatory stability.** Exchange rate volatility and legal uncertainty are the biggest barriers to investment in the bioeconomy. Without a stable legal and macroeconomic framework, medium- and long-term business planning is impossible.
3. **Differentiate between support for start-ups and scaling firms.** Small, rural, bio-embedded entrepreneurs require different instruments to technology-based biotech companies. Policies should provide tailored support, including legal frameworks that actively promote socio-ecological entrepreneurship, not just high-tech ventures.
4. **Strengthen the agricultural knowledge and innovation system and diversify its funding.** Over-

reliance on public investment reduces resilience. New incentives for public–private co-investment in R&D are needed, with reformed project financing mechanisms that reduce dependence on shrinking public budgets.

5. **Expand R&D across the full range of bioeconomy fields.** Biotechnology, agroecology, precision agriculture, AI, green chemistry, and biorefinery engineering are all underinvested relative to their potential. A strategic research agenda should connect these fields directly to Argentina's resource base and development needs.
6. **Plan territory and infrastructure proactively.** Biomass supply, transport routes, energy access, and land use must be coordinated at the regional level. Without deliberate territorial planning, bioeconomy expansion will generate land and resource conflicts and deepen rather than reduce regional inequality.

Future Research Needs

A bioeconomy-based development model for Argentina must consider **two main pillars:** innovations in a knowledge-based economy, and the challenge of sustainability (Deciancio & Mac Clay, 2023).

In this sense, we need to **better understand territorial innovation dynamics**, especially the conditions under which different types of innovation and value chains contribute to development in the diverse geographical regions of Argentina, and how these can best be promoted by local governments. Moreover, it would be important **to quantify the sustainability impacts and the framework conditions influencing them**. More studies are still needed to **determine the development potential** of the bioeconomy for Argentina **and the necessary policy measures**.

References

Bergset, L., & Fichter, K. (2015). Green start-ups – A new typology for sustainable entrepreneurship and innovation research. Journal of Innovation Management, 3(3), 118–144.

Bröring, S., Laibach, N., & Wustmans, M. (2020). Innovation types in the bioeconomy. Journal of Cleaner Production, 266.

Bugge, M. M., Hansen, T., & Klitkou, A. (2016). What is the bioeconomy? A review of the literature. Sustainability (Switzerland), 8(7).

Deciancio, M and Mac Clay, P. (2023). The Bioeconomy in Argentina: lessons for its development and sustainability. ZEF-Policy Brief 43.

Dietz, T., Börner, J., Förster, J. J., & von Braun, J. (2018). Governance of the bioeconomy: A global comparative study of national bioeconomy strategies. Sustainability (Switzerland), 10(9).

Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. Research Policy, 37, 163–173.

Levinsohn, D. (2013). Disembedded and beheaded? - A critical review of the emerging field of sustainability entrepreneurship. International Journal of Entrepreneurship and Small Business, 19(2), 190–211.

Müller, S., & Korsgaard, S. (2018). Resources and bridging: the role of spatial context in rural entrepreneurship. Entrepreneurship and Regional Development, 30(1–2), 224–255.

Rosário, A. T., Raimundo, R. J., & Cruz, S. P. (2022). Sustainable entrepreneurship: A literature review. Sustainability, 14(9), 5556

Trigo, E., Morales, E. V., Grassi, L., Losada, J., Dellisanti, J. P., Molinari, M. E., … Molina, S. (2016). Bioeconomía Argentina. Visión desde Agroindustria.

Project	*(1) STRIVE (Sustainable Trade and Innovation Transfer in the Bioeconomy)*	*(2) STRIVE - Transform2Bio (Integrated Transformation Processes and their Regional Implementations: Structural Change of Fossil Economy to Bioeconomy)*	*(3) STRIVE - Transform2Bio (Integrated Transformation Processes and their Regional Implementations)*	*(4) Transform2Bio - SABio (Transformation and Sustainability Governance in South American Bioeconomies)*
Objective	We examined the factors that influenced the bioeconomic initiatives of 23 companies of different sizes and technological levels, in the main sectors of the bioeconomy and in different regions of Argentina	Through a survey of 47 companies, we identified the different bioeconomic approaches in Argentina: biomass, biotechnology, and bioembedded	Through the analysis of 11 companies, we identified the factors that drive sustainable innovations, their link to the different characteristics of the value chain, and the main types of innovation.	We analyzed the socio-ecological bioeconomic model based on a sample of 34 companies from all regions of Argentina. We analyzed their innovations and contributions to the sustainability of their value chains and the territory.
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References	Sili, M.; Dürr, J. (2022). Bioeconomic Entrepreneurship and Key Factors of Development: Lessons from Argentina. Sustainability, 14, 2447. https://doi.org/10.3390/su14042447	Dürr, J.; Sili, M. (2022). New or Traditional Approaches in Argentina's Bioeconomy? Biomass and Biotechnology Use, Local Embeddedness, and Sustainability Outcomes of Bioeconomic Ventures. Sustainability, 14, 14491. 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. Business Strategy and the Environment, 1-19. https://doi.org/10.1002/bse.3845	Sili, M., & Dürr, J. (2025). The socio-ecological bioeconomy in Argentina: towards a typology. Cleaner and Circular Bioeconomy, 11, 100149. https://doi.org/https://doi.org/10.1016/j.clcb.2025.100149

Figure 2
ZEF Research Projects

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