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Circular and Bio Economy Barriers and Drivers in Worker Cooperatives

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ABSTRACT

Circular economy and the bioeconomy are increasingly recognised as complementary innovation pathways for achieving environmental sustainability, preserving economic competitiveness. A growing body of literature has examined circular- and bioeconomy-related innovation at the firm and sectoral level, yet there is little evidence investigating whether a company's organisational architecture impacts circular and bioeconomy adoption. In this paper, we delve into the worker cooperative model, where workers collectively own and manage the company. Accordingly, we propound that the drivers and barriers shaping circular-bioeconomy innovation in worker cooperatives may follow distinct patterns compared to conventional, investor-owned companies, due to the democratic governance and the embeddedness of such companies within territories and communities. This paper reviews academic literature on circular economy, bioeconomy and the union of the two, and worker cooperatives. Based on a sample of 28 peer-reviewed studies from Web of Science, we conduct a thematic analysis to identify and systematise the main drivers and barriers to circular and bioeconomy innovation of worker cooperatives. The analysis is organised along multiple analytical dimensions. In addition, the paper maps the indicators used in the literature to measure circular bioeconomy-related innovation, highlighting differences in operationalisation and the limited attention devoted to labour- and worker-related dimensions.

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Bioeconomy; circular economy; worker cooperatives; cooperatives

1. Introduction

It seems an expected research development that with a growing interest in circular economy and bioeconomy separately there would be a natural union of these two relevant concepts as interest is to be more environmentally sustainable. As clarified by previous research, there is still uncertainty about the definitions of circular economy and bioeconomy (Abad-Segura et al. 2021). While bioeconomy comprises, economic activities based on the use of renewable biological resources to produce food, feed, bio-based materials and energy (Ronzon and M'Barek 2018), circular economy refers

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to strategies aimed at resource efficiency to maintain material value, prolong use phases and reintegrate materials into production cycles (Geissdoerfer et al. 2016). More recent research (Figge, Thorpe, and Gutberlet 2023) highlights the numerous definitions provided for circular economy in research and frames the definition into a hierarchy of complementary strategies for narrowing, slowing and closing resource loops, complemented by the regeneration of natural systems with no ideal one-single-solution approach. The circular bioeconomy seeks to limit reliance on newly extracted renewable resources by promoting the reuse of biowastes (biomass) and by accounting for local environmental conditions and biodiversity throughout production processes emphasises the creation of value-added outputs through waste valorisation, thereby exploiting the full potential of biomass resources (Sadh et al. 2023; Sharma and Malaviya 2023). Certainly, while circular economy and bioeconomy share certain dimensions, they are not either mutually exclusive nor are they intrinsically sustainable. These concepts are set within certain boundaries with potential positive benefits to revisit our production and consumption processes relying much on policy and firm to do their part. In view that circular-bioeconomy strategies are not intrinsically sustainable, they are not set to guarantee even social sustainability as fair employment. Currently, firms require a transition period from linear to circular or bio-based production; therefore, there is the issue of labour transfer to greener processes that may need to revisit internal and external adaptations, like internal employee retraining or overall labour reallocation to less polluting practices (Di Santo and Sica 2025). Furthermore, the question has been raised if a particular firm type provides a more flexible structure to accommodate these required changes, like cooperatives (Filippi, Bidet, and Richez-Battesti 2023).

Cooperatives are socio-economic organisations rooted in democratic governance and collective ownership (Tortia 2022). These organisations aim at the betterment of society and pursue social goals in unison with economic sustainability (Sacchetti and Borzaga 2020). Similarly, the adoption of CE and BE practices, while providing competitive advantages to companies, generates positive externalities for territories and communities. If both cooperatives and circular-bioeconomy adoption convey positive benefits for society, then such positive effects may reinforce each other, making cooperatives a suitable vehicle to drive the circular-bioeconomy transition. Ultimately, the fact that cooperatives chase objectives different from pure profit maximisation makes these organisations a compelling object of analysis to study CE and BE innovations.

Recent studies investigate the role of cooperatives in the circular economy in Quebec (Ziegler et al. 2023, 2025), Italy (Guerreschi and Zecca 2024) or more generally in the scholarly literature (Guerreschi and Diaz Lopez 2023), but also referring to environmental sustainability more widely in worker cooperatives (Albanese 2024). The latter research underlines that worker cooperatives, along with other cooperative models, as spaces where the ownership and control of the company belong to worker members, provide a largely inclusive decision-making governance with higher environmental awareness and interest to innovate. However, there is little research on this cooperative type and their implementation of circular economy, bioeconomy or even circular-bioeconomy. Considering previous research, it is questioned if shaped governance and cooperatives are aiders and watchdogs to the implementation of circular-bioeconomy.

2. Theoretical background

It is quite a novelty the intersection between circular economy and bioeconomy. Many agree on the limitation being a non-standardised understanding and definition of either and circular-bioeconomy (Campagnaro and D'Urzo 2021) with others agreeing it is primarily focused in certain arenas such as academia and policy ones (Aggestam and Giurca 2022).

As previously mentioned in the introduction, circular economy's definition derives from extensive literature, like Geissdoerfer et al. (2016) who drawing from the needed transition from linear to circular (reuse) concept reflected on the overall sustainability of circular economy, or Kirchherr, Reike, and Hekkert (2017) who analysed 114 definitions. Figge, Thorpe, and Gutberlet (2023) acknowledged the numerous studies that aimed to frame circularity in four main dimensions for a cycle to be circular, referring to circular economy as regenerative and closed looped.

Bioeconomy in its effective term used in this paper is also not as recent, but more common especially for more biologically based disciplines, such as Ikeda (1979) who studied wood borer, *Phymatodes maaki* Kraatz feeding on wood. It was more recent studies such as Lehtonen (2004)'s who introduced the social element in BE. They addressed that the social dimension had long been considered the least developed pillar of sustainable development, addressing the social conditions underpinning environmentally sustainable transition, speaking of bioeconomy as the intersecting link between environment and social spheres.

As the diagram shows (Figure 1, produced by Aggestam and Giurca (2022)) the latter authors debated how the topic (circular economy, bioeconomy and circular-bioeconomy) remains discussed within single circles (ie. academia and policy) but particularly sector.

The literature increasingly highlights the convergence between the social economy and the circular economy as alternative economic models centred on collaborative design, production and citizen engagement (Bellemare et al. 2022). Within this debate, a transformational strand of circular economy thinking explicitly emphasises the role of local cooperatives and collective economic structures in redistributing power, wealth, knowledge and technological capabilities more equitably across society (Friant, Vermeulen, and Salomone 2020). At the policy level, BE strategies are often framed in relation to international climate commitments, such as the Paris Agreement, and are primarily developed through sector-specific policies in agriculture, forestry, food production, biotechnology and energy (Biekša and Baležentis 2019). At the same time, foundational circular economy contributions focus predominantly on maintaining socio-economic activities within environmental limits, particularly at micro- and meso-levels, through efficient resource management across the entire life cycle of materials, from extraction planning to post-use phases (Bruel et al. 2018). However, this efficiency-oriented framing largely abstracts from firm-level dynamics and employment outcomes, leaving the social and organisational implications of circular transitions comparatively underexplored.

Based on the European Union's (EU) Bioeconomy Monitoring System (European Commission n.d.) (indicators provided in Table 1) the persons employed in the bioeconomy sectors has been decreasing since 2008 (Figure 2) where total employment has fallen by around 3.24 million jobs, corresponding to a 16% decline.

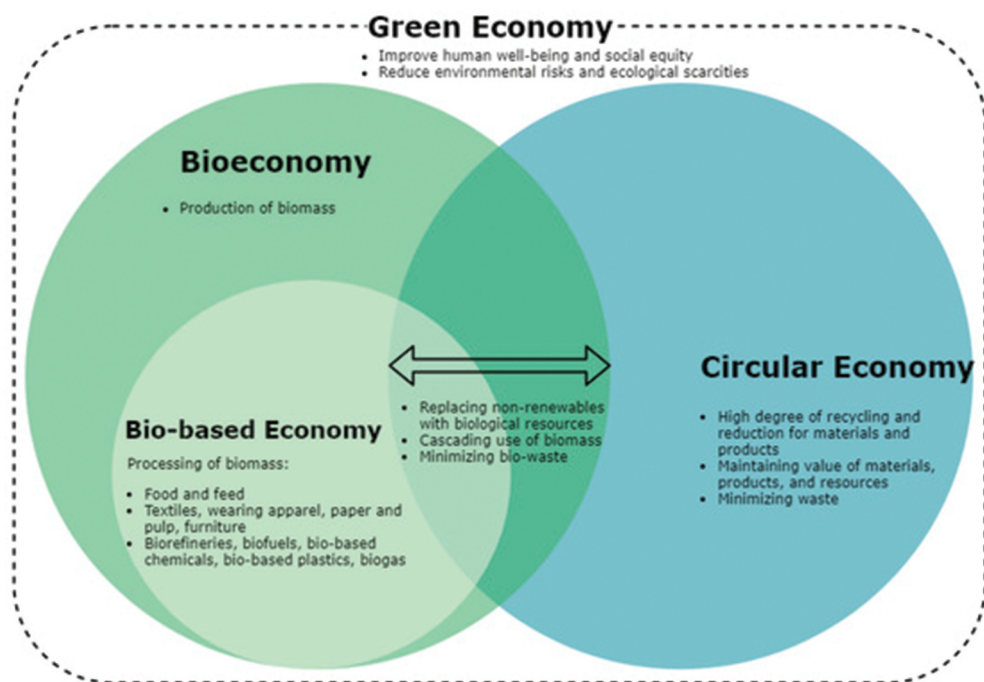


Figure 1. Framework of circular economy and bioeconomy (and the union of the two).

Source: Karding et al. (2021).

However, it is clearly an economic growing trade, especially in exporting countries and even a labour productive incentive in increase (Figure 3).

Considering the relevance of this topic and these strategies, it is our wish to frame this research wondering if specific governance plays a role as a driver for the implementation of the same, such as in the case of workers cooperatives.

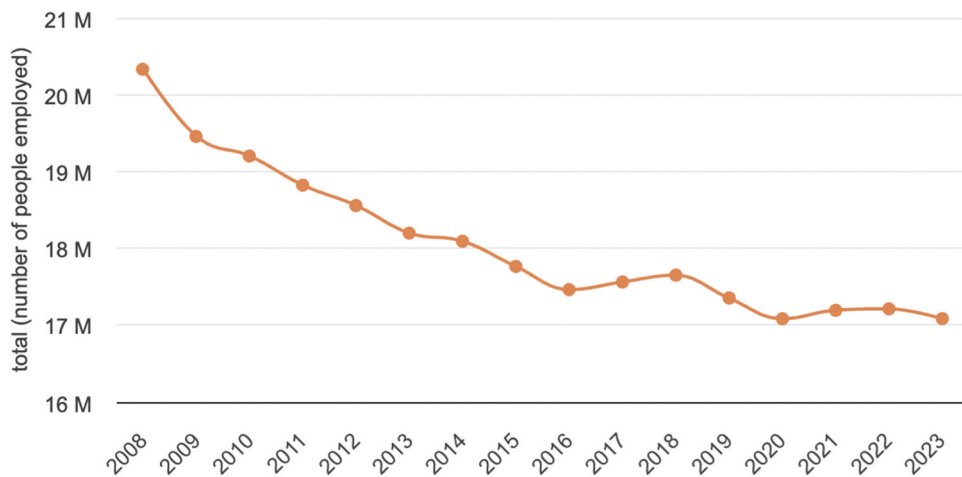
Worker cooperatives are economic organisations owned and controlled by its workforce. Here, worker members democratically control the decision-making process, following the rule ‘one person, one vote’. In addition, worker members seize the profits of the cooperatives, which are redistributed among members (Lomuscio, Tortia, and Cori 2023). The membership of every worker cooperative is mostly, if not entirely, made by workers; exceptions to this include the presence of investors among the members, with limited control and appropriation rights. The governance of such organisations is, consequently, democratic and, generally speaking, mono-stakeholder, since the workers are the ones holding the decision-making power within these companies.

Worker cooperatives generally aim at creating and preserving good-quality and accessible job opportunities. This attitude has been observed in different countries and epochs (Delgado, Dorion, and Laliberté 2014; Pérotin 2013; Tortia 2022). Beside employment creation/protection and differently from other types of cooperatives, such as housing, consumer, community or social cooperatives, worker cooperatives do not explicitly tackle pro-social objectives which can benefit society in general, as in the case of provision of welfare services or the production of commons. Job creation and protection are certainly beneficial for those who find jobs in these cooperatives (Albanese 2020);

Table 1. Dimensions provided by the EU bioeconomy Monitoring System.

System/Dimension	Indicator	Description
Primary production systems	Production of biomass	Output of biomass from agriculture, forestry, fisheries
	Employment in primary sectors	Number of persons employed in agriculture, forestry, fisheries
	Value added from primary sectors	Economic value generated by primary production
	Emissions from primary production	GHG and pollutant emissions from biomass production
	Management of primary production	Land-use, resource management practices, productivity
Secondary production systems	Uses of biomass	Allocation of biomass to food, feed, materials, energy
	Employment in secondary sectors	Employment in bio-based manufacturing and processing
	Value added from secondary sectors	Economic value generated by processing and manufacturing
	Emissions from secondary sectors	Emissions from bio-based industrial activities
Waste and circularity	Products	Bio-based and circular products derived from biomass
	Food waste	Quantity of food waste generated
	Biowaste	Organic waste streams from households and industry
Ecosystem condition	Circularity or recovery	Recycling, reuse, recovery and valorisation of bio-waste
	Agricultural ecosystems	Condition and sustainability of agricultural land
	Forest ecosystems	Forest health, biodiversity and resource stocks
	Freshwater ecosystems	Status of inland water bodies
Cross-cutting systems	Marine ecosystems	Status of marine environments and resources
	Urban ecosystems	Urban land use and environmental pressures
	Trade	Imports and exports of biomass and bio-based products

Source: own production.

**Figure 2.** Total number of people employed (million) 2008–2023 in bioeconomy sectors.

Source: Graph generated via the EU Bioeconomy Monitoring System Dashboard on (date last accessed) 24 December, 2025.

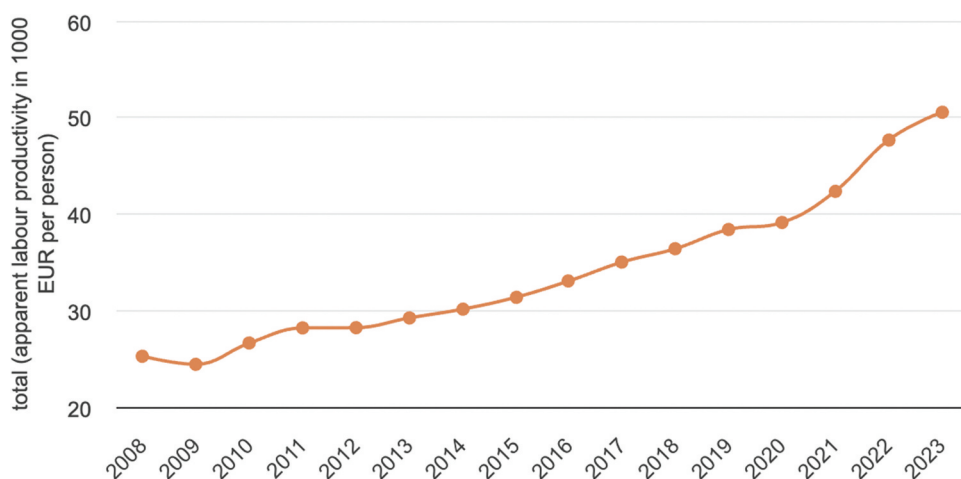


Figure 3. Total apparent labour productivity (1000 euros per person) 2008–2023 in bioeconomy sectors.

Source: Graph generated via the EU Bioeconomy Monitoring System Dashboard on (date last accessed) 24 December, 2025.

yet, this benefit is not necessarily different from job creation induced by investor-owned companies (Dorigatti et al. 2024).

Previous studies have emphasised the relationship between the worker cooperative model and sustainability (Filippi, Bidet, and Richez-Battesti 2023; Preluca, Hakelius, and Mark-Herbert 2022). This evidence shows that, in principle, the organisational structure and the cooperative values embedded in the worker cooperative model are conducive to more sustainable outcomes than traditional companies do. These results are sustained by the fact that the democratic governance of worker cooperatives is much more inclusive than the one of other company models, allowing for the integration of a plurality of ideas and goals, including environmental concerns. In addition, worker cooperatives are infused with cooperative principles, which strategically orientate the operations of these organisations towards a better and equitable society.

Under these premises, the worker cooperative model appears to be highly conducive of circular economy and bioeconomy innovations, which can be generically considered sustainability-oriented practices.

... since the transition to a circular model implies a necessary shift from an economic value-centric system toward a socio-ecological one, cooperatives should be observed as unique context in which sustainable development and the concern for the community are embedded core values. (De Bernardi et al. 2025, 1301)

Yet, the mechanisms through which the worker cooperative model vehicles circular economy and bioeconomy adoption remain largely unexplored. Beside affirming that the worker cooperative model *should* be conducive to sustainable practices, including circular economy and bioeconomy, the adoption of the latter practices by worker cooperatives is not deterministic. In other words, it is not possible to state that the sole worker cooperative model determines circular and bioeconomy adoption. As clearly emphasised by previous research, there are cases of degenerated or false worker

cooperatives, whereby the worker-cooperative legal vehicle does not convey to any cooperative value or outcome (Delbono and Reggiani 2025; Dorigatti et al. 2024; Preluca, Hakelius, and Mark-Herbert 2022).

However, previous research highlights the presence of mechanisms which influence sustainable behaviours of cooperatives, including worker cooperatives. Preluca, Hakelius, and Mark-Herbert (2022) argues that the democratic and inclusive governance of worker cooperatives creates organizational conditions that are particularly conducive to the adoption of sustainable behaviours, including circular economy and bioeconomy strategies. Since decision-making power is shared among worker members rather than concentrated in external shareholders, cooperatives tend to prioritize long-term collective value over short-term financial returns. This governance structure fosters an alignment between economic activity, environmental concerns and social objectives, making circular economy and bioeconomy more compatible with cooperative logics than with profit-maximizing goals. Similarly, Filippi, Bidet, and Richez-Battesti (2023) emphasizes that worker cooperatives, as part of the social and solidarity economy, are guided by values such as democracy, solidarity and concern for the community, which naturally extend to ecological responsibility and sustainable behaviours.

Following this reasoning, we hypothesise that:

- **Hp1:** Worker cooperatives might incorporate social and environmental concerns when the governance mechanisms are fully inclusive and democratic; or else, when there is no degeneration and with majority of votes by members workers;
- **Hp2:** *Ceteris paribus*, the choice to adopt circular economy and bioeconomy in worker cooperatives should align the long-term objectives of worker cooperatives and, ultimately, with workers' interests and goals.

In addition to democratic governance (Hp1) and social mission (Hp2), previous literature also discusses the existence of a third mechanism influencing the adoption of sustainable behaviours by cooperatives, and worker cooperatives among them. De Bernardi et al. (2025) finds evidence in support of the thesis that both territorial and network embeddedness positively influence the circular economy strategies and adoption of/by cooperatives. This paper shows that the propensity for the adoption of circular economy strategies is higher for cooperatives deeply anchored to territories, a relationship which is measured as the ties cooperatives maintain with local institutions, associations, other cooperatives, schools and the local communities more generally. In line with De Bernardi et al. (2025), it is possible to formulate a third hypothesis, stating that:

- **Hp3:** Worker cooperatives adopt circular economy and bioeconomy when the worker cooperative is embedded within the territory/community in which the company is located; in other words, when worker cooperatives express a concern for the local environment.

We can also assume that the presence and intensity of the social mission is correlated with the degree of embeddedness of worker cooperatives within territories, and vice

versa. However, since this relationship falls outside the scopes of this research, it is then taken for granted.

Following Hp1, Hp2 and Hp3, we discuss how the concern for the environment and the willingness to adopt circular economy and bioeconomy follows a concern for locality which is driven by both the social mission and the embeddedness of worker cooperatives. Also, we consider a precondition to this behaviour the correct functioning of the democratic governance of worker cooperatives. Overall, we argue that embeddedness and proximity, and social mission trigger circular economy and bioeconomy adoption in worker cooperatives. This is also confirmed by Bigi, Lomuscio, and Vieta (2026), which discusses that when workers, together with local stakeholders and solidarity networks, collectively deliberate on production choices, resource use and investments, environmental externalities become internalised within the decision process. Figure 4 shows the relationship among hypotheses and their influence over circular economy and bioeconomy adoption.

It is acknowledged that the literature is limited. A preliminary search carried out in December, 2025, with specific keywords on circular economy, bioeconomy and workers cooperatives, on Scopus, provided limited results as expanded in the methodology section.

3. Methodology

A preliminary semi-systematic literature review was performed, following Snyder (2019). The review aims at bridging the gap between apparently separate research domains, the ones of circular economy, bioeconomy and worker cooperatives. Differently from a systematic one, this review methodology aims at detecting themes, concepts and topics used in the literature rather than quantitatively presenting the state of the art about the subject under investigation (Snyder 2019). This semi-systematic literature review is complemented with a thematic analysis (Thomas and Harden 2008; Vaismoradi, Turunen, and Bondas 2013) in order to extract, develop and expand the still-unclear theoretical contours of CE and BE adoption in the worker cooperative domain.

The first step of this work consists in the semi-systematic literature review. The review was performed by using two different research databases, Web of Science (WoS) and Scopus, through a keyword search. Both databases were initially inquired. However,

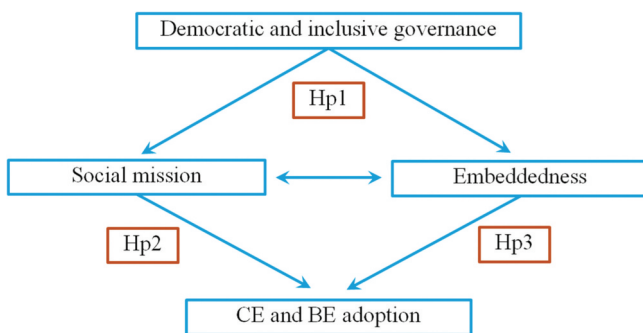


Figure 4. Conceptual map. Source: own production.

while the former returned a sample of 23 papers, the latter only returned one item as the outcome of the search. Given that the sole reported contribution by Scoups was also included in the list of contributions of WoS, the following steps proceed by taking into account only and solely the WoS database.

Figure 5 shows the PRISMA-generated graph reporting the keywords employed and the inclusion/exclusion criteria. The first systematic keyword search provided the direct niche keyword 'worker* co-operative*' but the results ($N=23$) manually reviewed singularly were not focusing on cooperatives or it would be exclusive topics even when the query provided the needed *AND*. Therefore, another search added similar terms related to worker cooperatives and extended the total number for the analysis to $N=28$ (Figure 4). From these two searches, there was one single duplicate, therefore highlighting that there is a keyword challenge.

This keyword challenge is caused by a non-globally standardised understanding of cooperative governance (at a norm level) that leads to inability to accurately compare cooperatives in general and then also by type. In the latter case, occurrences typically refer to studies based on survey data, conducted either at the national level to reduce methodological errors in cross-country comparison or at the sectoral level, where the cooperative form is not differentiated, focusing on firms by size or by only by macro type (ie. cooperative vs private firm) operating in the sector of interest. In the former case, when the analysis is embedded in a literature review, as in this paper, methodological coherence requires that the organisational type be explicitly identified through keyword selection. This can be achieved either by expanding the search strategy with more

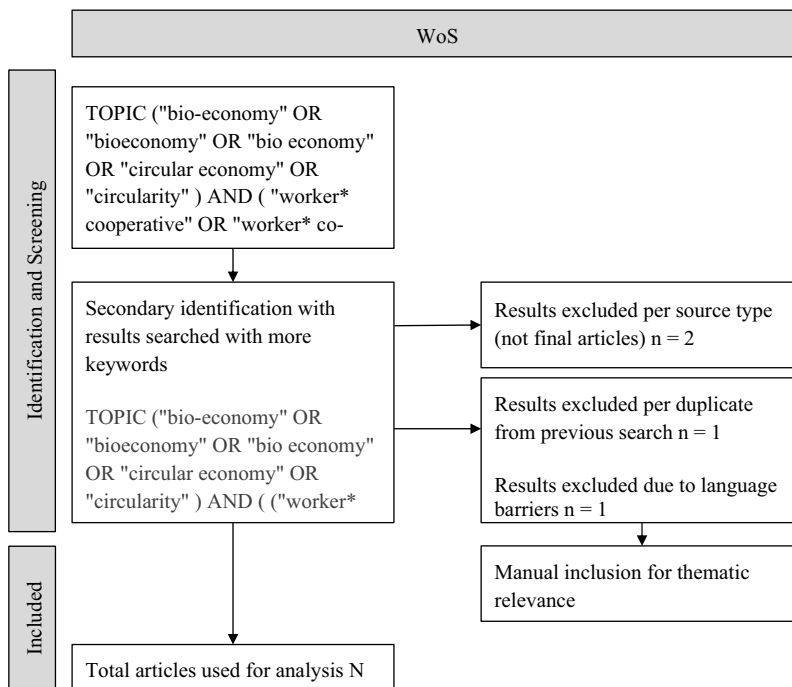


Figure 5. PRISMA-generated graph on database used for analysis downloaded on 15 December, 2025 and 24 December, 2025 from Web of Science (WoS). Source: own production.

granular keywords, as we do here, or by potentially making a deliberate methodological choice to exclude alternative organisational forms by not incorporating additional keywords

An example of this conceptual difference is the not-always clear distinction between producer and worker cooperatives. Depending on the region of the world on which the research is focused, producer cooperatives are treated as either agricultural cooperatives (Bijman & Wijers, 2019) or worker cooperatives, namely producer and worker cooperatives, as in the Italian context (Lomuscio, Tortia, and Cori 2023). Similarly, different legislation impacts the governance of worker cooperatives. For example, in Canada, worker cooperatives adopt a multi-stakeholder governance model, which is, to use another example, more commonly incorporated by social cooperatives in Italy. The very same issue of conceptual slippage also influences the search of definition and keywords of circular economy and bioeconomy which may take alternative forms (ie. under waste management or sectors – as agriculture for bioeconomy) or may be unclear as previous literature presented. Thus, considering these two limitations, we deemed it necessary to tackle keywords as shown in the PRISMA graph.

Following the identification of key research and contributions, a further step in the analysis was taken by proceeding with a thematic analysis (Thomas and Harden 2008; Vaismoradi, Turunen, and Bondas 2013). The methodology consists in in-depth read, search and thematic identification of all contributions emerging from WoS. This step is meant to analyse the themes emerging from the literature in order to provide a novel interpretation of the circular economy and bioeconomy adoption in the worker cooperative domain, a relationship which remains overlooked. Even though the identification of themes was performed inductively, by moving from the textual information in the papers to more defined theoretical concepts, this process was also guided by previous knowledge. By taking into account the scope of the research (see Figure 4 for the conceptual map), the analysis was limited to the identification of the barriers and drivers of circular economy and bioeconomy adoption in worker cooperatives. In other words, the analysis was tailored in order to identify the mechanisms influencing the circular-bioeconomy/worker cooperatives relationship. In addition, the barriers and drivers emerging from the literature were assigned to seven dimensions, thus creating a matrix of information: Technology, Organisation, Network, Economic, Policy, Social and Environmental. These seven dimensions were identified a-priori by the authors on the basis of previous research and readings, and anecdotal evidence.

4. Results

There are clearly three macro groups from the literature provided (1) sectoral; (2) constructs literature review of some kind; and (3) a minority researching social economy only in relation to circular economy. Additionally, the effects of employment are particularly focused within the realm of circular economy as a concept further analysed than bioeconomy or strictly focused on cooperatives. The inter-connection of the two instead aims to understand how they intertwine rather than

Table 2. Barriers and drivers of circular economy in worker cooperatives.

	Barriers	Drivers
Technology	Labour-intense (A12)	Especially for waste valorisation such as refinery biorefineries and anaerobic digestion (A09) Promote the uptake of new technologies (A10; A02) Renewable energy (A28) Green technologies (A28) Protection of knowhow (A29)
Organisation	Lack of internal skills to structure research and development activities (A12) Internal business models elements (A09) Non-member workers (A25) Business as usual (A03) Change management (A28)	Ability to develop locally based circular solutions (A12) Transformative posture (A12) Relying on public incentives (A09) Horizontal relationship (A07) Participative business approach (A07) Controlling the means of production (A03) Democratic management (A18) Democratic governance (A18) Inclusion of marginalised people (A25) Autonomous decision-making process not based on capital ownership (A25) Circularity by design (A25) Certifications (A28)
Network	External business ecosystem (A09) Collaboration with key partners (A09) Weak communication with stakeholders and end-users of the services (A12) Lack of cross-business and cross-industry relations (A22) Inconsistent metrics (A10)	Supply chain integration and strategic partnerships (A09) Geographic proximity can reduce costs (A09) Forming a business cluster (A09) Educate citizen (A08) Robust collaboration between business ecosystems (A02) Expert selection of discarded goods recollected (A12) Building trust in secondary materials and products (A02) Knowledge of institutions and territories (A12) Social capital (A25)
Economic	Required investments, operational costs and risks (A09) Lack the economic resources to set up collaborations with experts (A12) Highly competitive commercial dynamics from for-profit companies and commercial pressure (A03; A12; A25) Strongly subject to competition from new goods in terms of lower costs and consumerist rhetoric (A12) Increasing competition with local organisations (A12) Economic parameters in public tenders (A12) Scaling up (A25)	Making repair and refurbishment economically viable (A02) Public tenders (A12) Create new market opportunities (A08) Cooperatives to bid for services beyond their local areas (A12)
Policy	Conflicting policy incentives (A22) Lack of specific policies (A01) Lack of legislation and government support (A09)	Encourage the use of biomass (A08) Centralized depending on the country (A14) Environmental policy and market demand drive resource-efficient eco-innovations for a circular economy in EU firms (A14) Policies should align with environmental, economic and social principles to ensure the sustainability of the circular bioeconomy (A08; A10) Supportive regulatory framework and institutional support (ie. Italian scenario) (A02; A12; A29)
Social	Social dimension of sustainability is also not always explicitly addressed in CE (A14; A10)	Circular society (A03) Beneficial to socio-ecological communities (A18) Create circular jobs (A28) Salvation of the workforce (A29)
Environment	Eco-effectiveness bound to leakage (A14) Rebound effect (A14)	Workers' concern for the environment (A03)

Note: please find the table connecting papers' ID and references in the [Appendix](#).

Source: own production.

their effects (ie. on employment or implementing actors, such as diverse firm types).

4.1. Barriers and drivers of CE in worker cooperatives

This section discusses the results of the thematic analysis concerning circular economy adoption in worker cooperatives. All themes emerging from the analysis are reported in Table 2 and commented further ahead per dimension and per barriers/drivers.

4.1.1. Technology

4.1.1.1. Barriers. The technological dimension shows barriers related to process intensity and operational complexity. Specifically, circular technologies are described as labour-intensive, particularly in waste valorisation processes (collection, sorting, remanufacturing, etc.) (A12). This indicates that technological solutions, while available, require significant human input and operational effort, which may limit adoption or scalability.

4.1.1.2. Drivers. Drivers in this dimension are associated with technological innovation and energy transition. The literature highlights the promotion of new technologies (A10; A02), the use of renewable energy (A28) and green technologies (A28) as enabling factors. Additionally, protection of know-how (A29) is identified as a driver, suggesting that safeguarding technological knowledge supports long-term engagement with circular technologies.

4.1.2. Organisation

4.1.2.1. Barriers. Organisational barriers mainly concern the organisational inertia of worker cooperatives. On the one hand, there are issues pertaining to the skills of workers and managers. More precisely, these issues relate to the lack of internal skills to structure research and development activities (A12) and the difficulties in managing the change associated with the circular transition (A28). On the other hand, issues related to organisational structure also emerge. A03 also points to persistence of business-as-usual approaches, suggesting that organisational routines of worker cooperatives can limit the adoption of circular economy strategies due to an unwillingness to change. A25 suggests that the presence of non-member workers can weaken the alignment with cooperative governance, cooperative values and circular economy adoption. The potential impact of internal friction and business model elements is highlighted as well (A09).

4.1.2.2. Drivers. Organisational drivers are linked to the alternative governance models and organisational practices of worker cooperatives. A series of themes pertain to the democratic, inclusive and participatory nature of cooperative governance. Strong emphasis is placed on participative and democratic structures, including horizontal relationships (A07), a participative business approach (A07), democratic management and governance (A18) and autonomous decision-making not based on capital ownership (A25). Such a governance structure allows the inclusion of marginalised people (A25), indicating organisational arrangements that structurally embed circular and social objectives. Thanks to this organisational model, worker cooperatives are entitled with

a transformative posture (A12) and are presented as organisations which are circular by design (A25). The ability to develop locally based circular solutions (A12) and the employment of certifications (A28) further drive the adoption of circular economy solutions in worker cooperatives.

4.1.3. Network

4.1.3.1. Barriers. Network-related barriers reflect weaknesses in inter-organisational interactions and coordination. The literature emphasises the existence of barriers connected to lack of collaborations with key partners (A09), the communication with stakeholders and end-users (A12) and a lack of cross-business and cross-industry relations (A22), including problems connected to inconsistent metrics among stakeholders and actors (A10). Overall, the themes emerging from the literature suggest that worker cooperatives are positioned in fragmented networks where collaboration, communication and common evaluation frameworks are insufficiently developed.

4.1.3.2. Drivers. Drivers in this dimension emphasise embeddedness within ecosystems. Key enabling factors include supply chain integration and strategic partnerships (A09), geographical proximity (A09) and forming business clusters (A09). These themes suggest that agglomeration effects may be in place, allowing worker cooperatives to grasp spillover effects, enhanced communication and knowledge sharing, and local collective competition goods. In addition, the literature suggests that proximity can have a beneficial impact on cost reduction for the adoption of CE solutions (A09). Beside locality and proximity, the literature also suggests the presence of positive network effects, among which robust collaboration between business ecosystems (A02), trust in secondary materials and products (A02), knowledge of institutions and territories (A12) and the presence of social capital (A25). This second group of drivers are much more related to the social capital endowment of territories and regions, which consequently affect trust among stakeholders, knowledge sharing and reciprocity.

4.1.4. Economic

4.1.4.1. Barriers. Economic barriers are primarily associated with financial constraints and competitive pressure. Strong competition from for-profit companies, combined with lower costs of new goods and consumerist rhetoric, is repeatedly mentioned (A03; A12; A25). The literature identifies required investments, operational costs and risks (A09), alongside a lack of economic resources to collaborate with experts (A12) as further barriers. Economic barriers also arise in public procurement, where economic parameters dominate public tenders (A12), thus lowering the returns on investments and increasing the competition among economic actors. Also, the importance of economic parameters in public procurement generates competition and, potentially, friction with local organisations (A12). Among the barriers to CE adoption, the literature also emphasises the well-known issue of scaling up (A25), which affects worker cooperatives but also cooperatives more generally.

4.1.4.2. Drivers. While public procurement presents traps and barriers to the adoption of CE strategies, they also have positive implications. The requirement and the

competition linked with public tenders trigger circular economy adoption in worker cooperatives (A12). Public tenders are also identified as drivers when they allow organisations to operate beyond local boundaries, as in the case of cooperatives bidding for services beyond their local areas (A12). In general, circular activities are described as enabling new market opportunities (A08) and making repair and refurbishment economically viable (A02).

4.1.5. Policy

4.1.5.1. Barriers. The themes emerging from the analysis suggest that policy barriers stem from misalignment, absence or fragmentation of regulatory frameworks. More precisely, the literature reports conflicting policy incentives (A22), a lack of specific policies (A01), and lack of legislation and government support (A09) as key policy barriers that limit the circular economy adoption of worker cooperatives.

4.1.5.2. Drivers. The literature and the theme emerging regarding both barriers and drivers are partially contrasting. Notwithstanding the barriers identified, the presence of a supportive regulatory framework and institutional support, such as in the Italian context, is explicitly mentioned as a core driver of circular economy adoption for worker cooperatives (A02; A12; A29). This is mostly due to the fact that environmental policy and market demand drive resource-efficient eco-innovations, particularly in the EU region (A14). Potentially, the discrepancies in views concerning the role of policies in generating barriers and drivers could be connected to different actions or misalignments in the adoption of specific pieces of legislation.

4.1.6. Social

4.1.6.1. Barriers. The literature emphasises that the social dimension of sustainability is not always explicitly addressed in circular economy approaches (A10; A14), indicating a gap between circular practices and social objectives.

4.1.6.2. Drivers. From the side of the drivers, the social dimension is much more present and valued within the reviewed literature. Social drivers are associated with positive outcomes of circular initiatives and the social benefits act as motivating and legitimising factors for circular economy adoption. Among the drivers, the literature puts those initiatives aimed at creating and preserving good-quality jobs, a characteristic well recognised in the literature on worker cooperatives. The operations of worker cooperatives in the circular domain are considered beneficial for socio-ecological communities (A18), and they create circular jobs (A28) and preserve the workforce of companies in distress (A29).

4.1.7. Environment

4.1.7.1. Barriers. Among the barriers, the literature suggests that eco-innovation and eco-effectiveness can lead to leakage and the rebound effects (A14), suggesting that environmental gains from circular economy adoption may be partially offset or undermined by an expansion of production or by the increase of pollution/consumption of competitors.

Table 3. Barriers and drivers of BE in worker cooperatives.

	Barriers	Drivers
Technology	bioeconomy relies heavily on techno-scientific solutions (A14)	Especially for waste valorisation such as refinery biorefineries and anaerobic digestion (A09) Promote the uptake of new technologies (A10)
Organisation	Internal business models elements (A09)	Standard-setting (A14) Relying on public incentives (A09)
Network	External business ecosystem (A09) Collaboration with key partners (A09) Lack of cross-business and cross-industry relations (A22) Inconsistent metrics (A10)	Collaboration between supply chain partners (A09) Supply chain integration and strategic partnerships (A09) Geographic proximity can reduce costs (A09) Forming a business cluster (A09) Educate citizen (A08)
Economic	Required investments, operational costs and risks (A09) Less economically competitive (A14) Related to economic interests and not primarily sustainability concerns (A14) Potential impact on food prices (A11)	Financial incentives (A14) Create new market opportunities (A08)
Policy	Conflicting policy incentives (A22) Legislation and government support (A09)	Encourage the use of biomass (A08) Centralized depending on the country (A14) Policy, regulatory and legislative frameworks (A02) Policies should be developed to establish legal frameworks in line with environmental, economic and social principles to ensure the sustainability of the circular bioeconomy (A08)
Social	///	///
Environment	Key issues are the sustainability of biomass sourcing and the value of biomass uses (and competition) (A10; A11; A14)	///

Note: please find the table connecting papers' ID and references in the [Appendix](#).

Source: own production

4.1.7.2. Drivers. Among the environmental drivers, workers' concern for the environment is identified as crucial (A03), indicating that environmental values at the workforce level support engagement in circular economy practices.

4.2. Barriers and drivers of BE in worker cooperatives

This section discusses the results of the thematic analysis concerning bioeconomy adoption in worker cooperatives. All themes emerging from the analysis are reported in [Table 3](#) and commented further ahead per dimension and per barriers/drivers.

4.2.1. Technology

4.2.1.1. Barriers. The literature explicitly states that bioeconomy relies heavily on techno-scientific solutions (A14). This suggests that technological development is central but also potentially constraining, as it concentrates bioeconomy efforts around specific, technically complex pathways.

4.2.1.2. Drivers. The promotion of the uptake of new technologies is explicitly identified as a driver (A10), indicating that policies or strategies encouraging technological deployment play an enabling role in advancing bioeconomy solutions. This is particularly

valid in the case of waste valorisation processes such as refinery, biorefineries and anaerobic digestion (A09).

4.2.2. Organisation

4.2.2.1. Barriers. A09 points to internal business model elements as a barrier, suggesting that existing organisational configurations may not be fully aligned with bioeconomy solutions.

4.2.2.2. Drivers. The presence of standard-setting (A14) is identified as a driver, indicating that shared organisational or sectoral standards can support alignment and comparability. Also, the fact that worker cooperatives operate in BE sectors relying on public incentives is considered a driver (A09).

4.2.3. Network

4.2.3.1. Barriers. Similarly to the context of circular economy, even in the case of bioeconomy, network-related barriers reflect structural fragmentation and lack of coordination. The reviewed research reports a lack of cross-business and cross-industry relations (A22), a lack of collaboration with key partners (A09) and with the external business ecosystem (A09), alongside inconsistent metrics (A10), indicating difficulties in establishing coherent, standardised collaboration across sectors.

4.2.3.2. Drivers. Drivers within the network dimension strongly emphasise supply chain integration and embeddedness. Multiple forms of supply chain integration are identified, including collaboration between supply chain partners (A09). Additional drivers include forming business clusters (A09) and geographic proximity for cost reduction (A09), indicating the importance of spatial and relational embeddedness.

4.2.4. Economic

4.2.4.1. Barriers. Economic barriers are associated with required investments, operational costs and risks (A09) among the major constraints. Bioeconomy activities are also described as less economically competitive (A14) and as being related to economic interests rather than primarily sustainability concerns (A14). Furthermore, a potential impact on food prices is highlighted (A11), indicating economic trade-offs linked to biomass use.

4.2.4.2. Drivers. The presence of financial incentives (A14) is explicitly identified as enabling bioeconomy in worker cooperatives. Additionally, the capacity to create new market opportunities (A08) is highlighted, suggesting that economic viability can be enhanced through the development of new or alternative markets for bio-based products and services.

4.2.5. Policy

4.2.5.1. Barriers. Among the policy barriers, the reviewed literature reports conflicting policy incentives (A22) and a lack of legislation and government support (A09).

4.2.5.2. Drivers. Policy drivers, instead, focus on the alignment of regulatory frameworks. Encouraging the use of biomass is identified as a policy driver (A08). More broadly, policy, regulatory and legislative frameworks are highlighted as enabling factors (A02).

4.2.6. Social

No social barriers and drivers are explicitly identified in the literature.

4.2.7. Environment

4.2.7.1. Barriers. Environmental barriers for bioeconomy adoption in worker cooperatives are framed around biomass sustainability and competing uses. Key issues concern the sustainability of biomass sourcing and the value and competition of biomass uses (A10; A11; A14), indicating constraints linked to resource availability and trade-offs between alternative biomass applications.

4.2.7.2. Drivers. No environmental drivers are reported in the bioeconomy literature analysed.

5. Conclusion

This paper examined whether and how the organisational architecture of worker cooperatives shapes the adoption of circular economy and bioeconomy strategies, with a focus on the drivers and barriers emerging from the peer-reviewed literature. Based on a semi-systematic review of 28 studies retrieved from WoS and an inductive thematic analysis, we systematised evidence across seven dimensions (technology, organisation, network, economic, policy, social, environmental) and mapped the indicators used to operationalise circular-bioeconomy innovation.

The main results show that cooperatives (and workers cooperatives in particular) such as more social topics remain lateral to these macro topics generally more focused on environmental practices. Contrary to circular economy that provides somewhat a debate on its impact on social topics, such as horizontal participation, bioeconomy evidence is thinner and less explicitly tied to cooperative governance or related topics (ie. governance).

Discussion of the theoretical background in relation to results:

Hp1: the circular economy results provide empirical alignment with this hypothesis. The thematic analysis reveals that, among the organisational drivers, democratic governance, participative business approaches, horizontal relationships and autonomous decision-making are well established in the literature. By contrast, bioeconomy results offer weaker support for Hp1. The organisational dimension in bioeconomy does not explicitly review democratic governance as a driver.

Hp2: The circular economy findings offer support of this hypothesis. Circular economy adoption is associated with long-term organisational strategies, such as investment in skills and education, employment stability and job quality. However, the presence of significant economic barriers, such as high investment costs, competitive pressure and difficulties in scaling up, indicates that short- and long-term goals, including social ones, should be adequately balanced – a tough coordination task. Circular economy adoption

appears compatible with workers' long-term interests, but only when short-term risks are mitigated, for example, through policy interventions. In the bioeconomy case, support for Hp2 is more ambivalent. While financial incentives and new market opportunities are identified as drivers, bioeconomy activities are also described as less economically competitive and primarily driven by economic interests rather than sustainability concerns. Moreover, potential impacts on food prices and the heavy reliance on technoscientific solutions suggest trade-offs that may complicate the alignment between bioeconomy adoption and workers' long-term interests.

Hp3: This hypothesis is supported in both empirical domains, though with different emphases. In circular economy references, network drivers consistently stress geographic proximity, supply chain integration, business clusters, social capital and knowledge of local institutions as key drivers of circular economy adoption in worker cooperatives. These findings closely reflect the theoretical argument that embeddedness internalises environmental externalities through collective deliberation and proximity-based coordination, making circular economy adoption in worker cooperatives relational and place-based. The results from the thematic analysis of bioeconomy barriers and drivers goes in a similar fashion. Bioeconomy adoption is associated with network drivers such as supply chain collaboration, clustering and agglomerations, with an emphasis on supply chain integration rather than social capital endowments.

The implications of circular-bioeconomy are not within the presence of studies that clearly lacks, rather the absence that demonstrates that the focus is in the strategy implementation, which is relevant, but not on who or what may aid in its implementation if not general (ie. SMEs or firms in general). Therefore, this perspective overlooks issues of inclusion and governance, including who makes decisions and how decisions are taken, thereby weakening the potential 'watchdog' role. Yet, it is precisely inclusive decision-making processes that can frame circular-bioeconomy strategies in a way that preserves their sustainability over time, as participatory governance enables internal oversight and collective accountability. The hypothesis is that participatory governance can provide stronger accountability useful to tackle EU policies, but cooperative methods that can further reinforce needed connections to efficiently implement circular-bioeconomy strategies.

6. Limitations

Despite the relevance of the topic and the contribution of organising a fragmented field, this study has several limitations that should be considered when interpreting the findings.

The empirical corpus on circular-bioeconomy adoption in worker cooperatives is still small, which constrains the breadth of inference. Moreover, the evidence is uneven: circular economy -related discussions and cases are more frequent and better articulated than bioeconomy-related ones, which makes cross-domain comparisons asymmetric and inevitably gives circular economy greater analytical weight.

Many contributions that mention 'cooperatives' do not distinguish worker cooperatives from producer, social, multi-stakeholder or community cooperatives, and this affects internal validity. In addition, even when worker cooperatives are explicitly referenced, the literature rarely measures how democratic governance functions (e.g.

participation intensity, member control, internal accountability and presence of non-member workers). As a result, the analysis cannot robustly separate ‘cooperative form on paper’ from ‘cooperative functioning in practice’, including degeneration or hybridisation patterns.

The review is sensitive to terminology. Both the cooperative domain (worker/producer/employee-owned/WBO (workers’ buyout)/recuperated enterprise) and the circular-bioeconomy domain (reuse/repair/waste management/industrial symbiosis/biomass valorisation) suffer from multiple labels used inconsistently across countries, disciplines and journals. This creates a risk of missing relevant studies that address the phenomenon but do not employ the chosen keywords, and of including studies that use similar terms while referring to different organisational realities

It is additionally acknowledged that this limitation is caused by a framed terminology-use consequence to avoid spillovers from topics that were not directly of interest. As previously mentioned, there is a growing, but yet limited understanding of cooperatives’ (generally) implementation of circular economy, even less for bioeconomy. Hence, it is quite a risk to speak of workers, however, deemed it needed considering the relevance of this governance structure. The underlying assumption is that a higher democratic implementation can support a more efficient implementation of environmental strategies such as circular-bioeconomy or even a larger cooperation among firms who will have to transition due to policy pressures – at least in the EU. Other examples as those in the US or developing countries – two opposing mentions – which might be defined differently can be provided with more directed case study to include other types (or terms) such as the employee stock ownership plans (ESOPs) where workers are direct firm owners via tax-advantaged defined contribution plan. Additionally, other research aims to identify if political interest to contribute within a firm equals to political actions outside of the same. Authors such as Jungook Kim (2024, 2021) demonstrate that in the US scenario this appears true, while framed to only particular political activities including larger interest in environmental and corporate responsibility actions.¹

The evidence is drawn from a limited set of indexed peer-reviewed articles (Scopus or WoS-centric), which may under-represent relevant work published in books, practitioner outlets, cooperative-sector reports, policy evaluations and non-English sources – often important and more available in cooperative research. This may lead to publication bias and an incomplete picture of real-world practices. Furthermore, the reviewed studies span different legal frameworks, sectoral structures and institutional environments. Cooperative law, procurement rules and labour-market institutions vary substantially across countries and can shape both drivers and barriers. Aggregating results into common ‘dimensions’ is analytically useful, but it cannot fully resolve context dependence; the same driver (e.g. public procurement) can be enabled in one setting and constrained in another depending on design and enforcement.

The thematic analysis is well suited to early-stage fields, but it remains interpretive. Coding decisions, category boundaries and the assignment of drivers/barriers to dimensions entail judgement. In addition, the themes do not establish causal effects: the review identifies reported mechanisms and recurring explanations, but it cannot adjudicate which factors dominate once confounders and interactions are considered. The key limitation, also central to this contribution, is that the literature often treats labour outcomes indirectly (e.g. ‘job creation’ and ‘inclusion’) without consistent metrics (job quality, wages, skill

upgrading, participation, stability, health and safety). This reduces the ability to link circular-bioeconomy adoption to the worker-cooperative mission in a measurable way and may bias the discussion toward technological and supply-chain issues.

The bioeconomy-related findings are relatively thin and often framed through techno-scientific pathways, value-chain competitiveness or biomass sourcing trade-offs, with limited attention to cooperative governance mechanisms. Consequently, conclusions regarding bioeconomy (and the circular-bioeconomy) are more tentative and should be read as hypotheses-generating rather than definitive. Given the semi-systematic design and the heterogeneity of methods, the review does not provide a formal quality appraisal (risk of bias) nor quantitative synthesis. This limits the capacity to weigh evidence by methodological robustness and to compare magnitudes of barriers/drivers across studies.

Note

1. In particular, Kim (2024) uses latent class analysis to demonstrate that employees engaged in participatory work environments show higher levels of civic participation (e.g. voting and community involvement). These results provide empirical backing for spillover theory within employee ownership frameworks.

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Appendix

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A03	Bellemare, M.-F., Martin-Déry, S., Ziegler, R., Vezina, M., Raufflet, E., & Walsh, A. (2022). Synergizing Social Economy and Circular Economy. <i>Canadian Journal of Nonprofit and Social Economy Research</i> , 13(1), 1–5. https://doi.org/10.29173/cjnser591 .
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Note: references listed following the progressive number of the ID. A13 discarded following the inclusion/exclusion criteria listed in [Figure 4](#).