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Barriers to Circular bioeconomy transitions in the agri-food waste system

Clément Jacquet ^{*†}, Tiago Teixeira Da Silva Siqueira ^{* ‡ 1}

¹ Département Environnements et Sociétés – CIRAD, UMR SELMET, F-34398 Montpellier. – France

Barriers to Circular bioeconomy transitions in the agri-food waste system The case of Reunion island

Jacquet C. a b, Siqueira T.T.S.a b

a CIRAD, UMR SELMET, F-97410 Saint-Pierre, Reunion, France

b SELMET, Univ Montpellier, CIRAD, INRAE, Institut Agro, Montpellier, France

1- Introduction

Circular bioeconomy (CBE) is attracting increasing attention from public authorities and private stakeholders as a way to drive sustainable transitions in agri-food-waste systems (AFWS). Previous studies have identified various barriers to the development of a CBE including technological, cultural, political and organizational (Kirchherr et al., 2018). These barriers have primarily been studied at the scale of industrial sectors valorizing bio-based products (Chrispim et al., 2024; Neves and Marques, 2022). However, very few studies have examined the mechanisms of barriers and lock-ins underlying transitions through a CBE in AFWS (Chhetri et al., 2010; Magrini et al., 2016; Meynard et al., 2018). To address this gap, we sought to identify the barriers encountered in the development of CBE initiatives within the AFWS of Reunion Island.

2- Methods

To this end, a comprehensive approach was employed to identify barriers hindering the development of CBE initiatives. A stakeholder mapping exercise, 44 semi-structured interviews, and a participatory workshop involving 30 AFWS stakeholders were conducted. For each initiative, barriers were identified and then grouped into different categories commonly found in the literature: technical, environmental, economic or organizational commonly found in the literature.

3- Results

Among the 38 identified CBE initiatives, organizational barriers related with governance issues

*Speaker

†Corresponding author: clement.jacquet@cirad.fr

‡Corresponding author: tiago.teixeira_da_silva_siqueira@cirad.fr

emerge as the primary challenge, surpassing technical, environmental, or economic barriers. The most frequently cited barriers include: i) a low degree of participation in collective actions (e.g., consumer awareness campaigns); ii) administrative burden; iii) tensions in actor dialogues; iv) inadequate regulations (e.g., ICPE(1) standards); v) difficulties in accessing financing; and vi) an increased workload associated with innovation development.

Initiatives requiring strong coordination among stakeholders, such as the development of fodder banks, composting platforms, or anaerobic digestion units, face significant challenges in fostering collective action. These difficulties are often rooted in a lack of trust between stakeholders, fueled by historical tensions or constraints associated with transitioning to new organizational models. Tensions are particularly pronounced in innovations aimed at substituting imported materials, such as peat alternatives, which place additional pressure on access to local biomass. Furthermore, projects using biomass frequently encounter regulatory constraints like in the composting initiatives. The absence of an institutional framework for certain innovative processes also results in additional administrative burdens, prolonging implementation timelines by several years and sometimes leading to project abandonment. Finally, the development of certain innovations imposes additional workloads, particularly on farmers. This includes the time required to manage the logistics of collective composting platforms or oversized projects relative to available human resources, such as those in territorial food projects.

4- Discussion and Conclusion

The study conducted by Mehmood et al. (2021) identified several barriers to the development of a CBE in agriculture, echoing our findings by highlighting a marked prevalence of institutional barriers. These include both the rigidity of regulatory frameworks, which hinder the adoption of new practices, and a lack of institutional support for project leaders driving innovation. Such institutional constraints reflect the inability of current systems to adapt swiftly to the specific needs of circular initiatives, often discouraging initiative leaders. Economic constraints identified by these authors are also reflected in our observations, particularly the high initial investment costs, which remain a significant barrier given the uncertainty surrounding their profitability and long-term payback. This underscores the need for improved access to tailored financing and economic support mechanisms to facilitate the transition. Michel et al. (2022), on their study about market gardening systems in Provence, also highlights similar challenges, emphasizing the central role of collective dynamics. These systems, while potentially rich in innovation, are often hindered by a lack of coordination among stakeholders and interpersonal tensions. Such tensions, whether arising from historical conflicts or divergent interests, undermine the ability of actors to collaborate effectively and achieve shared objectives. Similarly, Meynard et al. (2013) demonstrated that initiatives aimed at diversifying agricultural crops in France face comparable barriers. Inadequate public policies and the absence of suitable regulatory frameworks are recurring barriers that limit the implementation of CBE innovations, as corroborated by Martínez-Moreno et al. (2024).

These convergences between our findings and existing studies reinforce the relevance of our analysis by showing that the barriers identified are not specific to a particular context. Instead, they reveal common challenges deeply rooted in institutional, economic, and social structures that hinder the transition to circular agricultural practices. This highlights the critical need for structural reforms, including adapted regulatory frameworks, incentivizing public policies, and robust financing mechanisms, to enable CBE practices to establish themselves sustainably within AFWSs.

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