Exploring Diverse Practices in Sugarcane Straw Management: A Case Study in Réunion Island

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1.Introduction

Sugar cane (*Saccharum officinarum*) on Réunion, a volcanic island in the Indian Ocean, is considered "one of the main pillars of the island's agricultural economy" (MAA, 2021). Sugarcane-growing areas account for 55% of the useful agricultural area, with a diversity of cane-growing systems linked to the soil and climate context, with over 200 microclimates (Augier et al., 2021), and to the island's agricultural history marked by this crop (Jarousseau, 2014). In addition to this diversity of cane-growing systems, there are currently major constraints weighing on the way they operate: the scarcity of labor, rising fertilizer costs and land saturation (Ulysse, 2017). All these factors force growers to continually adapt their practices, questioning their ability to maintain satisfactory yields and the short-term viability of their farms (Shili-Touzi et al., 2023).

One possible response to this context of reducing authorized phytosanitary molecules is to use cane straw as an agroecological lever for weed control and soil fertilization (Rasche, 2019). However, sugarcane straw is in tension with other uses: it is a resource used to produce biofuels and bioenergy (Cabral et al., 2020) as well as for livestock in the form of bedding and/or fodder (Augier et al., 2021). Thus, its export from the plot for various uses could pose certain risks.
The aim of the study is to identify the diversity of practices carried out by the growers themselves, by analyzing straw production and export strategies in response to the agronomic, environmental, energy and socio-economic issues surrounding sugarcane.

2. Methodology

The objective of the field phase was to comprehensively explore cane straw management practices from the growers' perspectives, considering the complexity of the sugarcane context and the multifaceted issues surrounding the straw resource. To achieve this, various scales of analysis were employed: i) the plot level, focusing on the technical itinerary of cane cultivation; ii) the farm level; and iii) the networks of stakeholders associated with the farm. The methodological approach relied on semi-structured interviews, with surveys conducted among 128 growers between May and June 2023, across 6 areas of the island characterized by different straw management contexts (Figure 1). The interview protocol was structured around four main themes, with an average duration of 2 hours: i) introduction to the farm and the grower; ii) exploration of the sugarcane technical itinerary; iii) investigation of straw management practices and exportation; and iv) an open-ended section covering broader topics unrelated to straw. Prior to the study, a survey sample was constructed based on analysis of existing literature and the identification of three key factors: i) the size of the sugarcane cultivation area on farms, categorized as [< 5 ha], [5-20 ha], and [> 20 ha]; ii) the type of cutting method employed, classified as [pei cutter], [sliced cut], or [manual]; and iii) the farm's operational workshops, categorized into three groups: [diversification into market gardening or arboriculture], [presence of livestock], and [100% sugarcane farm]. The results presented are given in terms of response occurrence.

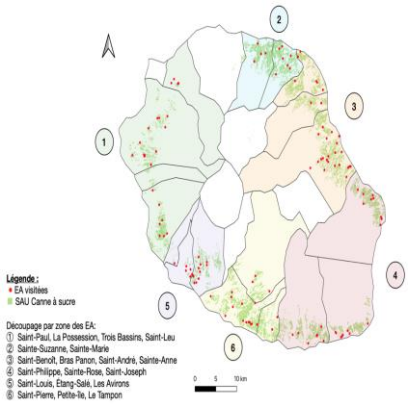

Figure 1: Réunion Island divided into study zones

3. Results

Several factors influence straw production, including the choice of sugarcane variety. Three varieties, R585, R586, and R577, have been identified as the most productive in terms of straw yield, accounting for 30%, 26%, and 12%, respectively, according to farmers' statements. Secondly, climate and rainfall variations are cited by 36% of farmers as significant factors influencing this production. Additionally, 10.8% of farmers mentioned other factors that could also influence straw production, such as soil type, slope, altitude, irrigation, or geographical location.

In terms of beneficial roles, weed control is highlighted by the majority of growers (94%), resonating with the current context of reduced herbicide availability in Réunion. Next, there is a considerable interest in using straw for organic soil amendment (52%). The significant number of growers mentioning this interest could be attributed

to the increasing prices of chemical fertilizers, leading to a desire to retain maximum organic matter in the soil. Finally, soil moisture retention is mentioned by 49% of farmers, with this benefit of straw more frequently cited in areas with lower rainfall (West). However, 7% of growers mentioned disadvantages of leaving straw in the field, such as stump rotting and an increase in the presence of pests. Additionally, the presence of a substantial layer of straw could hinder the effectiveness of herbicides by acting as a buffer, especially for pre-emergence applications.

These benefits are correlated with either retaining or exporting straw from the plot. The results indicate that exporting straw from the plot (for 57% of farmers) diminishes agronomic benefits in favor of economic and social considerations, especially when the export is destined for livestock. It was observed that most exports, both within and outside the farm, are largely utilized for livestock purposes (87.9% and 98.3% of exports respectively).

Among the 74 farmers involved in exporting, 31% export in round bales, 57% export in bulk, and 12% export both in bulk and in round bales. Generally, it can be observed that when referring to round bales, this is more associated with larger farms (cane surface > 40 ha) and therefore larger quantities of straw to export. On the other hand, when referring to bulk, this typically involves smaller farms (cane surface < 10 ha) with smaller quantities of straw to export, which are more associated with assisting livestock farmers and neighbors through outreach efforts.

4. Discussion

The study aimed to identify the diversity of cane straw management practices among growers, considering various factors such as livestock presence, cutting methods, replanting choices, and weed constraints. Geographical location also played a significant role in straw management, influencing technical strategies due to factors like slope, climate, and proximity to livestock. Interestingly, the presence of horticultural or orchard workshops did not significantly affect straw export, as some farmers preferred not to use straw due to concerns about weed seeds. While diversity in straw export practices was observed, limited variation in on-field straw management. Nonetheless, straw as a resource was highly valued in agriculture for its roles in mulching, fodder, and bedding.
From an agronomic perspective, literature suggests that mulching induces physicochemical changes within sugarcane systems that affect weed development. Studies indicate that straw cover reduces weed survival rates due to limited seed reserves, influences germination processes, and lowers weed emergence frequency, consequently reducing labor for weed control. Additionally, straw cover enhances soil moisture, organic content, microbial presence, and fertility while reducing nitrogen fertilizer requirements.

Moreover, straw cover affects soil temperature regulation and evaporation rates (Corrêa et al., 2019). It also increases water retention capacity and soil moisture levels (Corrêa et al., 2019, Gmach et al., 2019, Santos et al., 2021). However, straw cover may create a conducive environment for pests, although it also attracts predator species that help control pest populations (Souza, 2010). The effects reported by growers align with literature findings, particularly regarding weed suppression, organic matter enrichment, soil moisture retention, and pest presence.

Sugarcane producers raised numerous concerns regarding the sugarcane industry and their management of sugarcane straw in the future. They unanimously agree that straw is a resource to be maximally valorized according to the challenges they face. They recognize the pivotal role of straw in field management and endeavor to conduct their own trials to tailor practices to their specific pedoclimatic conditions.

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