Circular economy in the olive oil value chain: assessment of by-product generation in the main olive-growing area of Argentina, San Juan

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INTRODUCTION

The **Argentine olive-growing chain** has great potential to adopt sustainable practices through the **valorization of by-products**: olive pomace (alperujo) and olive pruning residues.

Olive pomace, due to its high organic load and phenolic content, represents an environmental challenge that requires proper treatment. Different technologies make it possible to valorize it by generating new commercially relevant products as nutrients and bioactive compounds with significant added value.

Olive pruning residues could be valorized as a renewable energy source at the local scale or through a composting process to obtain organic amendments, among other technological options.

MATERIALS AND METHODS

To survey the amount of fruit milled from 2022 to 2025 the interview methodology was used. Based on those data, factor of 0.8 and 0.5 were applied to estimate the amount of olive pomace generated and pruning residues, respectively, in each location.
Thematic cartography was prepared to represent the geographic distribution of the industry plants where these materials are generated and the main road networks, aspects of importance when proposing different scenarios for their valorization. The location of each industry was represented by a point symbol graduated according to the average value in tons of the variable considered, olive pomace and olive pruning.

RESULTS

By-products Generation

Olive pomace

Analysis of **olive pomace generation between the 2022 and 2025** campaigns indicates that most industrial plants maintained relatively stable production, with low interannual variability. Some plants, however, exhibited fluctuations exceeding 30% data variability, which do not appear to follow a defined pattern and are likely associated with changes in processing capacity or with the inflow of olives from other production areas (**Figure 1**).

As can be seen in **Figure 2**, the total amount of olive pomace generated during the **last four years** showed **minimum** values of **57,600 tons** in 2022 and **maximum** values of **87,440 tons** in 2023, with intermediate values in the following two years.

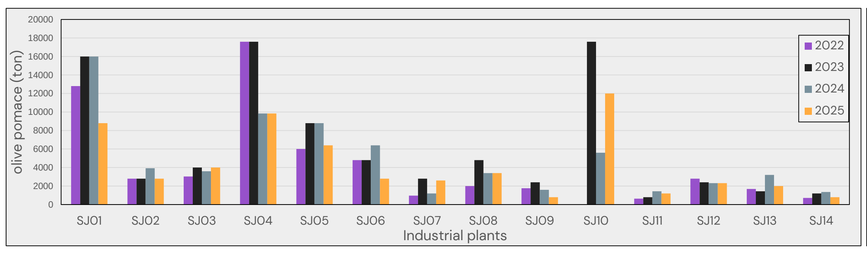

Figure 1. Olive pomace generation by industrial plant in the Sarmiento olive-growing zone during the 2022–2025 campaigns. The figure shows the annual production of olive pomace (in tons) disaggregated by industrial plant. Most facilities display relatively stable production levels with low interannual variability. However, some plants, such as SJO1, SJO4, and SJ10, exhibit fluctuations exceeding 30% data variability. These differences are likely related to changes in processing capacity or to the inflow of fruit from other olive-producing regions.

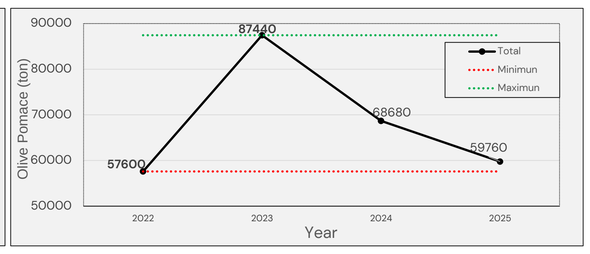

Figure 2. Total annual olive pomace generated by olive oil processing plants **in the area between 2022-2005.** Black dots represent total annual production, while the red and green dotted lines indicate the minimum and maximum values estimated across the plants, respectively.

Olive pruning residues

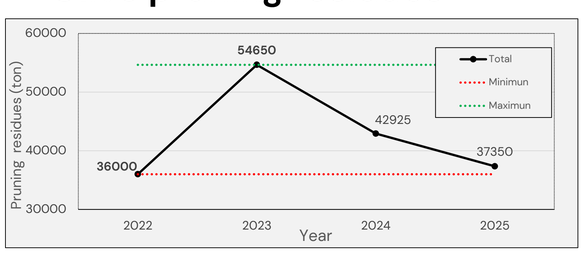

Figure 3. Olive pruning residues in Sarmiento, San Juan. The black line represents total values, while the red and green dotted lines indicate minimum and maximum values, respectively.

Figure 3 shows that the total amount of **olive pruning residues generated** by the olive oil sector in Sarmiento over the last four years ranged from a **minimum** of **36,000 tons** in 2022 to a **maximum** of **54,650 tons** in 2023, with intermediate values recorded in the subsequent years.

57,600-87,440
Minimun and Maximun
Tons of
OLIVE POMACE

36,000-54,650
Minimun and Maximun
Tons of
PRUNING RESIDUES

Geographic Distribution Mapping

Industry Mapping
The location of each industrial plant is represented by graduated point symbols according to the **average production** (in tons) of olive pomace and pruning residues.

Infrastructure Analysis.
The main road networks were mapped to evaluate logistical aspects of valorization scenarios and collection efficiency.

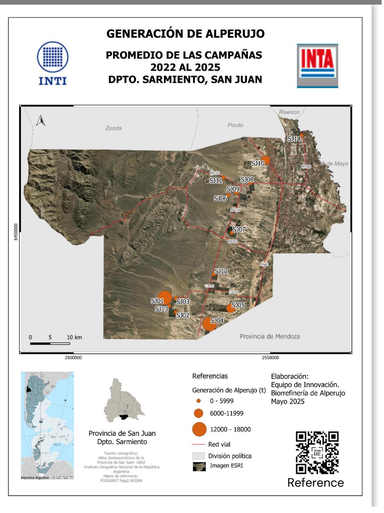

Figure 4. Olive pomace generation **average**, 2022-2025 campaigns.

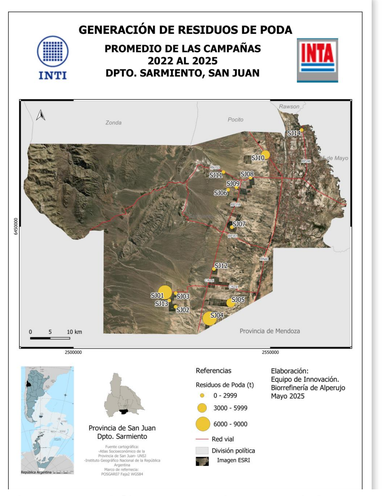

Figure 5. Olive pruning residues average, 2022-2025 campaigns.

Figures 4 and 5 show the **average values of olive pomace** and **pruning residues generation** between 2022-2025 campaigns, respectively, by industrial plants, georeferenced and mapped within an olive-growing area of the Sarmiento Department, San Juan Province. The **14 industrial plants** are located along approximately **70 km of road**, where a **remarkably high volume of secondary olive by-products** is **generated**. This spatial concentration of production, combined with the magnitude and relative stability of olive pomace and pruning residues outputs, and the presence of connecting road networks, represents a key advantage for advancing the implementation of integrated olive oil by-product valorization processes.

CONCLUSIONS

The **olive-growing area of the Sarmiento Department, San Juan Province** generates a **significant** and **stable volume of by-products** during the **last four years,** from **57,600** to **87,440 tons of olive pomace** and from **36,000** to **54,650 tons of pruning residues**. The high and relatively consistent production levels of these secondary materials, that are generated in **14 plants** located along approximately **70 km of road** constitute a significant **opportunity** for their **valorization.** The **georeferenced data** of these materials, together with the **existing road network connecting the industrial plants**, provide **essential inputs** for **developing technological and feasible solutions regionally** adapted.

These factors create **favorable conditions** for **add value to the national olive-growing chain**, implementing circular economy models that **transforming biomass** into **viable and profitable business. Biomass valorization models** create lasting **environmental** and **economic benefits,** fostering **technological innovation** and **strengthening regional economies**.

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