# Case for Responsible Use of Agricultural Biomass Feedstocks in PLA Production.

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## Introduction

Plastic pollution and climate change have intensified the search for sustainable alternatives to petrochemical plastics. Polylactic acid (PLA) has emerged as a leading plant-based plastic, used in packaging, consumer goods, medical applications, 3D printing, and more due to its renewable origins, compostability, and functionality. PLA is typically produced by fermenting sugars into lactic acid, which is polymerized into plastic.

Crucially, the source of those fermentable sugars has become a topic of debate: should we use food-related crops (agricultural biomass) or alternative feedstocks such as waste and residues? Using agricultural biomass feedstocks for PLA can be done responsibly and can yield multiple benefits, from lower greenhouse gas emissions to agricultural resilience.

## Efficient Agricultural Biomass for Bioplastics:

Agricultural biomass feedstocks like corn, sugarcane, and sugar beet are currently the most efficient sources of fermentable sugars for bioplastics such as polylactic acid (PLA). They offer high yields per hectare and require minimal land relative to output [1], making them a practical choice for scaling bio-based plastics production.

Crops such as sugarcane, sugar beet, and corn provide some of the highest carbohydrate yields per hectare globally, supported by long-term agricultural optimization. According to European Bioplastics [1], these feedstocks require only a fraction of global agricultural land to supply today's bioplastics production. Their integration into existing farming, milling, and logistics systems also enables rapid industrial scalability without new infrastructure demands. Data from USDA/FAS crop statistics [9] and NatureWorks land-use analysis [10] further confirm that industrial corn and sugar streams used for PLA originate from surplus or non-food varieties, minimizing pressure on food markets.[2]

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## Food Security and Co-Products:

Agricultural biomass feedstocks support food security through substantial co-product generation, including high-protein animal feed and fibers. EU biorefineries consistently produce more animal feed than fuel, as shown in ePURE audit data [6] and Biofuels International reporting [3]. Globally, the agricultural land used for all bioplastics remains extremely small (0.01% today, <0.07% by 2028) [10], demonstrating negligible competition with food. NatureWorks' analysis of PLA production [11] also highlights that co-products from corn wet milling flow directly into food and feed markets. [2]

A Wageningen University scenario concluded that even replacing all fossil plastics with bio-based plastics would require only about 5% of global biomass harvest, an unlikely but illustrative case showing manageable land demand [1]. Life-cycle studies from an independent PLA carbon-footprint assessment [7] further shows that bioplastics' land-use requirements remain modest, especially as co-products reduce the need for imported feed. As alternative feedstocks like waste-derived sugars grow, total land demand is expected to decline further. [2]

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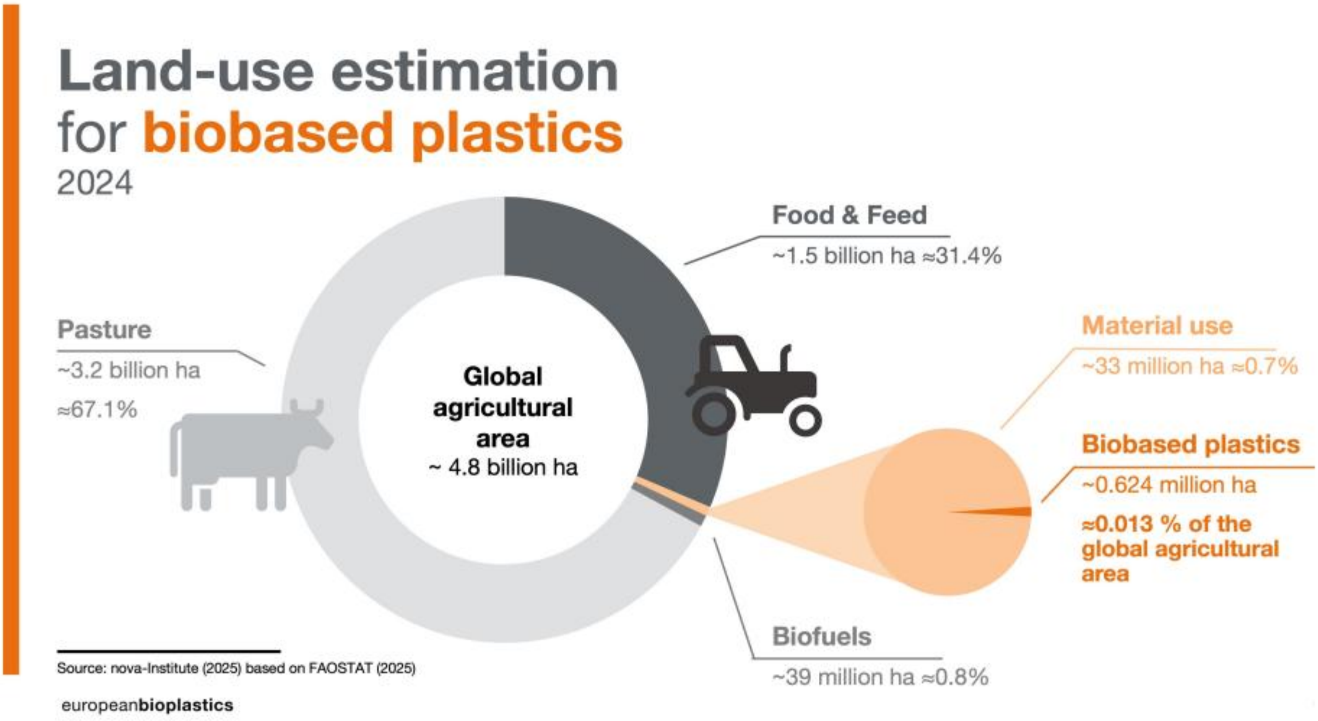



Estimated land use for biobased plastics [1]

## Environmental and Climate Benefits:

Our LCA study shows that PLA produced from corn or sugarcane can achieve over 75% lower greenhouse-gas emissions versus fossil plastics.[15] These reductions result from biogenic $CO_2$ uptake, efficient crop-to-polymer conversion, and declines in agricultural emissions driven by precision-farming technologies. Alternative feedstocks such as residues and waste streams will play an increasing role, but global analyses indicate they cannot yet meet large-scale polymer demand alone [1][4]. Agricultural biomass feedstocks therefore remain essential for scalable low-carbon bioplastic growth while newer pathways mature.

Another aspect is supply. While alternative feedstocks should be used where available (e.g. use waste where it makes sense), their total potential is limited. There are only so many tons of straw or wood residues that can be collected sustainably each year. Studies for Europe indicate that even all realistic biomasses would only meet a portion of total chemical and fuel feedstock needs by mid-century, so agricultural biomass would still be relied upon to hit climate targets in a high-renewables scenario.

## Economic and Agricultural Advantages

Agricultural biomass feedstocks strengthen farm-level resilience by giving farmers multiple market outlets—food, feed, fuel, and bio-based materials, helping stabilize income and reduce exposure to commodity price swings. EU biorefineries demonstrate this clearly, consistently generating high-value co-products such as protein-rich animal feed alongside ethanol and industrial sugars [6].

Large agricultural regions such as the United States and Brazil also produce significant crop surpluses, enabling both food markets and emerging bio-based industries to coexist without additional land expansion [10]. Meanwhile, advances in precision agriculture are improving yields and resource efficiency, allowing farmers to support industrial users like PLA producers while maintaining strong food-sector output [5]. Together, these factors create a more stable and future-ready agricultural system.

## High-Tech Sustainable Agriculture:

Advances in agriculture (precision farming, improved crop varieties, regenerative practices) are making agricultural biomass feedstocks more sustainable. These technologies, largely applied to major food crops, have boosted yields and resource efficiency: for example, farmers using precision agriculture have achieved 4% higher crop output while using 6–9% less fuel and agrochemicals [5]. By producing more with less, high-tech agriculture reduces the land, water, and fertilizer needed per unit of crop, alleviating pressure on natural ecosystems. Intensification of existing farmland means less incentive to clear new land, thereby protecting biodiversity. In practice, modern corn, sugarcane, and beet farming is steadily shrinking its environmental footprint while increasing output which is a win-win for food and bioplastic feedstock production [2][5].

## Global Context and Case Studies:

The benefits of agricultural biomass feedstock use in bioplastics are being realized globally, not just in Europe.

**United States (Corn → PLA)**

The U.S. uses field corn for PLA, with NatureWorks operating the world's first large-scale PLA facility. Corn is abundant (360+ million tons/year) [9], and PLA uses only a tiny fraction, with all co-products (protein, oil, fiber) still going to food/feed [10]. High farm efficiency and sustainability programs show that corn-to-PLA integrates smoothly without impacting food supply.

**Brazil (Sugarcane → Bio-based Plastics)**

Brazil's sugarcane sector supports food, ethanol, and bioplastics simultaneously thanks to decades of yield improvements [13]. Braskem's 260,000-ton bio-PE demonstrates large-scale biopolymer production using cane without affecting food markets [12]. This model shows how sugarcane-based agricultural biomass can serve multiple markets sustainably.

**Thailand (Sugarcane → PLA)**

Thailand uses surplus sugarcane to produce PLA [13] at the TotalEnergies Corbion plant. Thailand's PLA success proves agricultural biomass feedstock use can be tied to strong sustainability standards, boosting rural jobs and the national Bio-Circular-Green agenda, while only 1% of their cassava and sugarcane output goes into bioplastics. [14]

Emerging Economies (Africa & Asia)

African and Asian countries have large cassava and sugarcane sectors. Countries like Kenya, India, and Indonesia see agricultural biomass feedstocks (sugarcane, cassava) as a path to rural investment and higher yields. When managed responsibly, bioplastic demand can encourage farmers to adopt better technology, improving both food and industrial output on the same land. The key is ensuring projects respect local food needs and land rights.

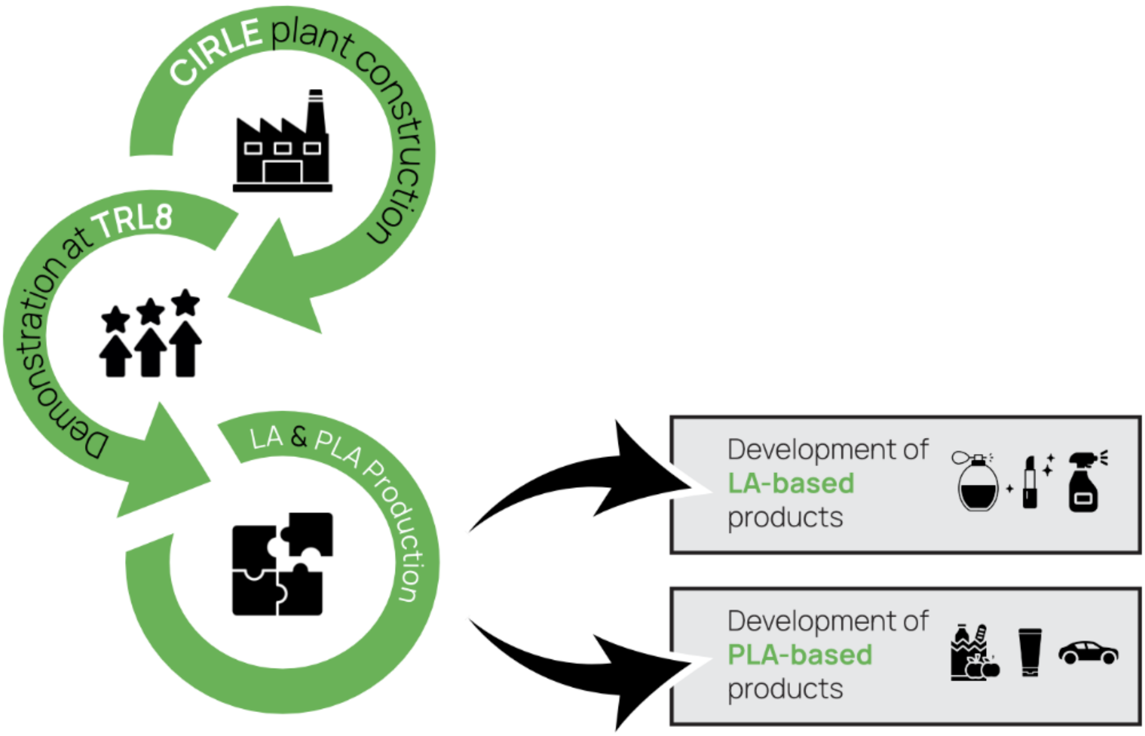
**European Union**

Europe has been cautious with agricultural biomass feedstocks, but declining sugar beet demand and strong sustainability potential make PLA a promising outlet. The nova-Institute argues that excluding agricultural biomass crops would actually hurt Europe's climate goals due to their high efficiency and scalability. Globally, regions using agricultural biomass feedstocks are advancing fast, and the EU risks falling behind if policy remains overly restrictive.

## Can PLA be made from organic waste?

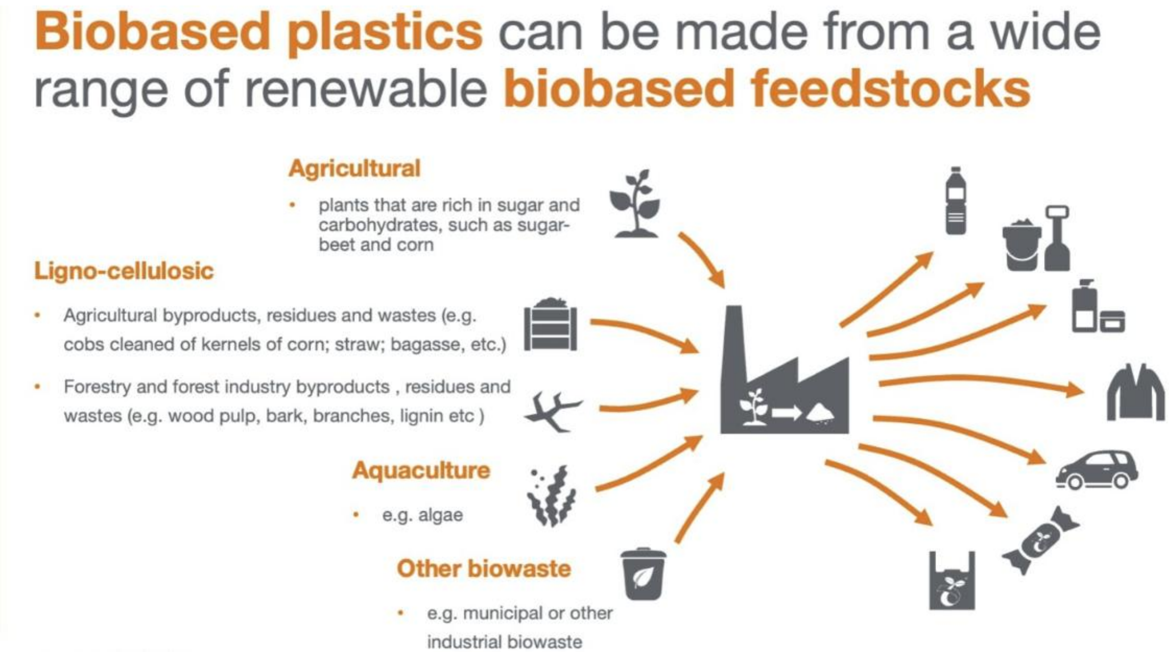
Emirates Biotech is part of the CIRCLE Consortium, that is developing technology to produce PLA from organic food waste. Together with a range of value chain partners, we are evaluating the technical and economic viability of using waste as our feedstock. This initiative is part of Horizon Europe and is supported by the Circular Bio-based Europe Joint Undertaking (CBE JU) under the European Commission. On pilot scale, food waste has already been converted to lactic acid using optimized fermentation technology. On lab scale, the lactic acid has also been converted to PLA. The consortium is currently validating production in a flagship plant to get to a larger scale of production.

Emirates Biotech and the consortium partners still have many challenges to overcome that are typically related to using food waste as a feedstock for fermentation. Challenges include ensuring food-contact compliance for the resulting PLA, maintaining consistency of supply given the variable nature of waste streams, and achieving cost competitiveness with conventional feedstocks.




Waste to PLA process [16]

The UAE is also exploring innovative pathways for alternative feedstocks, including projects that convert date-palm waste into lactic acid. We have evaluated this option as well, and while the concept is promising, particularly from a local circular-economy and regional development perspective, current cost estimates remain significantly higher than conventional feedstocks. As technologies mature and scale improves, this route may become more viable in the medium to long term. In the meantime, we remain committed to identifying and supporting solutions that are locally sourced, economically sustainable, and aligned with the UAE's broader vision for a circular economy.




Different types of feedstocks for biobased plastics [17]

## Conclusion

Global evidence shows that agricultural biomass feedstocks can play a practical and effective role in scaling bio-based plastics like PLA. Their high sugar and starch yields, established supply chains, and co-product benefits allow them to support industrial production without undermining food security. Life-cycle studies consistently demonstrate that PLA made from agricultural biomass delivers significant greenhouse-gas savings compared to fossil plastics, helping accelerate decarbonization efforts.

At the same time current practices ensure that these crops can be integrated into the bioeconomy with minimal land pressure and strong environmental safeguards. Global case studies—from the U.S. to Brazil, Thailand, and emerging markets show that agricultural biomass feedstocks can coexist with food and feed systems while supporting rural development and climate goals. As the bio-based materials sector grows, agricultural biomass feedstocks provide a reliable bridge, complementing the ongoing transition toward alternative feedstocks.

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