2020 Fact Sheet

Feedstocks

2020

Bioplastic Feedstock Alliance

BFA Fact Sheet - Feedstocks

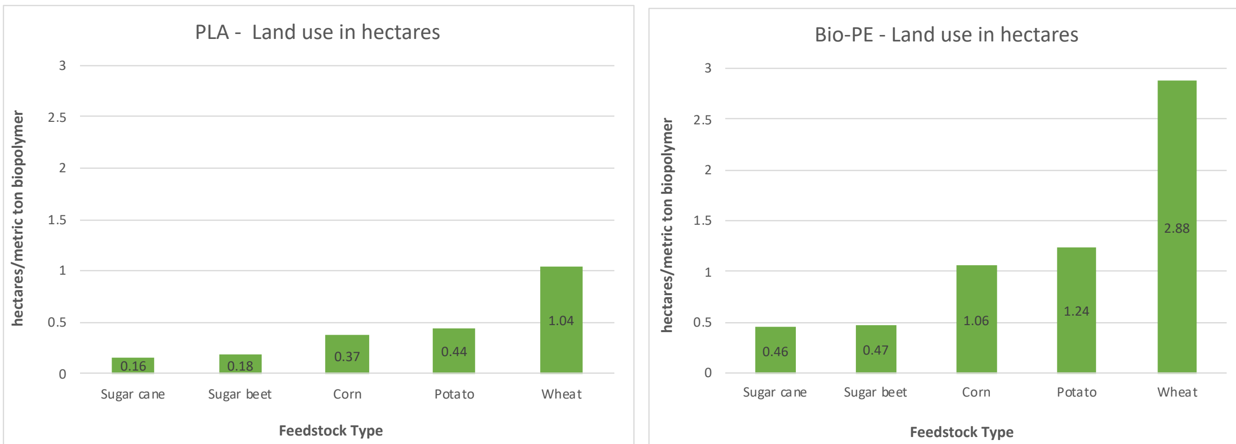
Many choices of feedstocks exist for many geographies and for many applications. Biobased plastics can be made from a wide variety of feedstocks, each of which has its own advantages and disadvantages. The impacts of these feedstocks are highly variable across geographies. For example, sugar cane grown in Brazil has different impacts and considerations for sustainability than sugar cane grown in India. The complex nature of choosing a biobased feedstock for a specific application in a specific geography means that there is no “best” feedstock. Trade-offs must be evaluated to determine the best option for the region and intended use, and whether or not biobased options are suitable at all in the local context. Biomass production systems are complex and interwoven with local economies and livelihoods, and the ecological and social impacts will vary greatly on a case by case basis.

A feedstock is the raw material used for an industrial process, for example, for the production of bioplastic. Biobased plastic feedstocks are sometimes classified by generation, which simply categorizes feedstocks based on the order in which they came into use for this purpose. First generation feedstocks are traditional agricultural crops, second generation are typically from cellulosic crops, residue, and agricultural waste, and third generation are based on novel, typically non-land-based sources such as algae. The generation a feedstock belongs to is not necessarily indicative of the broader environmental sustainability of that feedstock. The generation is also no guarantee of climate impact and cannot predict the effects that the cultivation of the feedstock will have on the local population. Feedstocks must be evaluated individually on their advantages and trade-offs, including their regionally specific impacts.

Many factors contribute to the overall land-use efficiency of a feedstock including: the specific yield of the required substance (e.g. starch, oil, sugar), the efficiency of the manufacturing process, and the ability of the material to satisfy specific performance criteria. Changes to these factors will determine the overall land-use efficiency of a specific feedstock. For example, crops with high overall biomass yield but low yields of the specific required substance; inefficient manufacturing processes; or a crop that requires higher amounts of material to satisfy performance criteria would all result in a larger amount of land required.

The general productivity of a feedstock is just one contributing factor to a feedstock’s overall land-use efficiency (the amount of land needed for a crop versus its yield) [1]. First generation feedstocks are often more land-efficient than second generation feedstocks since farmers and scientists have optimized them for maximum efficiency over hundreds of years. These crops consistently provide high yields with relatively lower inputs than less conventional alternatives. However, the use of food crops for biomaterial production must be very carefully considered to ensure that the production of these crops does not negatively impact food security at the local or global level through impacts such as price changes of commodity crops or indirect land use change (when existing crops are used for a new purpose and this triggers ecosystem destruction elsewhere to make new room for agriculture).

As an example of land use efficiency comparison between feedstocks, data from Institute for Bioplastics and Biocomposites shows the different land use requirements to produce one ton of PLA or one ton of Bio-PE. For these two bioplastics, sugar cane and sugar beet require far less land to produce one ton of plastic than corn, potato, or wheat [2]. In addition to land use, whether or not crops are grown on degraded land, whether co-products and residues are produced, and the feedstock's water and nutrient requirements also play into the sustainability of a specific feedstock. Effects on food security are complex and must also be carefully considered in evaluating feedstock sustainability.



Land use comparison of sugar cane, sugar beet, corn, potato, and wheat for the production of PLA and Bio-PE, data from Institute for Bioplastics and Biocomposites, 2019

BFA supports the use of metric-based decision making to thoroughly evaluate the environmental and social risks, impacts, and opportunities of biomass sourcing. BFA has identified clear responsible sourcing criteria for biocontent [3]. The BFA scorecard, Methodology for the Assessment of Bioplastic Feedstocks, and the Supply Risk Inquiry Tool can all help users assess whether a feedstock meets these criteria [4]. Life Cycle Assessments are a useful tool for evaluating many environmental impacts, however, their focus on functional units means their results generally do not represent the full range of landscape effects of a feedstock's production. LCA results may exclude impacts from indirect land use change as well as the socioeconomic impacts of land use change. [5]

All feedstocks will have advantages and disadvantages, so the focus should be not on finding a perfect feedstock, but on committing to the continuous improvement of the best available option for that technology and sourcing region.

***A note on waste residue*:** Utilizing agriculture and forest residues, which are by-products of existing production, offers a potential opportunity to reduce the environmental and social impacts of bioplastic production. However, in using waste residue there must be assurance that the waste is truly waste, and not being displaced from another use. (BFA recommends the RSB methodology for determining wastes and residue, Advanced Products Standard).

Residues used for bioplastic production can displace the original uses, which include ground cover, fuel, fodder, fertilizer, fiber, animal feed, and pulp and paper. It is important to consider the environmental impacts of the substitutes that are used to replace residue materials, as this can significantly influence the environmental footprint of residue-based bioplastics. Furthermore, the removal of cellulosic and agricultural harvest residues from fields (i.e. where they would otherwise be left as ground cover) can have serious impacts on soil health and stability. Sustainable removal rates are highly variable, and currently each case must be considered individually.

References

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[5] M. De Rosa, “Land Use and Land-use Changes in Life Cycle Assessment: Green Modelling or Black Boxing?,” *Ecological Economics*, vol. 144, pp. 73–81, Feb. 2018, doi: 10.1016/j.ecolecon.2017.07.017.

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