

Rethinking the Food vs Fuel Debate in Scaling Up Biomass Feedstocks Sustainably

Policy Brief 2

**RSB - ROUNDTABLE ON SUSTAINABLE
BIOMATERIALS ASSOCIATION**

June 2024

Contents

1.	Introduction	3
2.	Exploring the food vs fuel debate from a regional & local context	4
2.1	The case of the EU	4
2.2	The case of Malaysia & Indonesia	7
2.3	The case of Brazil	8
2.4	The case of the US	10
3.	Recommendations	12
4.	Conclusion	14
5.	References	15

This policy brief is the second in a series of three, developed for the RSB Sustainable Biomass Policy Platform (SBPP). The SBPP brings together RSB members from industry to civil society to collaborate, discuss, and provide recommendations on implementing and ensuring sustainable practices within the expanding scope of legislation regulating sustainable biomass feedstock production and use. These policy briefs are an initial analysis by the SBPP, laying the foundational thinking and point of view of the working group on the sustainable scaling of biomass feedstocks.

Authors: Carina Wessels, Alex Ehrenhaus, Juan Vivier

1. Introduction

In the pursuit of a more sustainable future, integrating renewable resources into our economic systems has become imperative. Central to this endeavour lies the utilisation of biomass feedstocks within the bioeconomy – a key pathway towards reducing reliance on finite fossil fuels and mitigating environmental impacts. However, ensuring the sustainability of biomass feedstock production and utilisation is paramount for the long-term viability of a bio-based circular economy.

The challenge of reconciling the demand for biomass feedstocks in the biofuels and biomaterials industries with the imperative to ensure food security in food insecure regions, presents a complex challenge at the intersection of agriculture, energy, and environmental sustainability. Efforts to scale up the production of biobased fuels and materials are intensifying to mitigate climate change and reduce dependence on fossil resources. Yet, concerns persist regarding the potential competition between food and fuel production.

The food vs fuel debate emerged prominently in the early 2000s as the biofuels industry began to gain traction as a potential solution to both energy security and environmental concerns. At its core, the debate revolves around the competition between using agricultural crops for food production versus their utilisation for biofuel feedstock (as well as feedstock for other biochemicals or bioproducts), particularly in the context of rising global food demand and concerns about food security.

Biofuels, particularly ethanol derived from corn in the United States and biodiesel from oilseed crops in Europe, were heralded as promising alternatives to fossil fuels. However, as demand for biofuels increased, so did concerns about their impact on food prices and availability. The debate intensified in the wake of the 2007-2008 global food crisis, during which food prices soared to unprecedented levels. In part, the crisis was attributed to the increased demand for biofuels leading to significant land use changes and competition for agricultural resources (Mittal, 2009). However, literature suggests that financial speculation on commodity prices had a substantial role in this crisis (Mittal, 2009). This prompted a re-evaluation of biofuel policies and ignited discussions about the need for more sustainable approaches to biofuel production.

Since then, the food vs fuel debate has evolved as policymakers, researchers, and industry stakeholders seek to strike a balance between biofuel production and food security. Furthermore, a growing recognition of the potential synergies between food and biofuel production has emerged. The concept of "food-energy-ecosystem nexus" emphasises the interconnectedness of food, energy, and environmental systems and highlights opportunities for integrated approaches that enhance both food security and bioenergy (or other bioproduct) production while minimising trade-offs.

This policy brief, the second in a series of three exploring sustainable biomass feedstock scaling, will delve into the food vs fuel debate, looking at how it is essential to adopt holistic approaches that consider the complex interactions between food, energy, and environmental systems to ensure that the bioeconomy contributes positively to global sustainable development goals.

We will examine various regions, to gain insight into how different areas address these multifaceted challenges and manage the equilibrium between food security and the sustainable expansion of biomass feedstocks. This small step is essential in navigating the transition to a more sustainable bioeconomy, not only regarding concerns over food security, but also biomass scaling issues, cost considerations, greenhouse gas (GHG) emissions, land requirements, insufficient investment, competition between sectors, and the imperative for enhanced sectoral collaboration (e.g., Collett et al., 2023).

2. Exploring the food vs fuel debate from a regional & local context

According to the Food and Agriculture Organization of the United Nations, food security involves four essential components: food availability, food access, food utilisation, and food stability. The use of food crops, or the land it is cultivated on, for producing biofuels or other biomaterials is a significant factor affecting all four components of food security, particularly as the bioeconomy expands alongside global population growth. However, there is growing belief that the bioeconomy can positively contribute to enhancing food security, if suitable policy measures are in place that ensure appropriate land management conditions, and also consider regional and local context.

In the sections below, we will explore examples from the European Union (EU), Malaysia & Indonesia, Brazil, and the United States (US) to understand how different regions approach this complex issue and navigate the balance between food security and scaling up biomass feedstocks sustainably.

2.1 The case of the EU

The EU has been actively implementing policies to promote the sustainable transition of its member nations towards climate neutrality by 2050. This is part of a broader framework of the European Green Deal, which aims to cut 80% of GHG emissions within the transport sector by 2040 and 90% by 2050 (European Commission, 2019; Carbon Brief, 2024). A significant measure in this regard is the Renewable Energy Directive ([RED III](#)), which mandates binding targets for renewable energy use, including in transportation, with specific sustainability criteria for biofuels and bioliquids.

The RED III has set a cap on the maximum contribution of crop-based biofuels, allowing it to only contribute up to 7% of the total energy mix in the transport sector. This cap is a response to the ongoing food vs fuel debate and is designed to promote the use of more sustainable biofuel sources and minimise the impact on indirect land use change (ILUC).

ILUC is one of the major concerns related to the sustainable production of biomass feedstocks. It occurs when changes in land use, often driven by the demand for specific crops for biofuels lead to indirect impacts such as increased demand for new land to compensate for reduced food crop production. This can exacerbate deforestation and food and resource insecurity. The assessment of ILUC values is intricate and challenging due to the various components and assumptions involved. To mitigate the risk of ILUC, it is crucial to maintain original levels of agricultural production to supply other essential needs, such as food and animal feed. Sustainable practices that can help in this regard include enhancing crop productivity, cultivating crops on previously degraded lands, and utilising wastes and residues as feedstocks.

The European Commission is required to set criteria for classifying both “low ILUC” and “high ILUC” biofuels. “High ILUC” biofuels are defined as those produced from feedstocks for which a significant expansion onto high carbon stock land is observed. On the other hand, “low ILUC” biofuels are defined as those produced from feedstocks that avoid displacement of food and feed crops through improved agricultural practices or through cultivation of areas not previously used for crop production. The RED III includes provisions to limit the contribution of biofuel feedstocks that cause ILUC. Similarly, the International Civil Aviation Organization’s (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation ([CORSIA](#)), incorporate ILUC values into their GHG emissions calculations. These policies could serve as a foundation for shaping future policies aimed at avoiding ILUC in the sustainable production of biomass feedstocks for other sectors as well.

Annex 9 of the RED III focuses on defining sustainability criteria for solid and gaseous biomass fuels, such as wood, agricultural residues, co-products, wastes, and energy crops. Across Europe, the EU RED and corresponding national policies have notably increased the utilisation of waste-based biofuels, particularly in Nordic nations where regulations often surpass EU standards (ePure, 2024). Despite Europe’s leadership in this arena, there remains ample opportunity for advancement, as only a fraction of the vast waste reservoir has been tapped into.

Projections suggest that by 2030 approximately 66.83 million tons (MT) per year of biogenic waste will be sustainably available for biofuel production in the EU (Table 1; ICCT, 2021). This amounted up to 78.40 MT back in 2020, and estimations for 2050 are 36.66 MT (Table 1; ICCT, 2021). This decreasing trend is likely due to the EU Waste Framework Directive targets and decreasing population. However, fuels made from cellulosic materials and biogenic wastes require more complex technology to convert them to biofuel compared to food and feed-based (1st generation) fuels (Baldino, 2019).

As for agricultural residues, there is significant variation in production among EU countries. France, Germany, and Romania possess the highest sustainable availability of agricultural residues, attributed to their extensive agricultural sectors. Over time, most EU countries are expected to experience a rise in the sustainable availability of these residues and this growth is driven by anticipated improvements in crop yields, which in turn boost residue production. An estimated 77.01 MT of agricultural residues are currently deemed sustainably available in the EU, with projections indicating 83.34 MT by 2030 and 89.35 by 2050 (Table 1; ICCT, 2021).

For forestry residues, approximately 74.69 MT per year are generated annually in the EU, of which 51.43 MT are retained for soil quality (ICCT, 2021). It is estimated that 11.20 MT of forestry residues are currently sustainably available, with predictions of availability staying the same in 2030 and 2050 (Table1; ICCT 2021).

Table 1. Historical (2020) and future predictions (2030 and 2050) of total sustainable waste availability for biofuel production in million tonnes (MT) per year, on a dry basis, in the European Union. Source: International Council on Clean Transportation (ICCT, 2021).

Waste type	Sustainable availability (million tonnes per year)		
	2020	2030	2050
Biogenic municipal	78.40	66.83	36.33
Agricultural	77.01	83.34	89.35
Forestry residues	11.20	11.20	11.20

About 40% of the 118 to 139 MT of total annual organic waste in the EU is typically recycled into compost and digestate (ICCT, 2021), the remaining part being incinerated and a significant amount still ending up in landfills, where uncontrolled decomposition can lead to adverse climate impacts, primarily methane emissions, a short-lived gas with a high GWP (Global Warming Potential).

A key advantage of using waste and residues as biomass feedstocks lies in its reduced land and water footprint. Waste materials require disposal regardless, often incurring costs for owners. However, utilising it for biofuel and other biomaterial production typically does not necessitate additional land usage or water consumption, thereby mitigating the risk to food security and the risk of ILUC associated with biomass feedstock production. It also diversifies feedstock sources, which helps ensure resilience against potential disruptions, as well as reduces competition for the same feedstock between sectors.

Regarding palm oil, many organisations or movements, especially in Europe, have advocated excluding palm oil from the market. In 2019, the European Commission adopted a delegated regulation that classifies palm oil-based biofuels as a high-ILUC risk feedstock and having a significant impact on deforestation and GHG emissions (Mintec, 2022). According to RED III, the use of high-risk ILUC biofuels, such as those derived from palm oil, will be gradually reduced

starting in 2023, with the goal of phasing them out completely by 2030. Therefore by 2030, biofuels produced from palm oil should no longer count towards the EU's renewable energy targets. However, it's essential to note that the issue of palm oil use in biofuels and other biomaterials is complex and subject to ongoing debate and negotiations among stakeholders, including EU member states, industry representatives, environmental organisations, and palm oil-producing countries in Southeast Asia, Africa and Latin America. Academic literature on sustainable palm oil suggests that meeting current and future demands can be achieved without harming the ecosystem or environment (Khatun, et al., 2017). However, globally only 19% of palm oil is produced sustainably, according to the Roundtable on Sustainable Palm Oil (RSPO, 2021).

The EU's regulation and phase-out plan are expected to significantly impact palm oil imports for biofuel use in the EU. Countries that export palm oil to the EU, such as Indonesia and Malaysia, have expressed concerns and are negotiating trade agreements and sustainability standards to mitigate the impact. Below we will explore more on this in the case of Malaysia and Indonesia, which together account for 85% of global palm oil supply.

2.2 The case of Malaysia & Indonesia

In Malaysia and Indonesia, the utilisation of local biomass feedstocks (including from palm) for energy purposes is perceived not only as a means to address energy security concerns but also as an avenue to generate employment and income for farmers and rural communities. During the 2000s, biofuel development initiatives were led by trade and investment departments, setting ambitious targets without fully considering the interconnected economic, environmental, and social aspects. However, over time, both Malaysia and Indonesia have altered their strategies to acknowledge the necessity of integrating the bioeconomy within broader policy frameworks that address various sustainable development goals, especially economic growth, industrialisation, energy security, climate change mitigation, sustainable land use (agriculture and forestry), and rural development (Rashidi, 2022).

Palm oil serves as a vital crop in Malaysia and Indonesia, playing an important role in economic development. However, palm oil is often labelled as the culprit of extensive land use change that involves massive carbon stock loss. Many organisations and movements, especially in Europe, have advocated excluding palm oil from the market. However, studies show that there are still plenty of non-forested, degraded land in Indonesia that remain under-utilised (Jaung et al., 2018). Often, these vast areas of idle, non-forested, and low carbon lands would remain unused for food production regardless of biofuel development. In many instances, biomass production for biofuel and/or other biomaterials provide incentives that are seen as a means to activate these land resources for productive use, thereby offering new income opportunities for local communities. Furthermore, various terms such as 'abandoned', 'degraded', and 'marginal' land have been suggested to assess land available for future expansion of biomass

feedstocks, varying in interpretation and criteria across regions (Ahmed et al., 2017). For instance, abandoned land may not necessarily be degraded, and vice versa, leading to ambiguity in classification (Smit et al., 2013). Global estimates of 'degraded' land also vary significantly, from 1 billion ha to over 6 billion ha (Gibbs & Salmon, 2015), complicating monitoring efforts due to changing land conditions and the high cost of implementing high-resolution monitoring. Therefore, understanding future expansion on these lands requires consideration of multiple factors and stakeholder perspectives, and policies need to be implemented that safeguard the mobilisation of under-utilised lands from unwanted environmental impacts.

Promoting the use of under-utilised, low-carbon land resources with appropriate incentives and regulations can help deter unsustainable expansion and deforestation, as well as scale up the sustainable production of biomass feedstocks. At a landscape scale, the additional income generated by biomass feedstock production could facilitate sustainable transitions in agricultural landscapes, particularly in countries like Malaysia and Indonesia. While legal measures and subsidies may safeguard existing forests, supplementary funding and sustainable income streams, such as those derived from the bioeconomy, can aid local communities. There is also potential to integrate these efforts with incentives from carbon taxation or credit systems to support carbon sequestration and emission reduction initiatives. However, such integrated approaches are currently limited.

2.3 The case of Brazil

In Brazil, as in Malaysia and Indonesia, concerns about deforestation loom large, particularly in the context of expanding the bioeconomy and its potential impact on food production. Despite these concerns, Brazil has persistently worked to replace fossil fuels with biofuels since ethanol blending mandates were introduced in 1931. Today, biofuels are available at almost 42 000 gas stations across the country, with over 47 million vehicles, spanning from motorcycles to heavy trucks, relying on some form of biofuel (SDSN/FEEM, 2021). This domestic production reduces reliance on energy imports, bolsters national security, and yields social and environmental benefits, substituting around 600 thousand barrels of oil per day and avoiding 69 MT of CO₂ emissions annually (SDSN/FEEM, 2021).

The modern bioenergy industry in Brazil has made significant strides, leveraging advanced technology and sustainable management practices in feedstock production and processing. These advancements have led to high yields and efficiencies, effectively minimising land requirements for biofuel production. Brazil, a prominent player in the biofuel market, relies primarily on sugarcane for ethanol production, supplemented by corn, while soybean oil and tallow are the main sources of biodiesel, with minor contributions from other vegetable oils. These feedstocks collectively utilise about 11.2 million hectares (Mha), just 1.3% of the national area. In Brazil, cultivated and natural pastures occupy about 150 Mha, or only 18% of the national territory. The agroecological zoning for sugarcane in Brazil identifies approximately

65.0 Mha suitable for expansion, over six times the current area, excluding environmentally sensitive zones like steep slopes, native vegetation areas, and protected biomes (SDSN/FEEM, 2021). Sustainable biomass feedstock production is thus possible in low-productivity pasturelands without the need for Amazon biome lands. This leaves significant scope for the sustainable scaling of biomass feedstocks without encroaching on agricultural production, natural forests, or biodiversity.

It must be noted that there is pressure to promote sustainable economic activities in the Amazon with the aim to further job creation and income distribution. Among potential solutions, Macauba palm cultivation in degraded areas could be a promising option. Macauba, as a tree that is native to tropical regions of the Americas, and particularly found in Brazil, are known for its versatility. Its fruit contains a kernel that yields oil, which is rich in oleic acid and similar in composition to olive oil. This oil has potential applications in the food, cosmetic, and biofuel industries. Additionally, the Macauba palm is valued for its resilience and ability to grow in diverse environments, including degraded or marginal lands, making it an attractive option for sustainable agriculture and reforestation efforts. This means that the production of sustainable biomass feedstocks would not rely on the Amazon, but the desired development of the region may incorporate it as a significant component. Nonetheless, effective governance and public policies, including measures to prevent issues like land grabbing, are imperative to ensure social equity and address concerns of local communities, extending beyond bioeconomy initiatives.

Agroforestry production systems in Brazil offer a promising approach to increasing the efficiency of land use by enhancing agricultural output per unit of land area (e.g., tons per hectare). These integrated systems combine trees and shrubs with crops and livestock, delivering substantial benefits compared to conventional production systems. Research in Brazil indicates that agroforestry can enhance biodiversity by up to 45% and ecosystem service levels by 65% (Santos et al., 2019). These advantages are particularly evident in degraded areas where the sustainable management of natural resources is legally permitted (Santos et al., 2019). Therefore, by promoting agroforestry practices, Brazil can significantly increase its agricultural yield without expanding into natural forests or compromising food security. Furthermore, switching to agroforestry can be a significant investment and to fully realise the potential of agroforestry in upscaling sustainable biomass production, it is crucial to invest in innovation, as well as research and development (R&D). For example, a WWF (2020) study found that transitioning from soy monoculture to agroforestry in the Amazon costs around \$1,060 to \$1,180 per acre, compared to a few hundred dollars for soybeans. While ongoing labour costs are higher due to the need for regular pruning, denser growth, and multiple harvests per year, the increased productivity and additional crops allowed farmers to earn back roughly twice their investment, recouping setup costs within two years. Funding for these initiatives, along with grants and incentives, can help overcome initial barriers and promote widespread adoption. Such support will be essential in demonstrating that with the right

practices and policies, it is possible to achieve both food security and sustainable biomass production.

Brazil's advancement in bioenergy efficiency and productivity can be attributed to extensive local R&D efforts across the entire supply chain, spanning agriculture to final use. Over recent decades, various innovative technologies emerged from Brazilian research centres and universities including the development of new plant varieties, biological pest control, reduced tillage and other precision agriculture methods, and improved harvesting practices. Additionally, advancements in cogeneration, biogas production, and nutrient recycling have contributed to reduced pollution, minimised chemical usage, and optimised water consumption. For example, water consumption in sugarcane mills plummeted to a mere 5% of original figures, while in Brazil's ethanol industry, energy productivity tripled over three decades, showcasing the efficacy of these advancements (SDSN/FEEM, 2021). Consequently, these initiatives have boosted bioenergy competitiveness, while promoting environmental sustainability, reducing the risk of encroachment on food security. These efforts have been supported by policies like [RenovaBio](#), the country's national biofuels policy, which establishes targets for reducing GHG emissions in the transportation sector, incentivising the production and use of biofuels through a market-based mechanism. This underscores the critical role of supportive policies in facilitating R&D, attracting investments, and providing incentives for sustainable practices.

2.4 The case of the US

In the US, biofuel initiatives gained momentum in the 1970s and concerns over potential conflicts between food vs fuel have persisted since then. However, it's important to recognise that the primary challenge for the US food system then, and perhaps still today, has been an overabundance of food rather than scarcity that has been associated with agricultural dumping (Murphy & Hansen-Kuhn, 2019). Therefore, it can be argued that biomass feedstocks from the US offer a potential pathway for sustainable development of the bioeconomy. The US Department of Energy (DOE) has recently demonstrated that the US can sustainably triple its production of biomass to more than 1 billion tons annually to meet biofuels feedstock demand by 2050 (Figure 1; Department of Energy, 2023). The largest source of biomass in the future is predicted to be purpose-grown energy crops with a potential to provide 300–600 MT of biomass per year. It is possible for these energy crops to be produced outside prime cropland while meeting projected demands for food, feed, and fibre (Department of Energy, 2023).

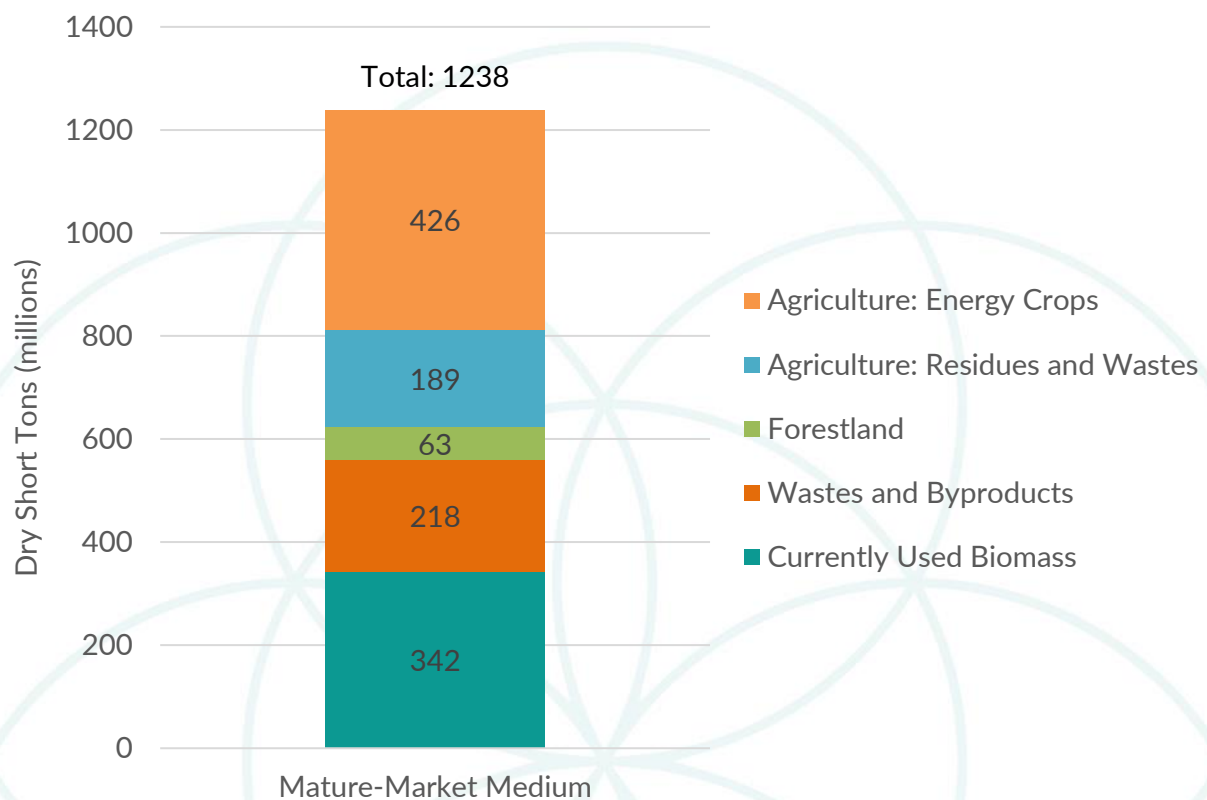


Figure 1. The USA can sustainably produce more than 1 billion tons of biomass annually to meet biofuels feedstock demand by 2050, with the largest portion predicted to come from purpose-grown agricultural energy crops. Source: Department of Energy, 2023.

Similar to Brazil, efforts in plant breeding, as well as precision agriculture techniques, have effectively enhanced biomass yields across various bioenergy crops in the US. These include first-generation biofuel crops (food crops) like corn, soy, and canola; cellulosic annual crops (non-food) such as biomass sorghum; short rotation woody crops including willow and poplar; and perennial grasses like switchgrass, miscanthus, and energy cane (Owens, 2018). Additionally, integrating bioenergy double crops with food crops during fallow periods have yielded important synergies in the US. Carinata, a promising oil crop for the bioeconomy, are typically cultivated as cover crop in crop rotation systems, and when grown under reduced or no tillage management practices, it can offer the multifaceted benefits consistent with regenerative agriculture practices (Seepaul et al., 2023). Regenerative agriculture has the potential to restore degraded soil biodiversity, improving soil water holding capacity, enhancing soil organic matter, maximising soil carbon sequestration, and as a result lead to a lower carbon footprint (WEF, 2023).

Research indicates that over 20% of US cropland is economically marginal for annual food crop production (Jarchow et al., 2015). A considerable portion of this land can be repurposed for more resilient bioenergy crops, resulting in minimal impacts on food production while offering

substantial enhancements to ecosystem services such as soil carbon, biodiversity, and water quality. Cellulosic non-food biomass sources such as agricultural residues (e.g., corn stover, wheat straw), dedicated energy crops (e.g., switchgrass, miscanthus), and woody biomass (e.g., forestry residues, energy crops like willow or poplar) holds significant potential for growing on marginal lands. It offers several advantages over first-generation biofuel crops, including reduced competition with food crops, lower GHG emissions, and the potential to utilise non-arable land for feedstock production.

Recognising the complex interplay between food security and biomass production for the bioeconomy, it's essential to underscore the importance of sustainable practices in scaling up biomass feedstocks in the US. For instance, while food scarcity may not be a pressing concern, the impact of biomass feedstock cultivation on ecosystems, soil health, and water resources remains significant. For example, corn is the primary feedstock for US ethanol, accounting for more than 98% of production (USDA, 2024), but if corn is not grown sustainably it can lead to adverse effects on ecosystems, soil erosion, and water contamination. Policy measures are essential to steer project development towards more sustainable alternatives. These policies should be based on robust sustainability frameworks, sound scientific research, and supported by quantitative tools like life cycle analysis assessments. Performance-based incentives, such as California's Low Carbon Fuel Standard (CARB, n.d.), have demonstrated effectiveness in encouraging innovation and expediting deployment of biofuels with low carbon intensity. Echoing such measures and incentives that prioritise environmental and social sustainability, safeguard food security, and drive biofuels and biomaterials towards achieving "negative carbon" status is essential.

3. Recommendations

Mitigating the potential risks outlined above necessitates a strategic approach to policymaking. Optimal outcomes can only be realised through collaborative efforts, fostering co-learning and co-design among stakeholders across sectors and scales. By harnessing the synergies generated from integrating transformative strategies across different sectors, policymakers can pave the way for sustainable and inclusive solutions. Based on the insights gathered from the various regions and their approaches to the food vs fuel debate, the following policy recommendations are made for scaling up biomass feedstocks sustainably:

- Ensure robust methodologies and tools are adopted and applied to assessing and sourcing feedstock risks, particularly as related to ILUC, displacement emissions, feedstock and food security assessments.
- Encourage the use of diverse feedstock sources, including waste and residues, non-food biomass, and under-utilised or degraded lands, to reduce competition with food crops and minimise land use change.

- Adopt and implement methodologies and tools that enable identifying available land for biofuels which does not compete with land for food or conservation (e.g., feedstock modelling).
- Support sustainable land management practices such as precision and regenerative agriculture, agroforestry, and reforestation, by including requests in purchasing and sourcing policies. In this way soil health, biodiversity, water quality, etc are indirectly improved while maximising biomass productivity.
- Allocate resources for R&D initiatives focused on improving biomass crop yields, enhancing technologies, and developing innovative feedstock sources to increase efficiency and reduce environmental impacts.
- Strengthen and align policy instruments such as mandates, carbon incentives and other carbon pricing mechanisms, and sustainability certification schemes to incentivise sustainable biomass production and discourage practices that harm food security or the environment.
- Foster collaboration between sectors and regions to share best practices, exchange knowledge, and to collect data and information on industry performance that serves as input to feedback into improving biofuel policy design. To enable this, broad sectoral and robust monitoring and evaluation mechanisms should be adopted to assess the social, environmental, and economic impacts of biomass feedstock production.
- Ensure that policies and initiatives empower local communities, especially in developing countries, by providing economic opportunities, protecting land rights, and promoting participatory decision-making processes.
- Advocate for the unrestricted use of available feedstocks when equipped with the appropriate safeguarding that guarantees sustainable production, processing and sourcing, including certification and the use of validated sustainability frameworks that mitigate the risk of food security (e.g., ILUC, feedstock assessments, food security assessments, GHG displacement emissions calculations, etc.).
- Develop key communication material that provides evidence as to the feasibility of producing fuels from feedstocks without compromising fuels, to support discussions with policymakers.

Next steps for the SBPP

To advance the vision of sustainably scaling up biomass production without undermining food security, the following next steps are recommended for the SBPP:

- To promote cross-sectoral collaboration, partnerships should be encouraged among SBPP stakeholders in agriculture, energy, materials, chemicals and environmental sectors to develop integrated solutions that address the scaling up of sustainable biomass feedstock production.
- Advocate for policies that support sustainable land use where fuel and food are complementary production systems that can co-exist. Develop strong communication material that provides evidence and business cases to support the use of feedstocks for fuel. Incentivise research geared towards monitoring the relationship between fuel and food, feed and fibre to support the design of land use policies and as input for policymakers.
- Link financial institutions to feedstock production that support innovative biomass production methods, such as regenerative agriculture, agroforestry and advanced technologies.
- Narrow the scope of key topics and policies for further analysis to identify areas where knowledge exchange and dissemination of best practices among different regions and sectors are needed, in order to advance a cross-sectoral feedstock sourcing strategy.

4. Conclusion

The findings in this policy brief highlight that biofuel production can indeed be scaled up without compromising food security. The examples from the EU, Malaysia, Indonesia, Brazil, and the US demonstrate that with appropriate policy measures, sustainable land management practices, and a focus on local and regional contexts, it is possible to achieve a balance between biofuel production and food security.

Fostering dialogue and collaboration among stakeholders across the food, energy, and environmental sectors is essential for shifting the narrative on the food vs fuel debate. By engaging with diverse perspectives and sharing knowledge and best practices, it is possible to identify synergies, mitigate trade-offs, and develop holistic solutions that promote both food security and bioenergy sustainability. Policy frameworks that incentivise sustainable land use practices, promote research and innovation in biomass utilisation, and support smallholder farmers and rural communities are crucial for realising this vision. By adopting the policy recommendations above, stakeholders can work towards reconciling the food vs fuel debate

and scaling up biomass feedstocks sustainably, thereby contributing to the transition to a more sustainable and resilient bioeconomy.

By building on the recommendations above, we can advance a cohesive and globally aligned approach to sustainable and equitable biomass feedstock scaling across various sectors, to develop a well-regulated cross-sectoral approach.

5. References

Ahmed Et Al., Using The Ecosystem Service Approach.; Goh, C.S., Wicke, B., Potter, L., Faaij, A., Zoomers, A. & Junginger, M. 2017. Exploring Under-utilised Low Carbon Land Resources From Multiple Perspectives: Case Studies On Regencies In Kalimantan. Land Use Policy. 60:150-168.

Baldino, C. 2019. Advanced Alternative Fuel Pathways: Technology Overview and Status. Retrieved from the International Council on Clean Transportation. Available: <https://theicct.org/publications/advanced-alternative-fuel-pathways>

CARB, n.d. California Air Resources Board (CARB). Low Carbon Fuel Standard. Available: <https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/about>

Carbon Brief. 2024. Q&A: European Commission calls for 90% cut in EU emissions by 2040. Available: <https://www.carbonbrief.org/qa-european-commission-calls-for-90-cut-in-eu-emissions-by-2040/>

Collett, K. A., Fry, E., Griggs, S., Hepburn, C., Rosetto, G., Schroeder, N., Sen, A., and Williams, C. 2023. Cleaning up Cleaning: policy and stakeholder interventions to put household formulations on a pathway to net zero. Oxford Smith School Working Paper 23-07.

Department of Energy. 2024. 2023 Billion-Ton Report: An Assessment of U.S. Renewable Carbon Resources. Available: <https://www.energy.gov/eere/bioenergy/2023-billion-ton-report-assessment-us-renewable-carbon-resources>

ePure. 2024. Overview of biofuels policies and markets across the EU. Available: <https://www.epure.org/report/updated-for-2023-overview-of-biofuels-policies-and-markets-across-the-eu/>

European Commission. 2019. Sustainable mobility. The European Green Deal. Available: https://ec.europa.eu/commission/presscorner/api/files/attachment/860070/Sustainable_mobility_en.pdf.pdf

Gibbs & Salmon. 2015. Mapping The World's Degraded Lands. *Applied Geography*. 57:12-21.

ICCT (The International Council on Clean Transportation). 2021. Waste and residue availability for advanced biofuel production in the European Union and the United Kingdom. Available: <https://theicct.org/sites/default/files/publications/eu-uk-biofuel-production-waste-nov21.pdf>

Jarchow, M.E., Liebman, M., Dhungel, S., Dietzel, R., Sundberg, D., Anex, R.P., Thompson, M.L. and Chua, T. 2015. Trade-offs among agronomic, energetic, and environmental performance characteristics of corn and prairie bioenergy cropping systems. *GCB Bioenergy*. 7(1):57-71.

Jaung, W., Wiraguna, E., Okarda, B., Artati, Y., Goh, C., Syahru, R., Leksono, B., Prasetyo, L., Lee, S. & Baral, H. 2018. Spatial Assessment of Degraded Lands for Biofuel Production in Indonesia. *Sustainability*. 10.

Khatun, R., Reza, M.I.H., Moniruzzaman, M. & Yaakob, Z. 2017. Sustainable oil palm industry: The possibilities. *Renewable and Sustainable Energy Reviews*, Volume 76, p. 608.

Mintec. 2022. EU Discontinuing Soybean and Palm Oil as Biodiesel Feedstock from 2023. Available: <https://www.mintecglobal.com/top-stories/eu-to-discontinue-soyabean-oil-and-palm-oil-as-biodiesel-feedstock-from-2023#:~:text=EU%20to%20Discontinue%20Soyabean%20Oil%20and%20Palm%20Oil%20a>

Mittal, A. 2009. The 2008 Food Price Crisis: Rethinking Food Security Policies. G-24 Discussion Paper Series. A United Nations Publication. Available: https://unctad.org/system/files/official-document/gdsmdpg2420093_en.pdf

Murphy, S. & Hansen-Kuhn, K. 2020. The true costs of US agricultural dumping. *Renewable Agriculture and Food Systems*. 35(4):376–390.

Rashidi, N.A., Chai, Y.H. & Yusup, S. 2022. Biomass Energy in Malaysia: Current Scenario, Policies, and Implementation Challenges. *Bioenerg. Res.* 15:1371–1386. Available: <https://doi.org/10.1007/s12155-022-10392-7>

RSPO. 2021. Annual Communication of Progress 2020. Available: <https://rspo.org/acop-2020-latin-america-and-north-america-report-robustresults/>

Santos, P.Z.F., Crouzeilles, R. & Sansevero, J.B.B. 2019. Can agroforestry systems enhance biodiversity and ecosystem service provision in agricultural landscapes? A meta-analysis for the Brazilian Atlantic Forest. *Forest Ecology and Management*. 433:140-145.

SDSN/FEEM 2021. Roadmap to 2050: The Land-Water-Energy Nexus of Biofuels. New York: Sustainable Development Solutions Network (SDSN) and Fondazione Eni Enrico Mattei (FEEM).

Seepaul, R., Small, I.M., Devkota, P., Sintim, H.Y., Mulvaney, M.J., George, S., Leon, R., Paula-Moraes, S., Esquivel, I., Bennett, R., and Poknywinski, A., 2023. Carinata, the Sustainable Crop for a Bio-based Economy: Production Recommendations for the Southeastern United States, SS-AGR-384/AG389, 8/2023, Florida, p. 15.

Smit, H.H., Meijaard, E., Van Der Laan, C., Mantel, S., Budiman, A. & Verweij, P. 2013. Breaking the Link between Environmental Degradation and Oil Palm Expansion: A Method for Enabling Sustainable Oil Palm Expansion. PLoS ONE. 8.

Owens, V.N. 2018. Sun Grant/DOE Regional Feedstock Partnership, Final Technical Report. Available: <https://www.osti.gov/biblio/1463330>

WEF. 2023. 5 benefits of regenerative agriculture – and 5 ways to scale it. World Economic Forum. Available: <https://www.weforum.org/agenda/2023/01/5-ways-to-scale-regenerative-agriculture-davos23/>

WWF. 2020. Agroforestry is a development alternative in the Amazon. Available: <https://www.wwf.org.br/?76990/Agrofloresta-e-alternativa-de-desenvolvimento-na-Amazonia>