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The Socioeconomic Implications of Biofuel Production and Environmental Sustainability: Myth or Reality

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Abstract:

The most essential issue that is being debated around the world is energy. Environmental friendliness of energy sources is a crucial differentiating feature. The fundamental goal of renewable energy is to promote economic development, improve energy security, increase energy access, and reduce climate change. Sustainable development can be achieved through the use of renewable energy and assuring citizens' access to affordable, reliable, sustainable, and contemporary energy. As a strategy of combating climate change, Bioenergy has gained widespread acceptance. It is pollution-free and free from carbon emission. It is the practical alternative to fossil fuels. Biofuels are growing in popularity as a sustainable, renewable energy source that might reduce a country's reliance on imported fossil fuels and increase energy self-sufficiency. Contrast to the limited supply, geopolitical unpredictability, and negative global repercussions of fossil fuel energy, it is becoming increasingly obvious that biofuels may be a practical source of renewable energy. Due to the high cost of production and chemical transformation processes, commercial biofuel production on a wide scale has not yet been achieved. Therefore, commercializing biomass-based biofuels requires an effective and cost-effective production technique. This article emphasizes an overview of renewable and sustainability for biofuel. Increasing the use of biofuels in developing countries is currently risky and uncertain due to unanticipated effects on food and biological resources. To achieve a more equitable balance between sustainability and the needs of the nation, the researcher will highlight the consequences on biological diversity and food for biofuel expansion in this chapter.

Keywords: *Renewable energy, Bioenergy, Biofuel, Biomass, Energy efficiency, Sustainable Development*

Introduction

Sustainable development has risen to the forefront of many countries' recent national policies, strategies, and development plans. The Open Working Group proposed a set of global 2030 Agenda For sustainable development (SDGs) at the United Nations in New York, which contained 17 goals and 169 targets. The SDGs place a higher emphasis on science and set more expectations on it than the Millennium Development Goals. In order to address climate change, renewable energy, food, health, and water provision, a global monitoring and modelling of numerous social, economic, and environmental elements is required.

Energy services are required in all civilizations to provide basic human needs including health, electricity, transport, and communication, as well as to act as generative processes. The energy sector's two overarching problems on the road to a sustainable future are securing energy supply and reducing energy's role to climate change. It is astonishing to discover that 1.4 billion people in the planet lack access to electricity, with 85 % of them living in rural areas. As a result, the number of rural populations reliant on biomass for energy is expected to increase from 2.7 billion now to 2.8 billion in 2030.[2]

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[1] Legal Consultant, Ahmedabad, Gujarat

[2] Abbasi, T., Premalatha, M., & Abbasi, S. (2011). The return to renewables: Will it help in global warming control? Renewable and Sustainable Energy Reviews, 15, 891–894.

The world's growing energy demand, combined with rising population, resulted in the continued use of fossil fuel-based energy sources (Coal, Oil, and Gas), which posed a number of problems, including depletion of fossil fuel reserves, greenhouse gas emissions and other environmental concerns, geopolitical and military conflicts, and volatile fuel prices. These issues will exacerbate unsustainable situations, posing a potentially irreversible threat to human societies.[3] Renewable energy sources, on the other hand, are the most impressive option and the only solution to the escalating issues.[4] Renewable energy sources provided 22% of total global energy generation in 2012[5], Tester defines sustainable energy as, "a dynamic harmony between the equitable availability of energy-intensive goods and services to all people and preservation of the earth for future generations".[6]

Utilising currently available residual biomass supplies can help minimise any potential harm to natural ecosystems while partially meeting the increased demand for bioenergy. Refineries' proximity to natural ecosystems has already had an effect, even though it is projected that growing bioenergy generation will continue to change both direct and indirect land use. More electricity is anticipated to be generated in the future utilising bioenergy, such as liquid biofuels, solid biomass, and biogas. Land is more and more in demand as the bioenergy industry expands for the purpose of producing feedstock. It would be required to implement sizable direct and/or indirect land-use changes, such as turning over new land to agriculture or boosting the productivity of farms that are already in operation.

In the developed world, tropical biodiversity is typically seen as a global resource, with the host nation serving as both a custodian and a donor on behalf of humanity. The researcher examines the effects of increased biofuel production on invasion processes from the perspectives of the targeted crops and the species associated with those crops. The impacts of expanding biofuel production on agricultural and aquatic ecosystems that get the nitrogen- and phosphorus-rich fertilisers and pesticides required to create biofuels are the subject of additional research. After examining how biofuels affect biodiversity in diverse places, it comes to a conclusion.

Increased agricultural product demand, restrictions on the quantity of land that may be utilised for agriculture, and the loss of farmland due to deterioration and urban and exurban growth are the main causes of the conversion of natural ecosystems to agriculture. Global factors like the expanding human population, rising wealth in developing nations like China and India, which increases meat consumption and subsequently the demand for grain, and increased emphasis on biofuels as petroleum substitutes all have an impact on decisions about land use at the local level.

Higher than anticipated energy needs will result from population and economic expansion in the future. According to the IEA, energy consumption will have risen 17% to 50% from 2012 levels by 2040, averaging between 15,629 and 20,039 million tonnes of oil equivalent. Meeting these demands at the current rate of fossil fuel exploitation is likely to result in increases in the global atmospheric temperature of over 3.6 °C by 2100 compared to pre-industrial levels, causing widespread adverse changes in ecological communities and increasing the risk of

[3] Asumadu-Sarkodie, S., & Owusu, P. A. (2016). The potential and economic viability of wind farms in Ghana Energy Sources, Part A: Recovery, Utilization, and Environmental Effects.
[4] Ajanovic, A. (2011). Biofuels versus food production: Does biofuels production increase food prices? Energy, 36, 2070–2076.
[5] Ayoub, M., & Abdullah, A. Z. (2012). Critical review on the current scenario and significance of crude glycerol resulting from biodiesel industry towards more sustainable renewable energy industry. Renewable and Sustainable Energy Reviews, 16, 2671–2686.
[6] Hoogwijk, M., Faaij, A., Eickhout, B., de Vries, B., & Turkenburg, W. (2005). Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios. Biomass and Bioenergy, 29, 225–257.

species extinction. Coal, oil, and gas accounted for 82% of all primary energy consumption in 2012.[7]

An overview of India's Biofuel

A well-thought-out biofuels system can supply both food and energy. It is possible to implement a community-based biodiesel distribution programme that boosts local economies on all fronts, from the farmers who provide the feedstock to the neighbourhood companies that produce and supply the fuel to users. More than any other sector, transportation has seen an increase in greenhouse gas (GHG) emissions. Fossil fuels, which made up 96.3% of all transportation fuels in 2018, are significantly reliant on the industry. Additionally, transportation is to blame for 23% of all energy-related CO2 emissions and 15% of global GHG emissions. Biofuels are widely regarded as viable alternative transportation fuels that can help reduce reliance on petroleum-based fuels and combat climate change. [8]

Biofuels are widely regarded as a sustainable and environmentally benign source of energy that can improve national energy security and reduce reliance on foreign imports of fossil fuels. Any fuel created from biomass—that is, plant or algal material or animal waste—is referred to as biofuel. Biofuel is considered a renewable energy source since the feedstock material can be easily renewed, unlike fossil fuels like petroleum, coal, and natural gas.[9] Biofuel is frequently promoted as a cost-effective and environmentally friendly alternative to petroleum and other fossil fuels, especially in light of rising petroleum prices and growing concern about fossil fuels' implications to global warming. Because of the economic and environmental expenses connected with the refining process, as well as the possible loss of enormous amounts of arable land from food production, many environmentalists are concerned about the extent of the spread of certain biofuels.[10]

Biofuels that have been used for a long time, such as wood, can be burned directly as a raw material to generate heat. The heat can then be used to power generators at a power plant. Several existing power plants use grass, wood, or other types of biomass to generate electricity. Liquid biofuels are particularly appealing due to the extensive infrastructure already in place to support their use, particularly in transportation. The most common liquid biofuel is ethanol (ethyl alcohol), which is produced by fermenting starch or sugar. Biofuels may be solid, liquid or gaseous in nature.[11]

Biofuels and its Generations

Various distinguishing factors, such as the type of feedstock, the conversion process, the technical specifications of the fuel, and its intended application, can be used to categorise biofuels. Different definitions are used for different types of biofuel since there are so many conceivable distinctions. Two commonly used typologies are ‘first, second and third generation’ and ‘conventional and advanced’ biofuels.

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[7] Correa Diego F., Beyer Hawthorne L., Possingham Hugh P., Thomas-Hall Skye R., Schenk Peer M. Biodiversity impacts of bioenergy production: Microalgae vs. first generation biofuels, Renewable and Sustainable Energy Reviews, Volume 74, July 2017, Pages 1131-1146

8 https://www.drishtiias.com/to-the-points/paper3/road-safety-1

9 Green Bonds and ESG Investing: Evaluating Financial Returns and Sustainability Impact in Emerging Markets. AEIDA [Internet]. 2025 Jan. 1 [cited 2025 Jul. 8];2(1):1-12. Available from: https://aeidajournal.org/index.php/AEIDA/article/view/11

10 Das, B., Pandya, M., Chaudhari, S., Bhatt, A., & Trivedi, D. (2021). Global Research Trends and Network Visualization on Climate Action : A Bibliometric Study. Library Philosophy and Practice (E-Journal). https://digitalcommons.unl.edu/libphilprac/5818/

11 Available at https://www.drishtiias.com/to-the-points/paper3/road-safety-1 last visited (Jan 3, 2024).

First-generation

First-generation biofuels are manufactured with standard technologies from sugar, starch, vegetable oil, or animal fats. Bioalcohols, Biodiesel, Vegetable oil, Bioethers, and Biogas are examples of first-generation biofuels. Biofuels produced from food or animal feed crops are referred to as first-generation biofuels. Since First-generation biofuels are also referred to as "conventional biofuels" since they are generated using well-established methods including fermentation, distillation, and transesterification.

Second-generation

Second-generation biofuels, such as cellulosic biofuels and waste biomass, are made from non-food crops (stalks of wheat and corn, and wood). Advanced biofuels such as biohydrogen and biomethanol are examples. Second-generation biofuels are characterized by the fact that they are produced from non-food sources, including specialised energy crops (such as Miscanthus, switchgrass, short rotation coppice (SRC) and other lignocellulosic plants), agricultural waste, forest waste, and other waste products (e.g. UCO and municipal solid waste).[12]

Third generation

Biofuels of the third generation are made from microorganisms such as algae. Third-generation biofuel refers to biodiesel produced from microalgae using traditional transesterification or hydro-treatment of algal oil. In India Micro-organisms like algae can be grown using land and water unsuitable for food production, therefore reducing the strain on already depleted water sources. One disadvantage is that fertilizers used in the production of such crops lead to environment pollution. Example- Butanol[13]

Fourth-generation

Fourth-generation biofuels, like third-generation biofuels, combine genetically designed feedstock with genomically produced microorganisms, such as cyanobacteria, to efficiently generate bioenergy. They are made on nonarable land. In the production of these fuels, crops that are genetically engineered to take in high amounts of carbon are grown and harvested as biomass. The crops are then converted into fuel using second generation techniques. The fuel is pre-combusted and the carbon is captured. Then the carbon is geo-sequestered, meaning that the carbon is stored in depleted oil or gas fields or in unmendable coal seams. Some of these fuels are considered as carbon negative as their production pulls out carbon from environment.[14]

Due to the fact that the production methods or pathways for second- and third-generation biofuels are still in the research and development, pilot, or demonstration stages, they are frequently referred to as "advanced biofuels."

Production of Biofuels

India has approximately 500 million tonnes of biomass available per year, out of which 120 to 150 million tonnes are in surplus. Further, 12.83% of the total renewable energy generation is contributed by biofuels alone. Moreover, higher conversion efficiencies and lower costs are the significant drivers of bio-energy extraction. The benefits of biofuels are energy security, reduction of import dependency, cleaner environment, Municipality Solid waste (MSW) management, health benefits, and infrastructures investment in rural areas,

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[12] *Id.*
[13] *Id.*
[14] *Id.*

employment generation and overall additional income to farmers. The liquid biofuels are biodiesel or bioethanol and gaseous biofuel is compressed biogas (CBG) or Bio-CNG. According to the International Energy Agency (IEA), biofuels have the potential to meet more than a quarter of world demand for transportation fuels by 2050 if favourable policies and investments are in place. At present, biofuels are supported by governments in many different ways, including blending mandates or targets, subsidies, tax exemptions (exemptions from excise and pollution taxes, corporate tax breaks for biofuel producers) and credits, reduced import duties, support for research and development (R&D) and direct involvement in biofuel production, as well as other incentives to encourage local biofuel production and use.[15]

The following types of biofuel are available in solid, liquid, and gaseous forms:

Bioethanol:

It is produced using a fermentation method using corn and sugarcane. About two thirds of the energy in one litre of gasoline can be found in one litre of ethanol. It enhances fuel combustion and reduces carbon monoxide and sulphur oxide emissions when combined with gasoline.

Biodiesel:

A biochemical procedure called "Transesterification" is used to create it from vegetable oils, such as soybean or palm oil, vegetable waste oils, and animal fats. Compared to diesel, it produces extremely little or none at all of the hazardous gases. It can be used as a substitute for regular diesel fuel.

Biogas:

It is created by the anaerobic breakdown of organic materials, such as sewage from people and animals. Methane and carbon dioxide make up the majority of biogas, although it also contains minor amounts of hydrogen sulphide, hydrogen, carbon monoxide, and siloxanes. It is frequently utilised for autos, electricity, and heating. The Sustainable Alternative towards Affordable Transportation (SATAT) programme, which aims to set up compressed biogas production facilities and make CBG available for use as a green fuel on the market.

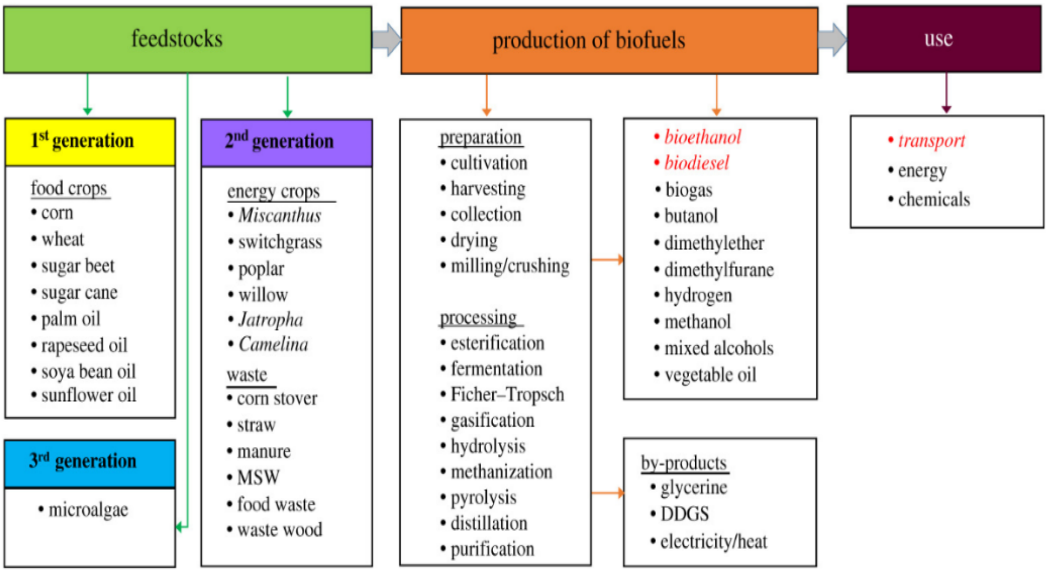
Biobutanol:

It is made using the same process as bioethanol, which is starch fermentation. Butanol has the highest energy content of all the gasoline substitutes. It can be used to cut emissions from diesel. It is used as a base in perfumes and as a solvent in the textile industry.

Biohydrogen:

Like biogas, biohydrogen can be made by a variety of techniques, including pyrolysis, gasification, and biological fermentation. It might be the ideal replacement for fossil fuel.

[15] https://promfgmedia.com/the-current-status-and-key-challenges-for-biofuel-in-india.



(Source: Road Safety, Drishti [16])

The Interplay between Biodiversity and Biofuel for Ensuring Sustainability

The predicted increase in biofuel production will have a substantial influence on biological variety, which is measured as the number of species of plants, animals, and microbes per unit area and characterised here as species richness. The loss of habitat, the spread of alien species, and pollution from pesticides and fertilisers will all have a negative influence on biodiversity. By reducing the rate of change in the planet's climate and atmosphere, increasing the production of biofuels may also have some favourable consequences on biodiversity. In prior chapters, the possibility of GHG reductions across diverse biofuel systems is examined in more detail. Certain biofuel technologies might lower global net carbon emissions.

Environmental Excellence

According to estimates, pollution from pesticides and fertilisers used in the production of biofuels will have a significant impact on terrestrial and aquatic biodiversity. On land, species richness can be decreased and the species mix altered by nitrogen deposition from industrial and agricultural processes, including the production of biofuels. Increasing the production of corn-based ethanol could be particularly detrimental to aquatic habitats because corn is a grain that needs a lot of fertiliser and pesticides to grow.

Despite the fact that coproduction can aid in lowering greenhouse gas emissions, the expansion of biofuels has an influence on emissions due to changes in land use and energy-intensive production methods. As a result of global warming, these greenhouse gas emissions have been connected to localised extinctions and modifications to the habitats of native species.[17]

Renewable Fuel Sources

Biodiversity has many advantages for forestry ecosystems, including increased community stability and resilience. When managing forests for climate change mitigation and adaptation, it is crucial to comprehend the relationships between tree biodiversity, site productivity, and the stocking of live trees in order to maximise and/or preserve

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[16] Available at https://www.drishtiias.com/to-the-points/paper3/road-safety-1, last visited (Jan. 1, 2024).

[17] Wiens John, Fargione Joseph, Hill Jason, Biofuels and biodiversity, Environmental Impact of Biofuels,Ecoogical Apllication Volume 21, 2011, page 1085-1095

aboveground biomass. Because it values all species equally, species richness may not be the best indicator of a tree's biodiversity in this case. Measures that consider species' evolutionary relationships should be more biologically meaningful substitutes for functional diversity within forest communities because more phylogenetically distinct species should contribute more to the diversity of traits within a community.[18]

We can reduce greenhouse gas emissions, improve the security of our energy supply, and promote rural development by substituting biomass for fossil fuels. However, the growth of land claims, conflicts with the food business, and impacts on other ecosystem services could result from the production of bioenergy crops. The effect of large-scale biofuel feedstock cultivation on biodiversity is one of the main sustainability problems linked to the rising demand for bioenergy. The consequences of biomass production might be direct, like when man-made or natural habitats are converted into energy crops, or indirect, such when natural vegetation is turned into land-use types that are elsewhere replaced by the growth of energy crops.

Possible Negative Consequences of Microalgae Cultivation Methods

Large agricultural regions are required to try to create enough first-generation biofuels, or those made from edible biomass like maize and sugarcane. As a result, there is a decrease in food production, increased land clearing, and increased pollution from agricultural production and harvesting. Production techniques using microalgae are a good replacement that are less damaging to the environment. It is vital to study studies and compare environmental factors that directly or indirectly affect biodiversity in order to assess the possible effects of microalgae production systems in comparison to first-generation biofuels.

In comparison to first-generation biofuels, microalga systems have reduced pressures on biodiversity per unit of fuel produced, mostly due to decreases in pesticide use, direct and indirect land use change, and water use if water is recycled. Further reducing CO2 emissions would require further technology and production methods, such as boosting productivity per square foot, situating close to industrial CO2 sources and wastewater treatment facilities, recycling nutrients and water, and utilising waste products for internal energy production. Through increased energy efficiency, nutrient recycling, and water reuse, overall pollution can be reduced. Microalgal systems offer a significant deal of promise to help meet the world's energy needs in a sustainable way.[19]

Land Utilization and Its Impact on Biodiversity Consequences

According to a number of estimates, habitat loss will be a major factor in the decline of biodiversity during the next 50 to 100 years. When a diverse ecosystem of living things, such as plants, animals, and bacteria, is replaced by a single kind of crop, extreme habitat loss takes place. A limited amount of land is currently utilised for various land uses. We can split agricultural land after we understand the various land uses and how they effect conservation. In order to make space for the production of biofuels, some current land usage must be discontinued.

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[18] Jesse R. Lasky, María Uriarte, Vanessa K. Boukili, David L. Erickson, W. John Kress, Robin L. Chazdon, The relationship between tree biodiversity and biomass dynamics changes with tropical forest succession, Ecology letters, Volume 17, 2014, Pages 1158-1167

[19] Correa Diego F., Beyer Hawthorne L., Possingham Hugh P., Thomas-Hall Skye R., Schenk Peer M. Biodiversity impacts of bioenergy production: Microalgae vs. first generation biofuels, Renewable and Sustainable Energy Reviews, Volume 74, July 2017, Pages 1131-1146

In the allocation process, land used for cellulosic ethanol must directly or indirectly compete with land utilised for conservation or livestock cultivation. Direct competition occurs when biofuels are planted on land that was previously designated for conservation, as opposed to indirect competition, which occurs when food crops are replaced by biofuels, which then replace conservation acreage.[20]

Numerous forest species, including endangered animals, can employ oil palm plantations if large swaths of forest are allowed to remain adjacent to biofuel facilities. It has been demonstrated that chimpanzees can exploit oil palm plantations as a source of food by consuming the young leaves, blooms, and fruits when other options are limited. If there are still some remaining native forest tracts, populations of large and medium-sized felids may frequent oil palm farms. However, when certain species are regarded as pests or are intentionally killed, unpleasant encounters between people and wildlife may reduce the advantages.[21]

For the currently favoured feed stocks for the synthesis of ethanol or biodiesel, the net energy return, which is the difference between the energy yield of the fuel and the fossil fuels required for production and processing, is only barely positive. There are two more first-generation biofuels with higher net energy returns: palm oil-derived biodiesel and sugar cane-derived ethanol. However, rising economic pressure to cultivate these crops will make the loss of protected habitat worse when land that was formerly used for other crops like wheat and sorghum is converted to maize production.

Sugarcane is predominantly a food crop in India (it produces sugar), so its potential for meeting biofuel demand may be limited. Currently, sugar molasses is the primary feedstock for ethanol production in India. Molasses cultivation on marginal lands is a viable option, though yields are likely to be low. The National Forest Policy of India prohibits the conversion of forest land to cropland. Furthermore, cropland is unlikely to be converted for biofuel production because it has been stable for more than 20 years, and government support in India is focused on growing biodiesel crops on wastelands. As a result, degraded grassland or wasteland are expected to meet the biofuel land requirement.

The gain of a biofuel crop, the distance between a biofuel manufacturing unit and a biomass source, and the mode of raw material transport are all important factors in determining the amount of emissions associated with biofuel. The production of a biofuel crop, the distance between a biofuel manufacturing unit and a biomass source, and the mode of raw material transport are all important factors in determining the level of emissions associated with the biofuel.

Inaccessibility of Food Prices for Future Generations

The rapidly growing global population and rising use of biofuels, which raised demand for both, made food and fuel shortages worse. Biofuels have significant environmental advantages over traditional energy sources in many ways, in addition to offering energy security, employment opportunities, economic growth, and social security. However, the rapid promotion of biofuels resulted in a sharp polarisation of public and policymaker opinion. Food prices rose due to the production of biofuels from food crops like corn, which raised significant

[20] Salaa Osvaldo E., Dov Saxa,b, and Heather Lesliea,b, Biodiversity Consequences of Increased Biofuel Production, Biofuels: Environmental Consequences and Implications of changing land use, Scintfic Committee on problems of Environment

[21] h Correa Diego F., Beyer Hawthorne L., Possingham Hugh P., Thomas-Hall Skye R., Schenk Peer M. Biodiversity impacts of bioenergy production: Microalgae vs. first generation biofuels, Renewable and Sustainable Energy Reviews, Volume 74, July 2017, Pages 1131-1146

moral and dietary concerns. Growing crops for fuel required the use of resources such as land, water, and energy that were also needed to produce food for human consumption.[22]

The conflict over the effect of biofuel production on food security is at the centre of the "food vs. fuel" debate. By 2050, the FAO projects that there will be 9.1 billion people on the globe.[23] Based on certain reviews, the competition for land and other resources, like water, between the production of first generation biofuel and food will cause food prices to increase. Futures trading indicate that high prices will likely persist in the medium term, providing incentives for an increase in biofuel production as a supplement to transportation fuels. Food prices and inflation have risen globally as a result of this, as well as droughts and animal diseases.

Food price increases are the result of a number of factors. Higher biofuel demand has resulted in higher corn and soybean prices, as well as price increases on substitute crops and increased the cost of livestock feed by providing incentives to switch away from other crops.

The new ethanol-blending target focuses primarily on food-based feedstocks, with the government claiming that the programme is a "strategic requirement" in light of grain surpluses and widespread availability of technologies. However, the blueprint differs from the 2018 National Policy on Biofuels, which prioritised grasses and algae; cellulosic material such as bagasse, farm and forestry residue; and rice, wheat, and corn straw.[24]

Conclusion

Land is also required for feedstock for biofuels, and for the time being, the more uniform the land, the better. There appears to be an inherent conflict. Current and future biofuel demand has the potential to reduce habitat availability, biodiversity value, and increase risks for already threatened species due to the factors listed in. Because there are currently constraints on transitioning maize production from food to biofuels, and yield growth has outpaced demand, the need for more land must be met by utilising marginal or abandoned farms. Despite the fact that some of these marginal lands are currently part of the CRP, there are significant economic incentives to plant crops on them.

Gene therapy will be used to develop feed stocks that are more tolerant of difficult growing conditions, extending agriculture's reach into previously unexplored habitats for biodiversity. Does this mean that we will be left with only a few species that can survive in the gaps between crop monocultures or in environments that are too harsh, rocky, or isolated for agricultural production across a large portion of the country?

Though some biofuel feedstocks are clearly superior to others, there is no such thing as the "best" biofuel feedstock. A variety of resources will be required to build a strong, resilient, and sustainable biofuels industry. Existing and emerging feedstocks differ in several ways, including the amount of water they require, how intensively and expensively they must be farmed to produce them, the cost of transportation, their net energy yields, and their carbon debt.

These biomass resources could help biofuels play a role in the transportation sector's transition away from petroleum. To meet transportation demands in a sustainable manner, however, it will be necessary to look beyond simple fuel substitutions and towards significantly improved fuel efficiency as well as internal combustion engine alternatives. Depending on the efficiency

[22] Murali Palanichamy, Prathap Puthira, Hari K., An Economic Analysis of Biofuel Production and Food Security in India, 2016

[23] https://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

[24] https://pib.gov.in/Pressreleaseshare.aspx?PRID=1532265

of cellulosic ethanol conversion, millions of metric tonnes of biomass would be required in addition to the currently available ethanol mixed fuels to meet the statutory advanced biofuel benchmark for renewable fuels by 2030.

As we build the biofuels industry, we must consider the benefits and drawbacks of competing land uses while remaining mindful of biodiversity concerns. Different levels of production have different space requirements. Historically, the most productive lands have been used to grow food crops, while the least productive lands have been used to create wilderness areas, parks, and other natural places.

Agriculture is being pushed into more marginal, less productive terrain thanks to fertiliser, water, and genetic engineering subsidies. Biofuels put increasing pressure on current land uses across a large portion of the undeveloped portion of the productivity gradient, but especially in the most productive areas.

These competing demands highlight the need for a thorough accounting of the costs and benefits associated with various land uses. Recent analyses of biofuel feedstock alternatives have considered the energy costs of cultivating and harvesting crops, the energy required to convert crops into biofuels, the energy required for transportation to and from the production facility to the end user, and the fuel's energy content.[25]

A lack of government support for sustainable supply chain standards and solutions, entrepreneurship support, and subsidies or incentives to encourage competition among bioenergy producers are all significant barriers to biofuel production. Some of the barriers may be removed through the implementation of new policies and strategies, as well as changes to existing ones. To promote the biofuel industry in India, the use of blending biofuel with conventional fuel should be made mandatory, and prices should be subsidised.

Even as supportive government policies and active participation from the neighbourhood community and private businesses can keep the programme running in the short term, a strong long-term strategy is required. Given the available feedstock options, technological state, and regulatory options, the current trajectory is unlikely to be sufficient in the long run. A significant research effort on the development of first, second, third, and fourth generation feedstock is required to meet the nation's future bioenergy needs.

[25] Wiens John, Fargione Joseph, Hill Jason, Biofuels and biodiversity, Environmental Impact of Biofuels,Ecoogical Apllication Volume 21, 2011, page 1085-1095