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A Critical and Methodical Analysis of Trends, Sociotechnical Systems and Policy Choices for the Food and Beverage Sector

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Introduction

There is a clear and pressing need for a more sustainable food and beverage industry. Agriculture alone consumes approximately 200 Exajoules of energy annually on the supply side more than China's or the United States' entire national energy demand. Food production is responsible for approximately 30% of global energy consumption when a comprehensive "farm to fork" (lifecycle) analysis that takes into account agriculture, food processing, distribution, and consumption is included. In addition, the food system is the largest land user on the planet, using 700 million hectares of land for cereal cultivation and 7.5 million hectares for vineyards which is twice as big as India. More than one-third of the food grown, procured, and processed is wasted, an unacceptable loss of resources and nutrients at a time when the demand for food is growing. The global food industry continues to produce highly processed foods like ready-to-eat meals and sugary beverages like soft drinks, both of which have been shown to have negative effects on public health [1].

Description

One study provided a stark summary: "The food and horticulture area is vital to endeavours to further develop general wellbeing today and secure and re-establish normal frameworks important to help great wellbeing later on. More than any other industry, the sector has a direct impact on employment, economic activity, and land and water resources.

According to a different report, the food and beverage industries behind global food systems are directly responsible for some of the most pressing sustainability issues, accounting for 60% of biodiversity loss, 60% of land conversion, 70% of nutrient overloading, and 30% of climate change. Additionally, the food system is responsible for more than fifty percent of the eutrophication of water, a process by which rivers and lakes begin to degrade as a result of an excess of nutrients. For every dollar spent on food, society incurs two dollars in economic, social, and environmental costs-totaling a cost of US$5.7 trillion (in 2019). These various negative costs are referred to as externalities. According to the same report, unsustainable food production processes could result in the deaths of approximately 5 million people annually by 2050-twice as many as the current obesity epidemic [2].

There are a variety of fundamental factors at play in these unfavourable connections between unsustainable food systems, climate change, and each other. Energy and natural resources-not just fossil fuels but also crops, soils, biomass, plastic, steel, and minerals-are necessary for food production and distribution. According to one lifecycle assessment the typical energy and resource requirements required to produce and deliver that food reached approximately 10 J for every 1 J delivered in a final food product consumed by a household. Changes in diet, continued population growth, and the economies that support them have all contributed to an increase in the demand for food and the energy it takes to produce. Between 1980 and 2015, the percentage of energy consumed by the food and beverage industry nearly doubled in places like Indonesia [3].

Surprisingly, signs appear to point to a less sustainable future. From 2004 to 2017, Sweden's food and beverage industry saw a decline in energy efficiency and an increase in energy consumption, both of which were in the wrong direction. Between 1990 and 2005, the amount of energy required to produce a ton of meat in Europe increased by 14 percent to 48 percent. The food manufacturing sector in the United States was found to be the worst performer and responsible for the "highest environmental impacts"-including 20% of national greenhouse gas emissions and 12% of water withdrawals-when a fuller array of the environmental impacts of industry is taken into account. The same study found that truck manufacturing and vehicle manufacturing were less harmful, for comparison [4].

In addition, over the coming decades, the global food system will be subjected to unprecedented pressures, such as competition for scarce land, water scarcity, rising waste flows, drought, and decreasing crop yields and productivity as a result of climate change. Food production requirements are expected to rise by up to 50% by 2030 due to the effects of climate change and the growing global population. The food and beverage industry will collectively require 45 percent more energy and 30 percent more water from agriculture by 2030. The world's population is expected to reach 9.3 billion people by 2050, resulting in a 60% increase in food demand. For examination, in 1960 one hectare of land was adequate to take care of 2 individuals, however in 2050, 1 ha of land will be expected to supply nourishment for five individuals-all in a future climate inclined to additional requirements.

This study takes a rigorously interdisciplinary approach to this seemingly neglected area of decarbonization at this crucial time for industry and the global climate. It asks: What factors determine the energy and carbon footprints of the food and beverage industry? How can the food and beverage industry be made more environmentally friendly and decarbonized? What technological innovations and solutions are currently available to make the industry zero, zero, or even zero carbon? What advantages will come from decarbonizing the sector, and what obstacles will need to be removed? The paper conducts a comprehensive and critical review of more than 350,000 sources of evidence and a short list of 701 studies on the subject of food and beverage decarbonization in order to provide answers to these questions. It also looks at food supply and agriculture, manufacturing and distribution, retail, and consumption and use through a sociotechnical lens.

However, despite the complexity and harm this sociotechnical system causes, 21 also reveal a variety of low-carbon initiatives, highlighted in green, that have the potential to reduce emissions. This includes farm automation and robotics that can help reduce emissions and increase energy efficiency, as well as better management of manure on farms. Along with at least 78 technologies that have the potential to change the world and provide cross-cutting solutions,

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such as steam management or the use of renewable energy, these tried-and-true methods can coexist. Also promising are eight crosscutting options.

Despite the fact that our investigation has revealed that there are numerous financial and economic, organizational and managerial, consumer and behavioral, and organizational and managerial barriers to disseminating these options (shown in grey), there are numerous advantages to doing so (shown in red). The framework overall and the businesses interconnected to it would profit from really enormous decreases in energy use and carbon reserve funds, monetary reserve funds with genuinely fast restitutions, a large group of natural co-benefits, as well as enhancements in specialist fulfillment and wellbeing [5].

Conclusion

Our review also identifies six upcoming research gaps and demonstrates how food and beverage infrastructure, environmental impacts, low-carbon interventions, benefits, barriers, and policies all coevolve in a system. We demand work that better monetizes the sector's global decarbonization costs and benefits; further examination of solutions that span multiple domains; possible synergies that arise from the food and beverage system's coupling and layering with other systems like energy, transportation, or plastics; the recognition of the necessity (and difficulty) of multi-scalar solutions; a lack of food security during the COVID-19 epidemic; furthermore, for additional work on non-Western areas and societies.

Acknowledgement

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Conflict of Interest

None.

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