

Role of Indian Food Industries in Sustainable Development: A Review

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Abstract

The Indian food industry has undergone remarkable growth, positioning itself as a significant player in the global food trade. Its prowess in adding value, particularly within the food processing sector, has established it as a high-growth, high-profit sector within India's economy. Recognizing the pivotal role the food industry plays in the economic development of nations, especially in India, this paper aims to provide a concise introduction to the Indian food industry and underscore its crucial role in achieving sustainable development goals (SDGs). While acknowledging the potential of the industry for promoting sustainable development, it is imperative to understand that innovative breakthroughs can lead to transformative changes, reshaping various aspects of the global food system and presenting both challenges and opportunities for SDG realization. Within this framework, the paper offers an overview of the Indian food industry and its impact on relevant SDGs. It further delves into the challenges and barriers encountered by the Indian food industry in its quest to contribute to SDGs. Lastly, the paper outlines strategies for enhancing sustainability within the industry. The intricate interplay of various SDGs emphasizes the significance of acknowledging the role of food production diversity in establishing crucial connections. This diversity not only directly contributes to multiple SDGs but also holds the potential to spur agricultural development and improve living standards in rural areas. While the SDGs offer substantial benefits for the food industry, it is crucial to acknowledge their limitations, including high implementation costs, sluggish progress, and limited resource availability. As we progress, researchers must actively consider these constraints and seek effective, cost-efficient solutions to expedite progress.

Keywords

Food processing Industries, Sustainable development goals, Zero hunger, Malnutrition and poverty

Introduction

The Future Food Institute's engagement with agro-based food systems and the SDGs has been praised [1]. Their principal purpose is to eliminate poverty, protect plants, and promote wealth, with varied opinions contributing to the goals. Policymakers, food authorities, and local governments use food as a potent weapon to solve environmental challenges and create essential behavioral changes [2]. As we face post-pandemic difficulties, it is clear that our strategy must take into account the human, cultural, environmental, and socio-political components [3]. The SDGs are critical to maintaining food security in industry, communities, and homes. They emphasize the importance of gender equality, hunger, climate change, and resource conservation in achieving food security [4].

The adi women of Arunachal Pradesh, India, are prime examples of how cultural eating customs optimize social and ecological resilience [5]. Traditional local foods are closely linked to their knowledge, access patterns, and socio-cultural institutions. Surprisingly, the plant species used for food, ethnobotany, and animal resources are abundant in isolated adi settlements. With only ten years remaining to achieve the SDGs, there is progress in the area of useful food innovations, but there is also a sense of urgency [6]. Increased efforts are required, especially in areas with high incidence of under-nutrition, to assess food innovations and resolve barriers [7].

Sustainable food systems play a crucial role in achieving clean and healthy food in an equitable and ethical manner. Figure 1 explains the common SDG in the food industry of India and nutritional composition of spirulina. The SDGs provide a valuable framework for a comprehensive sustainability assessment, fostering transparent policy dialogue and actionable insights [8]. Maize agro-food systems are instrumental for ensuring food and nutritional security [9]. Efforts must be coordinated, and investments directed toward optimizing the entire food system, with a specific focus on nutritional aspects [10]. In the context of food systems, the SDGs recognize the influence of different actors and mindsets, with these drivers affecting food system behavior in non-linear ways. Understanding these drivers is pivotal for achieving the SDGs [11].

Since the adoption of the SDGs, there has been a heightened focus on the role of food systems due to their substantial impact on society, the economy, and the environment [12]. The SDGs are particularly significant for the food industry and agro-food systems, with several key points to consider:

Eradicating poverty: A primary goal is to eliminate poverty in all its forms, across all regions. Ending hunger and ensuring food security: It's imperative to put an end to hunger,

achieve food security, and promote sustainable agriculture [13]. Optimizing nutrition plays a crucial role in this endeavor [14].

Ensuring healthy lives and well-being for all ages: Ensuring the well-being of individuals of all ages is a fundamental aspect of the SDGs. Promoting sustainable consumption and production patterns: Sustainable practices in consumption and production are vital for achieving these goals [15]. Despite the efforts made to reduce poverty and improve food security, there remains much work to be done. Shockingly, an estimated 650 million people still suffer from hunger. The issue of food security remains a concern and may even worsen due to the challenges posed by population growth [16].

Impact of sustainable practices on SDGs

The collaboration of the Future Food Institute with agro-based food systems and the SDGs remains a commendable effort. Their primary objective is to combat poverty, protect plants, and promote prosperity while contributing diverse perspectives to the goals is crucial. Food, often hailed as the most significant instrument on Earth, is utilized by policymakers, food authorities, and local governments to address environmental issues and drive necessary behavioral changes. In the post-pandemic era, it becomes evident that our approach must encompass the human, cultural, environmental, and socio-political dimensions [3]. Food security within industry, in local areas, and households plays a significant role in the context of the SDGs. The potential of the SDGs to help achieve household food security is evident. These goals not only recognize the importance of gender equality, tackling hunger and addressing climate change but also contribute to food security and the conservation of vital resources [4].

Cultural food practices, exemplified by the adi women in Arunachal Pradesh, India, are instrumental in optimizing social ecological resilience. Leveraging women's knowledge, access patterns, and socio-cultural institutions, traditional local foods are connected. It's noteworthy that remote adi villages harbor a rich variety of plant species used for food, ethnobotany, and animal resources [5]. The practical and emerging food innovations in the industry aimed at achieving the SDGs are backed by available evidence related to food processing methods, food matrix factors, and nutrient bioavailability. While there is progress, the clock is ticking, with just 10 years left to meet these crucial goals. It's essential to intensify efforts in analyzing food innovations and addressing the constraints, particularly in regions with high levels of undernutrition [7].

Sustainable food systems are paramount in achieving clean and healthy food within the industry. The SDGs provide a valuable framework for comprehensive sustainability assessment, fostering transparent policy dialogue, and providing actionable insights [8]. The maize agro-food systems are key players in ensuring both food and nutrition security in alignment with the SDGs. To reach this goal, coordinated efforts are required, along with investments in agronomic and farming systems to optimize the food system as a whole and prioritize nutritional aspects [10].

Within food systems, the SDGs recognize that drivers emerge from the mindset of various actors, influencing food system behavior in complex, non-linear ways. This under-

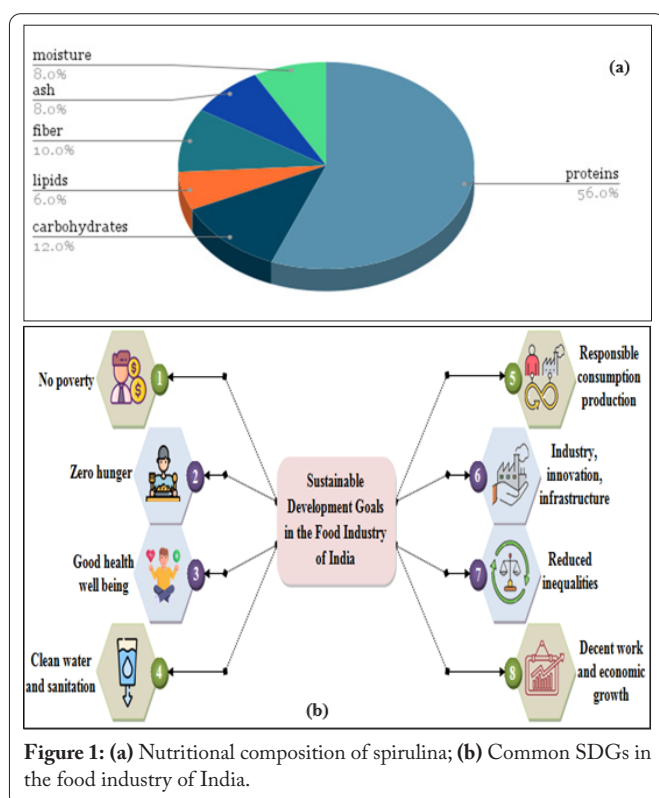


Figure 1: (a) Nutritional composition of spirulina; (b) Common SDGs in the food industry of India.

standing of drivers is critical to achieving the SDGs [11].

SDGs and their relevance to food industry

The food service businesses exhibit distinct characteristics, dealing with diverse situations based on food services and customer needs. Despite variations in services, restaurant and food industry owners confront various challenges. Global food systems encounter challenges like insufficient food access and nutritional insecurity in different periods, shaped by consumer demands and industry standards [17]. Challenges in the food industry encompass plastic ban enforcement, enhancing online visibility, and meeting the growing demand for vegan food. The SDGs play a crucial role in addressing hunger, ensuring food security, and optimizing nutrition [18]. SDGs, with related targets and indicators, provide a pathway for achieving long-term well-being within environmental limits. The sustainable transformation of food systems holds the potential to positively impact progress across most of the 17 Goals.

This paper underscores the importance and role of the food industry in the SDGs [19]. It begins by discussing the list of SDGs related to the food industry, providing an overview of the Indian food industry, explaining the role of Indian food industries in related SDGs, delving into challenges and barriers faced by the Indian food industry in contributing to the SDGs, and finally, discussing strategies for enhancing sustainability.

List of SDGs related to the food industry

The SDGs constitute a global call to action to combat poverty, inequality, protect the planet, and ensure health, justice, and prosperity [20]. Established in 2012, these 17 interconnected goals drive action in various areas, influencing each other's outcomes and contributing to social, economic, and environmental sustainability [5].

While there are 17 SDGs, the food production industry directly connects to eight of these goals, showcasing its significant role in sustainable development [21]:

- SDG 2 (no hunger): Addressing hunger is pivotal for the food industry, ensuring access to sufficient, safe, and nutritious food for all.
- SDG 3 (good health): The food industry's role is critical in providing access to nutritious food, fundamental for good health.
- SDG 6 (clean water and sanitation): The food industry impacts water use and sanitation, making it essential for addressing this goal.
- SDG 8 (economic growth): The food industry significantly contributes to economic growth and employment, aligning with the goal of sustained, inclusive, and sustainable economic growth.
- SDG 10 (responsible production): Responsible and sustainable food production practices are crucial for reducing inequality and promoting social and environmental responsibility.
- SDG 14 (life below water): Sustainable seafood practices and responsible fishing are key areas where the food industry contributes to the protection of life below water.

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- SDG 15 (life on land): Promoting sustainable agriculture and responsible land use is critical for this goal, emphasizing the food industry's significant role.
- SDG 17 (partnership): Collaboration and partnerships are essential for achieving all SDGs, with the food industry playing a role in fostering these partnerships for sustainable development.

The food industry's contribution to these eight SDGs underscores its importance in addressing global challenges related to hunger, health, environmental sustainability, economic growth, and more [14].

Food production is a complex and interconnected industry with a profound impact on several SDGs. While the food industry directly aligns with the eight mentioned SDGs, it's essential to acknowledge its indirect influence and contribution to other goals, establishing it as a significant player in the broader context of sustainable development [5].

The persistent challenge of global hunger, despite substantial food production, emphasizes the need to address not only food quantity but also issues related to access and affordability. The close connection between poverty and the ability to access and afford food makes food security a critical component of the broader anti-poverty agenda. Recognizing and addressing these interconnected challenges becomes paramount for comprehensive sustainable development [22].

The food industry's deep interconnection with multiple SDGs underscores its pivotal role in promoting sustainability, responsible production, and environmental stewardship. These efforts extend beyond achieving specific goals, contributing to the overall well-being of societies and the planet. By actively participating in the pursuit of SDGs, the food industry becomes a driving force for positive change, fostering a more sustainable and equitable world [23].

Overview of the Indian food industry

India holds a significant position in the global food industry, ranking as the world's second-largest producer of food after China, with the potential to claim the top spot [24]. The country's food sector has experienced remarkable growth, particularly within the lucrative food processing industry [25]. Notably, food and food products constitute the largest consumption category in India, contributing nearly 21% to the country's gross domestic product (GDP) and boasting a market size of \$181 billion [23].

As of 2022, the market size of India's food processing industry reached INR 25,455 billion. Projections by IMARC Group indicate further expansion, with the market expected to reach INR 45,345 billion by 2028. This reflects a noteworthy compound annual growth rate (CAGR) of 9.5% during the period from 2023 to 2028. The Indian food industry's substantial growth and market size not only make it a pivotal player in the global food trade landscape but also a significant contributor to India's overall economic prosperity [26].

Contribution of SDGs in the Indian food industries

Incorporating sustainable development practices into the

Indian food industry holds the potential for significant benefits. Primarily, such practices can enhance environmental protection by promoting responsible and sustainable food production methods. Moreover, they can contribute to improving the efficiency of food production, thereby addressing issues of hunger and malnutrition within the country [27]. Encouraging businesses associated with the food industry to embrace the SDGs and integrate them into their operations is crucial for successful implementation. To achieve this, presenting the goals in a business-friendly manner, translating their objectives into language that underscores their necessity and benefits for businesses, is essential. This approach can cultivate a positive perception of SDGs, portraying them as not only beneficial for the planet but also advantageous for sustainable business development [28].

India has proactively taken measures to support farmers, enhance rural incomes, and tackle issues related to under-nutrition and malnutrition in the country [5]. These efforts align with several SDGs, contributing to the sustainable development of the Indian food industry. Table 1 likely provides a detailed breakdown of how specific SDGs closely relate to and contribute to the four key Indian food industries. These contributions underscore the commitment of the Indian food industry to align with SDG and play a crucial role in addressing both national and global challenges.

Table 2 serves as a comprehensive resource, offering a detailed breakdown of the substantial contributions of SDGs to the four key Indian food industries. Drawing from data derived from various reputable sources [29], this breakdown underscores the significance of aligning the goals with the practices of the food industry. Recognizing the progress made in addressing hunger and malnutrition since 2000, the SDGs

emphasize the continued need for focused efforts to eliminate these challenges, particularly in regions like Asia and Africa. Success in nutrition is intricately linked to each of the SDGs, serving as a foundational pillar for sustainable global development [30]. These insights emphasize the pivotal role played by the Indian food industry. Not only does it contribute to its own growth and sustainability, but it also plays a crucial part in advancing broader global objectives related to nutrition, food security, and the elimination of hunger and malnutrition.

Challenges faced by Indian food industry in achieving SDGs

Challenges within the food industry are diverse and can be classified into various categories. The first category encompasses issues related to wastage and contamination, particularly concerning perishable products without proper packaging. The second category involves challenges associated with processed food products, including jams, juices, pickles, dairy, poultry, and chocolates [31]. These products often undergo processing using natural and artificial preservatives to extend their shelf life.

The food system faces complexities in meeting global environmental, social, and economic challenges in the 21st century. Several significant challenges hinder the attainment of SDGs [32]:

Wastage and contamination

The food industry encounters substantial challenges related to wastage and contamination. Improperly packaged perishable products can lead to significant economic losses and environmental concerns. Additionally, contamination, whether from bacteria, viruses, parasites, or chemical substances, can result in foodborne illnesses. Mitigating these challenges and

Table 1: Importance of the 8 SDGs with their relevance to the food industry.

SDGs	Aim/goal	Role in the food industry
SDG 2 (No hunger)	The main aim was that by the year 2030, hunger and all forms of malnutrition should be stopped	There will be better access to food. There will be no poverty and no malnourishment
SDG 3 (Good health)	To prevent needless suffering from preventable diseases and premature death	Only access to safe and nutritious food will ensure healthy lives and promote well-being for all
SDG 6 (Clean water and sanitation)	This goal makes sure to safe drinking water and sanitation for all, concentrating on sustainable management of water resources, wastewater, and ecosystems	Water shortages undercut food security and the incomes of rural farmers
SDG 8 (Economic growth)	This goal has to promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all	Since all forms of hunger and malnutrition stop by 2030, people have sufficient food that will help to optimize economic growth
SDG 12 (Responsible production)	To divide equality per capita global food waste at the retail and consumer levels and also to reduce food losses along production and supply chains, including post-harvest losses	This goal ensures sustainable food production in the industry
SDG 14 (Life below water)	The aim was to enhance the economic benefits of sustainable utilization of marine resources	This goal contributes to food production and functions as a carbon sink
SDG 15 (Life on land)	It focuses on managing forests sustainably, halting and reversing land, and natural habitat degradation, successfully combating desertification, and stopping biodiversity loss	The goal promotes sustainable agriculture, supporting small-scale farmers. It is interconnected with aspects of food production systems
SDG 17 (Partnership)	The aim was to strengthen the global partnership for sustainable development	This goal strengthens the global partnership for sustainable development in the food sector

Table 2: SDGs closely relevant contribution to the 4 important Indian food industries.

SDGs	Indian food industries	SDGs' contribution to Indian food industries
SDG 2 (No hunger)	Britannia industries	Ensure food security for all and also stop world hunger
SDG 3 (Good health)	Hatsun agro products	Hatsun agro product's mean healthiness score of 5.2 and relative category score of 6.8 results in an overall product profile score of 6.0 out of 10, ranking them fifth out of 16
SDG 8 (Economic growth)	Heritage food limited	SDG 8 was followed, and due to revenue from value added products (VAP), it attained an economic growth of 23.8% YoY to INR 2,313 million in Q4-FY23
SDG 12 (Responsible production)	Vadilal industries	The manufacture of goods and services in industry is in an ethical and sustainable way because of SDG 12

aligning with SDG goals necessitates implementing proper food safety measures [31].

Processed food products

The production of processed food items, such as jams, juices, pickles, dairy items, poultry products, and chocolates, presents challenges. These products often require the use of preservatives to extend their shelf life. Ensuring the quality, safety, and nutritional value of these processed foods is crucial, given their significance in the food market [31].

Food safety

Maintaining food safety is of paramount importance to prevent various diseases. Adhering to proper food safety standards and practices is essential for protecting public health. Addressing food safety concerns enables the food industry to contribute to SDG targets focused on improving health and well-being [33].

Poverty

Alleviating poverty is a critical element in achieving food security. People living in poverty often spend a significant portion of their income on food, making them vulnerable to fluctuations in food prices and agricultural output. Reducing poverty is essential for achieving SDG 2 (No hunger) and eradicating hunger [34].

Food fraud

Food fraud, involving deceptive practices in the food industry, poses a significant challenge. It can damage consumer trust and lead to health risks. Detecting and preventing food fraud are crucial for maintaining the integrity of the food supply chain and aligning with SDG objectives [35].

Unclean water and sanitation

Access to clean water and proper sanitation is fundamental for human well-being. Many people worldwide still lack access to these basic services, affecting not only their health but also the sanitation standards of food sector places and restaurants. The challenge of water scarcity due to climate change exacerbates the situation in some regions [36].

Addressing these complex challenges and integrating the SDGs into food industry practices is vital for achieving sustainable development, reducing poverty, ensuring food safety, and contributing to global goals [37].

Strategies for enhancing sustainability in the Indian food industry

Optimizing sustainability in the Indian food industry is a crucial objective, aligning with global efforts to minimize environmental impact and promote responsible waste management. Sustainable food practices aim to reduce contributions to climate change and ensure the efficient use of natural resources throughout the production process [28]. Achieving sustainability involves responsible waste disposal, improving production processes, and encouraging eco-conscious consumer choices, collectively fostering a more environmentally sustainable and socially responsible food processing industry [22]. Several ideas can be implemented to enhance sustainability in the food processing industry:

Enhanced regulations and governance

Effective regulations and governance are pivotal in the Indian food industry. The Food Safety and Standards Authority of India (FSSAI) plays a crucial role in defining regulatory standards for food products and overseeing their manufacturing, storage, distribution, sale, and import. Strengthening internal governance measures and ensuring compliance with external regulations are essential steps to further bolster sustainability [23, 33].

Optimize packaging

Packaging holds significant importance in the food processing industry, and there is a growing consumer willingness to pay for more sustainable packaging. Advanced packaging solutions, equipped with sensors, can be introduced to monitor factors like temperature, humidity, and food freshness. This empowers consumers to make informed decisions about storage and consumption, contributing to sustainable practices [20, 38].

Reduce food waste

Addressing food waste is a critical aspect of achieving sustainability in the food industry. The current approach involves recycling, donating, or repurposing food waste, but a more efficient strategy is to minimize waste at the initial production stage. This approach aligns with significant progress towards SDGs [39, 40].

Efficient processes within the food industry

Efficiency is a cornerstone of sustainability in the food

industry. Embracing the concept of a circular economy, which optimizes resources in the manufacturing process, is gaining prominence. The adoption of automation and robotics in food manufacturing, including tasks like packaging, labelling, and sorting, enhances efficiency, reduces labor costs, and boosts overall productivity [33, 34].

Implementing these measures contributes to making the Indian food processing industry more sustainable, environmentally friendly, and aligned with global sustainability goals.

Statistical representation

The market size of the food industry across India was significant in 2015 and is expected to grow from 2016 to 2020. It plays a crucial role in supplying food energy to the global population. Figure 2 shows a visual representation of the market size of the food industry in India for the year 2015, along with forecasts for the years 2016 to 2020 [34] and growth in India's food supply industry. This sector accounted for about 40% of the consumers.

Figure 2 demonstrates the significant economic development of the packaged goods industry, highlighting its substantial contribution to the country's economy [33]. In 2020, the market size for the food industry in India reached around 46 billion U.S. dollars, with expectations for continued growth and an increasing role in global food trade [20]. The growth of the food sector is further accelerated by partnerships with online delivery platforms like Swiggy, Zomato, and Foodpanda, which have expanded their presence across the nation, contributing to exponential growth [21]. Additionally, the SDG index on hunger in India as of 2021 has been analyzed, providing insights into the progress made by states and union territories in addressing hunger and related SDGs [26]. The figure 2 visually represents India's food industry trends from 2015 to 2020 and the SDG index on hunger in 2021 across states and union territories.

Figure 3 represents an assessment of the SDG scores across various states and union territories in India, specifically focusing on the goal of zero hunger (SDG 2). The analysis includes regions such as Chandigarh, Kerala, Goa, Lakshadweep, Punjab, Mizoram, Ladakh, Tamil Nadu, Andhra Pradesh, Manipur, and Nagaland. The SDG index score for zero hunger is shown to have a considerable variation, rang-



Figure 2: Graphical representation of the market size of the food industry across India in 2015 with a forecast from 2016 to 2020.

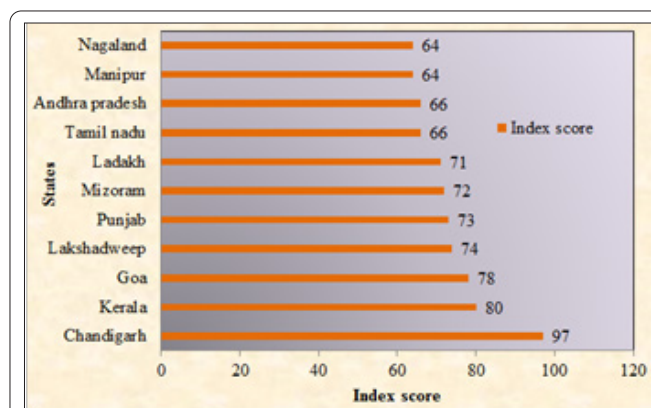


Figure 3: Graphical representation of India in 2015 with a forecast from 2016 to 2020 and SDG index on hunger in India as of 2021 by state and union territory.

ing from 97 to 19 for different Indian states and union territories [24]. Chandigarh stands out with the highest score of 97, showcasing exemplary progress in addressing the goal of zero hunger. Kerala also performs admirably, leading the states with a notable score of 80 in this regard. The figure 3 visually represents the varying levels of achievement in SDG 2 across different regions of India.

Conclusion

The intricate interplay between various SDGs highlights the pivotal role of food production diversity in forging connections and fostering sustainable development. This diversity not only directly contributes to several SDGs but also has the potential to stimulate agricultural development and enhance living standards in rural areas. However, achieving sustainability in the global food system and the food industry poses a significant challenge. The realization of SDGs necessitates the responsible management of substantial transformations across the world's food system, involving millions of farmers, complex supply chains, diverse food-producing industries, and a rich tapestry of food traditions and cultures.

Our exploration has shed light on essential aspects, including the market size of the Indian food industry in 2015, with projections extending from 2016 to 2020. Additionally, we delved into the SDG index on hunger in India as of 2021, categorized by state and union territory. While the SDGs offer substantial benefits for the food industry, it is crucial to acknowledge their limitations, encompassing high implementation costs, slow progress, and limited resource availability. Moving forward, researchers must actively consider these constraints and actively seek effective, cost-efficient solutions to expedite progress and realize the full potential of sustainable development in the food industry.

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None.

Conflict of Interest

None.

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