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Makhana and the Sustainable Development Goals: A Pathway to Nutrition, Livelihoods, and Environmental Sustainability

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Abstract

The Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 provide a comprehensive framework for addressing global challenges such as poverty, hunger, health, and environmental sustainability. Makhana (*Euryale ferox*), also known as fox nut or gorgon nut, is a nutrient-rich aquatic crop traditionally cultivated in eastern and north-eastern Part of India, particularly in Bihar (contribute 85% of total Makhana Production in India). This paper explores the potential relationship between Makhana consumption and the achievement of SDGs, focusing on its

contributions to food security, nutrition, economic growth, and environmental sustainability. By analyzing the nutritional, economic, and ecological aspects of Makhana production and consumption, this study highlights how promoting Makhana can align with multiple SDGs, including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production).

Keywords: Makhana, Sustainable Development, Nutrition, Environmental Sustainability

Introduction

The Sustainable development goals (SDGs) are a set of 17 goals that was adopted by the United Nations in 2015 as a part of the Agenda for Sustainable Development 2030. These goals can be achieved by the innovative and Sustainable Approach across various Sectors such as agriculture, health, and economic development. Makhana (*Euryale ferox*) is an aquatic plant that grows in stagnant water bodies such as ponds and lakes. It is primarily cultivated in India, particularly in the states of Bihar and Assam, as well as in parts of China. The seeds of the plant, commonly known as fox nuts or gorgon nuts, are harvested, processed, and consumed as a snack or ingredient in various dishes. Makhana is rich in protein, fiber, antioxidants, and essential minerals such as magnesium, potassium, and phosphorus. It is also low in calories and fat, making it a healthy food choice. Makhana has been a part of traditional diets in India for centuries, particularly in Bihar, where it is often used in religious ceremonies and festivals. In recent years, its popularity has grown due to its nutritional benefits and versatility in culinary applications. The Makhana industry also provides livelihoods for thousands of farmers and workers, Specially in rural areas where Secondary employment opportunities are limited. During the Presentation of the union budget 2025-2026, the finance minister of India announced the creation of Makhana board in Bihar, highlighted this lesser-known but highly nutritious aquatic crop. Makhana has the Potential to contribute Significantly to Several SDGs. This Paper emphasize the role of Makhana in food Security Promotion, examine the relationship between Makhana Consumption and the SDGs, improving nutrition, supporting livelihoods, and fostering environmental Sustainability.

Review of Literature

The Sustainable development goals (SDGs), adopted by the United Nations in 2015, aim to create a better and more sustainable future for everyone. Many studies have been conducted shows the relationship between Makhana cultivation and its consumption with Some of the Sustainable development goals.

Kumar and Das (2018) [2] has conducted a Comprehensive analysis of Makhana in which they highlighted the nutritional profile of Makhana emphasizing its high protein, Fibre and Mineral Content. The health benefits of Makhana Consumption include its anti-inflammatory and anti-oxidant Properties. It also has Low glycemic Index makes it suitable Snacks for diabetic Patients.

Singh (2020) has explored its importance in improving dietary diversity Composition, specially in the rural area where the availability of nutritional food is limited.

Singh and Singh (2020) [3] and **Bhattacharya (2019)** [4] highlighted the economic significance of Makhana Cultivation in Bihar. The results of the study shows how Makhana Farming provides livelihoods for the Marginal Farmers, Particularly Women and contributes in the Reduction of Poverty (SDG1). Their study also highlighted several Challenges Such as limited Market access and inadequate infrastructure.

Kumar (2020) [8] in his case Study shows that how Makhana Cultivation resulted in the magnification of Income of a Farmer who was Earlier engaged in traditional agriculture Practices.

Mishra (2017) [5] and **Patel (2021)** [6] conclude that Makhana Cultivation has low environment impact as its Cultivation requires less pesticides and chemical requirement and generally cultivated in water-logged area such as Ponds which does not require additional Water (such as Irrigation) compare to other Crops. These findings are align with SDG 12(Responsible Consumption and Production) and SDG 13 (Climate action).

Objectives

1. To Analyze the Nutritional and Health benefits of Makhana and their Alignment with SDG2(Zero Hunger) and SDG3(Good health and Well-being).
2. To Evaluate the Economic and Livelihood impacts of Makhana Cultivation and their Contribution to SDG1(No Poverty) and SDG8 (Decent work and Economic Growth).
3. To Investigate the Environmental Sustainability of Makhana Production and its Relevance to SDG12(Responsible Consumption and Production).



Source: sdgs.un.org

Research Methodology

The Methodology used in this study is basically exploratory in nature. The Study uses existing literature to explore the linkages among Makhana's nutritional value, economic impact, environmental Sustainability and its alignment with the sustainable development goals (SDGs). The study uses secondary source of data such as United nation website (sdgs.un.org), literature, articles and government reports.

Makhana and SDGS

1. SDG 1: No Poverty

Makhana cultivation and processing offer significant economic opportunities for smallholder farmers and rural communities. Bihar, the leading producer of Makhana in the Country having large working population in Primary sector activities, the cultivation of Makhana provides a significant work opportunities in the Mithila and Kosi-seemanchal region of Bihar (north and north-eastern part) where intensive makhana cultivation occurs. Makhana Cultivation is economically sustainable as it provides a significant difference in income from Cultivating other crops such as Paddy (Kumar 2020) [8]. From Production to Processing it provides livelihood to a major segment of population. By promoting Makhana production and improving access to markets, governments and organizations can help reduce poverty and enhance economic resilience in rural areas.

2. SDG 2: Zero Hunger

Makhana is a highly nutritious food that can contribute to addressing malnutrition and food insecurity. Its high protein and mineral content make it an excellent supplement to diets, particularly in regions where access to diverse and nutrient-rich foods is limited. Its Cultivation occurs at the region in Bihar which address severe malnutrition issues among the children. As it's availability at low price at local level certainly address the issues of zero-hunger. Besides this it's cultivation to Processing absorb large amount of labour to earn their livelihood will tackle this issue of hunger. Additionally, Makhana cultivation requires less land and water compared to other crops, making it a sustainable option for increasing food production.

3. SDG 3: Good Health and Well-being

The nutritional properties of Makhana have been linked to various health benefits, including improved digestion, reduced inflammation, better heart health and antioxidant properties (Gupta *et al.* 2019) [7]. Makhana is high in protein and low in fat, making it an excellent dietary option for improving protein intake without increasing fat consumption. It also contains essential micronutrients such as magnesium, potassium, and phosphorus, which are crucial for maintaining health and preventing deficiencies (Shetty, 2009) [9]. Its low glycemic index also makes it suitable for individuals with diabetes. By incorporating Makhana into diets, communities can improve overall health outcomes and reduce the burden of diet-related diseases.

4. SDG8: Decent Work and Economic Growth

The Makhana industry supports employment at various stages of the value chain, from farming and harvesting to processing and marketing. Makhana cultivation provides a significant job opportunities in the rural area for marginal farmers Particularly women (Bhattacharya *et al.* 2019) [4]. By investing in infrastructure, technology, and training, governments can enhance the productivity and profitability of Makhana production, creating more decent work opportunities and fostering economic growth.

5. SDG 12: Responsible Consumption and Production

Makhana cultivation is environmentally sustainable, as it requires minimal chemical inputs and can be grown in natural water bodies without depleting resources. It grows in stagnant water bodies and requires minimal pesticides or synthetic fertilizers. It mainly relies on natural pollination and organic matter which minimises soil and water Pollution (Nutri Makhana 2023). Makhana ponds support aquatic ecosystems fostering fish and other aquatic species by

providing nutrients from the plant and also support inter-cropping pattern such as water chestnuts. On the Consumption aspects, it consider as Super food due to its low calories and high dietary fibre and protein contents. Over the years, Makhana has not only gained popularity in national level but also at International Markets such as united states, Canada, UK and UAE are the largest export destination of Makhana. Promoting Makhana as a sustainable food source aligns with the principles of responsible consumption and production, encouraging consumers to choose eco-friendly and nutritious options.

Challenges and Opportunities:

While addressing the relationship between Makhana cultivation and the Sustainable development goals, there are several challenges and opportunities associated with it

Challenges

Despite its potential, Makhana industry faces several challenges, including limited awareness, inadequate infrastructure, and lack of access to markets. There are a significant loss in the harvesting process as a considerable portion of seeds are stuck in the water bodies. There are limited access of technology to the farmers to improve per hectare yield. Additionally, climate change and environmental degradation pose risks to its cultivation, as change in water availability affects the crop yields.

Opportunities

There are significant opportunities to promote Makhana as sustainable and nutritious food source. Public awareness campaigns, research and developments, and policy support can help overcome barriers and unlock the full potential of Makhana in contributing to the SDGs. The collaboration among governments, private sectors and Makhana processing cluster society is essential to drive innovation and investment in the Makhana Value Chain.

Policy Recommendations

To harness the potential of Makhana in achieving the SDGs we have to focus on some key areas such as to promote research and development to improve cultivation techniques, enhance nutritional values, and develop new products. This will help to increase productivity and expand market opportunities.

In the union budget 2025-2026, the creation of Makhana board to integrate makhana production cluster, will strengthen the value chain of makhana as to support the development of infrastructure, such as processing facilities and storage units, to reduce the post-harvest losses and improve the quality of Makhana products. It will also Facilitate access to market through better transportation and marketing networks. Also by providing training, financial assistance, and technical support to small land holder farmers engaged in makhana cultivation will help improve their livelihoods and ensure the sustainability of Makhana Production.

Conclusion

Makhana consumption has the potential to contribute significantly to the achievement of multiple SDGs, including poverty reduction, food security, health improvement, economic growth, and environmental sustainability. By addressing challenges and leveraging opportunities, stakeholders can unlock the full potential of Makhana as a sustainable and nutritious food source.

Policymakers, researchers, and industry actors must work together to integrate Makhana into sustainable development strategies and ensure its benefits reach communities worldwide.

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