



Makhana Production: Supporting Farmers' Livelihoods and Rural Development

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Makhana (*Euryale ferox* Salisb.), commonly known as fox nut or gorgon nut, is an important high-value aquatic crop predominantly cultivated in Bihar, particularly in the waterlogged areas of North Bihar. It plays a vital role in rural livelihoods by providing income and employment through cultivation, harvesting, processing, value addition and marketing. Women contribute substantially to labour-intensive activities such as harvesting, cleaning, drying, grading, roasting, popping, storage and marketing, making makhana an important source of household income and livelihood security. Despite its economic importance, the sector faces challenges including labour-intensive operations, inadequate mechanization, limited value addition, market constraints and poor access to improved technologies. Strengthening mechanization, extension services, value addition, market linkages and farmer capacity building can improve productivity, profitability and livelihood opportunities. Thus, sustainable development of the makhana sector can contribute significantly to rural employment, women's empowerment and income enhancement in Bihar.

Keywords: Makhana, *Euryale ferox*, farmers' livelihood, farmers' income, rural employment, value addition

Introduction

Makhana (*Euryale ferox* Salisb.), commonly known as fox nut or gorgon nut, is a high-value aquatic crop that plays an important role in the rural economy of Bihar. The crop is predominantly cultivated in the wetlands, ponds, tanks and other waterlogged areas of North Bihar, where favourable soil, water and climatic conditions support its production. Major makhana-producing districts include Madhubani, Darbhanga, Sitamarhi, Saharsa, Supaul, Purnia, Katihar, Kishanganj and Araria. Bihar is recognized as the major makhana-producing region in India, making the crop particularly important for farmers and rural communities dependent on aquatic resources. (icar.gov.in) Makhana production provides an important source of income and employment for rural households, particularly those utilizing low-lying and waterlogged areas that may have limited suitability for conventional field crops. The livelihood benefits extend beyond cultivation to harvesting, seed collection, drying, processing, popping, grading, packaging, transportation and marketing. Thus, makhana supports employment throughout its value chain and provides opportunities for livelihood diversification and rural entrepreneurship. Around five lakh families in Bihar are reported to be directly involved in makhana-related activities, demonstrating its substantial socioeconomic importance. (icar.gov.in) The crop also provides opportunities for small and marginal farmers to generate income from aquatic and otherwise underutilized areas. Makhana seeds are

processed into the edible popped product, which has gained increasing consumer demand as a nutritious and premium food. This growing market has created opportunities for value addition through improved processing, packaging and development of diversified makhana-based food products. Improved production technologies and the release of varieties such as ‘Swarna Vaidehi’ have further contributed to efforts to increase productivity and profitability. (icar.gov.in) Despite its livelihood potential, makhana production remains largely labour-intensive and farmers and processors face challenges related to traditional cultivation practices, harvesting and processing difficulties, inadequate mechanization, limited value addition, market fluctuations and insufficient access to improved technologies. These constraints can reduce labour productivity and limit the income benefits received by farming households. Therefore, strengthening extension services, mechanization, improved cultivation practices, processing technologies, value addition, market linkages and farmer capacity building is essential for improving the profitability and sustainability of the makhana sector. (icar.gov.in) Overall, makhana is more than an aquatic food crop; it is an important livelihood resource for farmers and rural communities in Bihar. Its potential for income generation, employment creation, utilization of waterlogged areas and value-chain development makes it an important crop for livelihood diversification and rural economic development. Promoting sustainable and economically viable makhana production can therefore contribute significantly to improving farmers’ income and strengthening livelihood security in Bihar.

Makhana Production in India

India is the leading producer of makhana (*Euryale ferox*) in the world, with Bihar as the major producing state. Makhana cultivation is mainly concentrated in North Bihar, where it provides an important source of income and employment for rural households. According to the Government of India, makhana production was 63,910 MT in 2024–25, with an average productivity of 2.03 MT ha⁻¹. The production is estimated to increase to 80,590 MT in 2025–26, with productivity of 2.34 MT ha⁻¹. Bihar alone is estimated to produce 60,000 MT in 2025–26. The increasing demand for makhana as a nutritious snack has expanded opportunities for processing, value addition, packaging and marketing. Improved varieties, modern production practices and government support through the National Makhana Board are expected to further enhance productivity, farmers’ income and employment opportunities.

Source of Income

Makhana is an important source of income and employment for rural households in Bihar. In 2025–26, Bihar produced an estimated 60,000 MT of makhana, while India’s total production was 80,590 MT (Government of India, 2026). Around 5 lakh families are directly involved in makhana cultivation, harvesting, popping and marketing (ICAR, n.d.). The crop generates income through seed production, processing, popping, grading, packaging and marketing. India exported 7,264.89 MT of makhana products valued at ₹192.96 crore in 2025–26 (Government of India, 2026). Mechanized popping has also been reported to increase the value of processed makhana by about ₹50 kg⁻¹ compared with traditional processing (ICAR, n.d.). Thus, improved processing, value addition, mechanization and better market linkages can further enhance farmers’ income and livelihood opportunities.

Employment Generation

Makhana cultivation is not only an agricultural activity but also an important source of rural employment in Bihar. About 5 lakh families are directly involved in makhana cultivation, harvesting, popping and marketing (ICAR, n.d.). Employment is generated at different stages of the value chain, including cultivation, harvesting, seed cleaning, processing, popping, grading, packaging, transportation and marketing. The traditional popping process is particularly labour-intensive and time-consuming, involving roasting at temperatures of about 250–320°C and manual popping (ICAR, n.d.). Mechanization of popping can reduce workers’ exposure to intense heat and improve working conditions while supporting value addition and rural employment (ICAR, n.d.).

Livelihood Diversification

Dependence on a single agricultural activity can increase the economic vulnerability of rural households. Makhana provides an alternative livelihood opportunity, particularly in ponds, wetlands and waterlogged areas where conventional field crops may be difficult to grow. Its cultivation allows productive use of such water bodies and generates income through cultivation, harvesting, processing and marketing. Thus, makhana can contribute to livelihood diversification and income security among rural communities in water-rich areas of Bihar (ICAR, n.d.; Government of India, 2026).

Scope for Value Addition

Makhana has considerable potential for value addition through processing and product diversification. Popped makhana can be used to prepare products such as makhana kheer, halwa, roasted snacks, flakes, cookies, mixtures and other ready-to-eat products. Processing and packaging can improve product quality, shelf life and marketability while creating additional income opportunities for farmers and rural entrepreneurs. Development of value-added products can therefore strengthen the makhana value chain and enhance farmers' returns (ICAR, n.d.; Government of India, 2026).

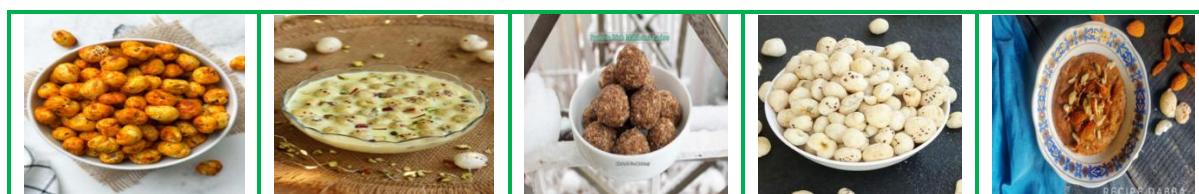


Fig.1. Product Diversification in Makhana: From Popped Makhana to Kheer, Halwa, Snacks, Cookies and Other Ready-to-Eat Products.

Contribution to Women's Employment

Women make an important contribution to the post-harvest handling and processing of makhana, particularly in activities such as cleaning, grading, sorting and processing. These activities provide employment opportunities for rural women and contribute to household income. The traditional processing of makhana is labour-intensive and provides opportunities for women to participate in the rural value chain (ICAR, n.d.). Women's participation can extend beyond processing to packaging, marketing and other value-added activities, creating opportunities for additional income generation. Strengthening women's participation through skill development, improved processing technologies, self-help groups and better market linkages could further enhance their economic contribution to the makhana value chain (Government of India, 2026).

Growing Demand for Healthy Food

Makhana has gained increasing attention as a nutritious snack and food ingredient because of its carbohydrate and protein content and relatively low fat content. Makhana seeds contain several minerals and other bioactive compounds, which contribute to their nutritional value (Jana et al., 2019). The calorific value of raw makhana seeds has been reported to be approximately 362 kcal per 100 g, while the composition of the edible popped product varies with processing conditions (Sundarraj et al., 2017). The growing interest in healthy snacks, plant-based foods and value-added food products has increased the market potential of makhana. Popped makhana can be consumed directly as a snack and can also be incorporated into products such as flavoured snacks, breakfast foods, sweets and other processed foods. This increasing demand provides opportunities for processing, value addition and improved returns to makhana growers (Government of India, 2026).

Challenges in Makhana Production

Labour-Intensive Production

Traditional makhana cultivation, harvesting and processing require substantial manual labour. Harvesting seeds from water bodies is physically demanding, while traditional popping and processing are time-consuming operations. The high labour requirement increases production

and processing costs and can limit the scalability of traditional production systems (ICAR, n.d.).

Limited Mechanization

Makhana production and processing are still largely dependent on traditional practices, particularly in harvesting and popping. Limited availability of suitable machinery and technical knowledge can reduce labour efficiency and processing capacity. Mechanization of important operations, particularly popping, therefore remains an important requirement for improving efficiency and working conditions (ICAR, n.d.).

Marketing Constraints

Farmers may face difficulties in obtaining better returns because of limited market linkages, dependence on intermediaries and inadequate access to organized markets. Strengthening farmer–market linkages, branding, packaging and organized marketing channels is important for improving farmers' share of the value generated from makhana. The Government of India has included market development, branding and export promotion among the objectives of the Makhana development programme (Government of India, 2026).

Inadequate Value Addition

Limited access to modern processing, grading, packaging and storage facilities can restrict value addition and product diversification. Traditional processing methods are often labour-intensive, while improved processing technologies can enhance efficiency and product quality. Development of processing and value-addition infrastructure is therefore important for increasing the economic returns from makhana production (ICAR, n.d.; Government of India, 2026).

Limited Access to Improved Technologies

Limited access to improved planting material, scientific production practices, training, machinery and post-harvest technologies can constrain productivity and profitability. Stronger linkages among research institutions, extension agencies and farmers are required to improve technology transfer and adoption. The Government of India has introduced support for production improvement, research, extension, capacity building and post-harvest management through the Makhana development programme (Government of India, 2026).

Makhana Life Cycle and Seasonal Schedule for Fish Stocking, Harvesting, and Nursery Management

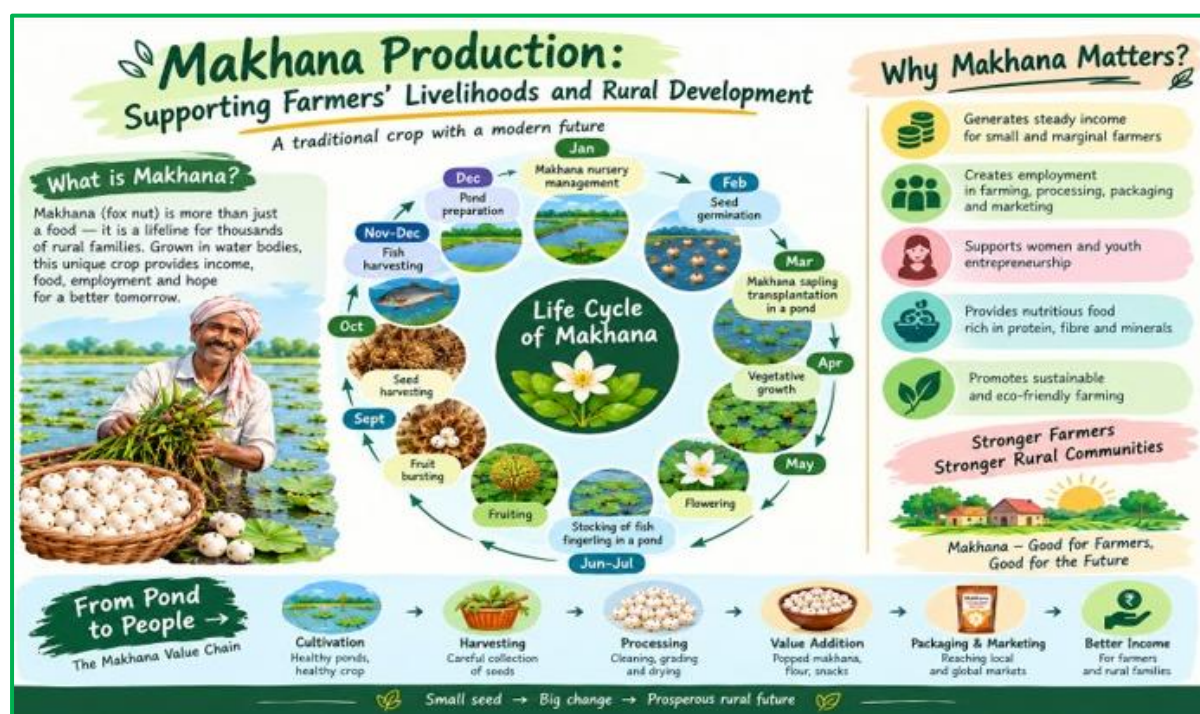


Fig.2. Life cycle stages of makhana plant along with the appropriate timing for fish fingerling stocking and harvesting.(June to October) and indicates makhana nursery management period (January to March)

Role of Extension Services

Agricultural extension services play an important role in improving makhana production, processing and farmers' livelihoods. Farmers need technical knowledge on improved varieties, scientific cultivation practices, pond- and field-based production, water and nutrient management, harvesting, post-harvest handling, processing, mechanization and value addition. Extension support is also important for packaging, branding, market information, digital marketing and entrepreneurship. Krishi Vigyan Kendras (KVKs), agricultural universities, ICAR institutions, research organizations and government agencies can support farmers through training programmes, demonstrations, exposure visits and capacity-building activities. The Government of India's current makhana development programme also emphasizes research, extension, capacity building, post-harvest management, processing, value addition and market development (Government of India, 2026). Effective extension can help farmers adopt improved production and processing technologies, reduce dependence on traditional practices and improve the quality, productivity and profitability of makhana. Strengthening research-extension-farmer linkages is therefore essential for sustainable development of the makhana sector.

Future Prospects

The makhana sector has considerable potential for improving productivity, farmers' income and rural livelihoods. Future development should focus on the adoption of improved varieties and scientific production technologies, expansion of field-based cultivation and greater mechanization of cultivation, harvesting and processing. Increased value addition, improved packaging, branding and quality management can enhance the marketability and economic value of makhana products. Strengthening domestic and export markets, improving farmer-market linkages and ensuring better price realization are also important for increasing farmers' returns. The sector also offers opportunities for rural entrepreneurship, women's participation and youth employment through processing, value addition, packaging and marketing. Strengthening research, extension services, training and capacity-building programmes will be essential for wider adoption of improved technologies. The establishment of the National Makhana Board provides an important institutional framework for supporting production, post-harvest management, processing, value addition, research, extension, branding, marketing and export promotion (Government of India, 2026).

Key Future Prospects

- ❖ Adoption of improved varieties and scientific production technologies
- ❖ Expansion of field-based makhana cultivation
- ❖ Mechanization of cultivation, harvesting and processing
- ❖ Development of diversified value-added products
- ❖ Improved packaging, branding and quality management
- ❖ Strengthening of domestic and export markets
- ❖ Better market linkages and price realization
- ❖ Promotion of rural entrepreneurship
- ❖ Greater participation of women and rural youth
- ❖ Strengthening of research, extension and capacity-building programmes

Conclusion

Makhana (*Euryale ferox* Salisb.) is an important livelihood crop, particularly for rural communities of Bihar. Its value extends beyond cultivation to harvesting, processing, popping, packaging, value addition and marketing, creating diverse income and employment opportunities. However, labour-intensive practices, limited mechanization, inadequate processing, technology gaps and marketing constraints continue to restrict its full potential. Strengthening extension services, mechanization, value addition, entrepreneurship and market linkages can improve farmers' returns and livelihood security. Greater participation of women and rural youth in processing and value-added enterprises can further strengthen the makhana

value chain. Thus, coordinated efforts among farmers, researchers, extension agencies, government institutions and markets are essential for making makhana.

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