



## Marketing Behaviour and Constraint Prioritisation among Foxnut Growers in Bihar

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### ABSTRACT

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Foxnut or makhana (*Euryale ferox* Salisb) is an important aquatic crop linked with wetland-based livelihoods, rural employment and emerging health-food markets in Bihar. The present study analysed marketing behaviour and identified the major constraints faced by foxnut growers in three major makhana-producing districts of Bihar: Madhubani, Saharsa, and Purnia. A descriptive and exploratory research design was adopted. Primary data were collected from 120 growers in six villages using a structured interview schedule. The data were analysed using frequency and percentage, Pearson correlation, multiple linear regression, and Rank-Based Quotient (RBQ) analysis. Results revealed that product quality was the most important selling consideration for 38% of respondents, while word of mouth (42%) and social media (41%) were the dominant buyer-contact methods. Most growers sold through local vendors (46%) or professional agents/traders (38%), and the average reported selling price was Rs. 982.5 per kg. Regression results showed that education, marital status, family income, pond type and landholding significantly influenced marketing behaviour, with the model explaining 65.3% of the adjusted variation. RBQ analysis identified a lack of credit facility, a lack of pond/land ownership and a lack of scientific knowledge as the top constraints. The study recommends FPO-based aggregation, credit linkage, market intelligence, scientific training and localised processing infrastructure to improve farmer bargaining power and market participation.

### 1. Introduction

Foxnut, locally known as makhana, is derived from the aquatic plant *Euryale ferox* Salisb. and occupies a distinctive position in Bihar's agrarian economy. It is cultivated largely in ponds, wetlands and low-lying waterlogged ecosystems, where conventional field crops may not offer comparable

returns. The crop is valued not only as a food commodity but also as a livelihood resource for fishing and wetland-dependent communities. Its relevance has increased further due to rising demand for low-fat, gluten-free, and nutrient-dense snacks in urban and export-oriented food markets (Kapoor et al., 2022; Mir et al., 2021). The commercial promise of foxnut, however, is not automatically translated into

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equitable farmer income. The primary producers continue to operate in a semi-organised marketing system in which local traders, village-level aggregators, middlemen, processors, and wholesalers control much of the value chain. Earlier studies on foxnut marketing and value chains have repeatedly indicated that farmers receive only a limited share of the final consumer price, as processing, grading, branding, and retail margins are captured by downstream actors (Singh et al., 2020). Similar concerns have been reported for marketing efficiency and price spread in makhana-growing areas of Bihar, where distance from organised markets and lack of collective bargaining reduce producer margins (Sah et al., 2013).

Marketing behaviour is a useful analytical lens for examining how growers make decisions about selling time, buyer selection, quality consideration, market channel and price negotiation. In high-value but weakly organised crops such as foxnut, marketing behaviour is not determined by market price alone. It is influenced by education, household income, land or pond tenure, access to information, processing ability, credit availability, and the pressure to meet immediate cash needs. A grower who has storage, working capital and market information can wait, grade and negotiate; a grower without these resources generally sells quickly to the nearest trader. Hence, the study of marketing behaviour must be linked with the institutional and socio-economic conditions of growers.

Constraints in the cultivation and marketing of foxnuts are multidimensional. Credit shortage, insecure pond ownership, lack of improved varieties, high labour cost, shortage of skilled operations and inadequate scientific knowledge have been reported as recurrent problems in the sector (Ahmad et al., 2020; Kumar et al., 2021; Sonu & Jha, 2025). The labour-intensive nature of harvesting and popping, combined with limited mechanisation, increases production risk and reduces smallholders' capacity to participate in value-added markets. Processing technologies, such as seed-grading equipment, can improve efficiency, but adoption remains uneven among small growers (Sundaram et al., 2014).

In this context, the present article focuses specifically on marketing behaviour and the prioritisation of constraints among foxnut growers in Bihar. The study is important for two reasons. First, Bihar is the core production region for makhana and therefore offers a relevant setting for understanding farmer-market relations. Second, the commercial expansion of makhana will remain socially incomplete unless grower-level constraints are addressed through

credit, collective marketing, extension support and local processing infrastructure. The article, therefore, attempts to generate evidence useful for policy, extension planning and value-chain strengthening.

## 2. Review of Literature

The literature on foxnut in India may be grouped into three broad streams: production ecology and agronomy, nutritional and processing potential, and marketing or livelihood dimensions. Agronomic studies emphasise that foxnut is well suited to wetlands and waterlogged environments, making it a viable crop for flood-prone regions and underutilised aquatic ecosystems (Kumar et al., 2016; Kumar et al., 2020). Integrated aquaculture systems involving foxnut and fish have also been reported to improve wetland productivity and generate additional returns for farming households (Singh et al., 2017).

A second body of literature highlights the food, nutraceutical and processing potential of foxnut. Studies report that popping and processing influence the physicochemical, antioxidant and technological properties of makhana seeds (Devi et al., 2020). The crop has attracted attention as a superfood due to its nutritional profile and its use in functional food formulations (Kapoor et al., 2022; Mir et al., 2021). This increasing demand strengthens the market potential of makhana but simultaneously exposes the gap between consumer-end growth and producer-end benefits.

Marketing-focused studies show that the makhana value chain is characterised by weak producer organisation, limited branding, inconsistent quality standards and substantial dependence on intermediaries. Singh et al. (2020) similarly reported that value-chain inefficiencies limit farmer profitability despite rising demand. Studies on price spread and marketing efficiency in Bihar indicate that farmers are disadvantaged when they lack access to direct markets and organised selling arrangements (Sah et al., 2013).

Research on constraints indicates that production and marketing problems are interlinked. Lack of pond ownership restricts long-term investment, while a credit shortage prevents timely purchases of inputs, hiring of labour, and adoption of improved technologies (Ahmad et al., 2020). Knowledge gaps are also serious because foxnut cultivation requires a specialised understanding of pond ecology, water management, harvesting, drying, roasting, popping and grading. Kumar et al. (2021) emphasised the importance of traditional knowledge in makhana cultivation, but recent studies have also

highlighted the need to integrate traditional wisdom with scientific extension and capacity-building approaches (Sonu & Jha, 2025).

### 3. Materials and Methods

The study employed a descriptive, exploratory research design. This design was appropriate because the investigation aimed to describe the existing marketing behaviour of foxnut growers and identify the underlying constraints affecting their participation in the market. The study was conducted in three major makhana-producing districts of Bihar: Madhubani, Saharsa and Purnia. These districts were selected because of their strong association with foxnut cultivation, availability of ponds and wetlands, and dependence of local communities on aquatic crop-based livelihoods.

A multi-stage sampling procedure was followed. From each district, two blocks were selected, and from each selected block, one village was covered. The final sample comprised 120 foxnut growers, with 20 respondents per village. Primary data were collected through a structured interview schedule covering socio-economic characteristics, marketing behaviour, price realisation, buyer-contact methods, selling channel, market challenges and perceived constraints. Secondary information from the literature, institutional publications, and earlier

studies was used to support the interpretation of the findings.

Marketing behaviour was assessed using selected indicators, including important selling considerations, the method used to reach potential buyers, common selling approaches, preferred selling times, immediate buyer categories, and actual prices received. Descriptive statistics, including frequencies and percentages, were used to summarise respondents' responses. Pearson correlation was used to examine associations between selected independent variables and marketing behaviour. Multiple linear regression was applied to estimate the combined influence of socio-economic and farm-related variables on marketing behaviour. The model included age, gender, marital status, education, family type, family size, family income, debt status, pond type and landholding as predictors.

Constraints were prioritised using Rank Based Quotient (RBQ) analysis. Respondents ranked the identified constraints by perceived severity. The RBQ score was calculated using the formula:  $RBQ = [\sum f_i(n + 1 - i) / (N \times n)] \times 100$ , where  $f_i$  is the frequency of respondents assigning the  $i$ th rank,  $n$  is the number of constraints, and  $N$  is the total number of respondents. Higher RBQ scores indicated more severe constraints. Ethical care was taken to ensure voluntary participation and confidentiality of respondents.

**Table 1. Distribution of Sample Respondents**

District	Block	Village	No. of respondents
Madhubani	Rahika	Basuara	20
Madhubani	Jhanjharpur	Santnagar	20
Saharsa	Kahra	Rohua	20
Saharsa	Sattar Kataiya	Sattar Kataiya	20
Purnia	Krityanand Nagar	Satkodariya	20
Purnia	Kasba	Barsuni	20
Total			120

### 4. Result and Discussion

#### 4.1 Marketing considerations and buyer-contact methods

Marketing behaviour among foxnut growers was first examined by examining the factors considered when selling makhana and the methods used to reach potential buyers. The findings show that quality was the most important factor for 38% of respondents, followed by quantity (22%), location (21%) and high selling price (19%). This indicates that growers recognise the market value of product quality, although their actual ability to grade, process

and store the produce remains limited. Quality consciousness is an encouraging sign because processed and graded foxnuts generally receive better prices in the market.

The most common method for reaching potential customers was word of mouth (42%), followed closely by social media (41%). This finding reflects the wider post-COVID shift in Indian agriculture, where information technology and digital communication tools became increasingly important for farmer information access, marketing communication and linkage with buyers (Prusty et al., 2021). Newspaper advertisements accounted for 15%, while radio

advertisements were almost negligible at 2%. This pattern suggests a transitional marketing environment. Traditional interpersonal networks remain important, but digital exposure is emerging among growers and local market actors. However,

social media use should not be confused with organised digital marketing; without grading, packaging, payment security and logistics support, social media alone cannot guarantee better farmer returns.

**Table 2. Marketing Considerations and Buyer-Contact Methods among Foxnut Growers**

Indicator	Category	Frequency	Percentage (%)
Selling consideration	Quality	46	38
Selling consideration	Quantity	26	22
Selling consideration	High selling price	23	19
Selling consideration	Location	25	21
Buyer-contact method	Social media	49	41
Buyer-contact method	Radio ads	2	2
Buyer-contact method	Newspaper ads	18	15
Buyer-contact method	Word of mouth	51	42

**Table 3. Selling Channel, Market Challenge and Price Realisation**

Indicator	Category	Frequency	Percentage (%)
Immediate buyer category	Direct sale	19	16
Immediate buyer category	Local vendor	56	46
Immediate buyer category	Professional agent/trader	45	38
Best time to sell	After harvest season	74	62
Best time to sell	Any time through the year	46	38
Marketing challenge	Lack of market infrastructure	53	44
Marketing challenge	Price fluctuation	67	56

#### 4.2 Selling channel, selling time and price realisation

The marketing channel used by growers reflects the level of market access and bargaining capacity. Although direct selling is generally preferred in theory because it can reduce dependence on intermediaries, the actual buyer pattern shows that most growers depend on local vendors and professional traders. In the present study, 46% of respondents sold through local vendors, 38% through professional agents or traders, and only 16% reported direct sales. This confirms the continued dominance of intermediary-led marketing in the foxnut sector.

Regarding selling time, 62% of respondents reported selling after the harvest season, and 38% reported selling at any time during the year. This finding should be interpreted carefully. Selling after harvest may reflect the availability of produce and immediate cash needs rather than strategic price timing. Without adequate storage, working capital and price information, farmers may not be able to hold produce for more favourable market conditions. Price fluctuation was reported as the major marketing challenge by 56% of respondents, while 44% identified the lack of market infrastructure as a major problem.

Price realisation varied across respondents. The average reported selling price was Rs. 982.5 per

kg. Most respondents were concentrated around the middle price bands: 30% received Rs. 1000 per kg and 27% received Rs. 900 per kg. Only 8% reported receiving Rs. 1200 per kg. The distribution suggests that a small proportion of growers can capture higher prices, likely because of better quality, processing capacity, market linkage, or bargaining position. The majority remain tied to moderate price bands, which is consistent with the observed dependence on intermediaries.

**Table 4. Actual Price Received during Foxnut Sale**

Price received (Rs./kg)	Frequency	Percentage (%)
800	17	14
900	32	27
1000	36	30
1100	25	21
1200	10	8
Average selling price		Rs. 982.5/kg

#### 4.3 Determinants of marketing behaviour

The regression model was statistically useful in explaining marketing behaviour among foxnut growers. The adjusted R<sup>2</sup> value was 0.653, indicating that approximately 65.3% of the variation in marketing behaviour was explained by the selected

socio-economic and farm-related variables. Education, marital status, family income, pond type and landholding emerged as significant predictors.

Education had a strong positive effect on marketing behaviour, indicating that more educated growers are likely to access price information, understand buyer requirements and adopt improved selling strategies. Family income also showed a significant positive effect, suggesting that financially stronger households may have greater capacity to

wait, transport, process or negotiate. Landholding had the strongest positive coefficient, confirming that resource ownership improves market participation. Marital status was also significant, possibly because household responsibilities and family labour arrangements influence marketing decisions. The pond type showed a significant negative association, suggesting that farmers operating under leased arrangements behave differently from pond-owning farmers due to commercial pressure and the need to recover lease costs.

**Table 5. Multiple Linear Regression of Selected Variables with Marketing Behaviour**

Variable	Coefficient	Std. error	t-value	p-value
Intercept	0.0876	1.7464	0.05	0.9601
Age	-0.0072	0.0181	-0.40	0.6925
Gender	0.2450	0.3603	0.68	0.4979
Marital status	2.0111	0.6222	3.23	0.0016
Education	1.4711	0.1810	8.13	<0.0001
Family type	0.5379	0.3699	1.45	0.1488
Family size	-0.0678	0.1061	-0.64	0.5241
Family income	0.0000	0.0000	7.37	<0.0001
Debt status	-0.8394	0.4373	-1.92	0.0575
Pond type	-1.0953	0.5223	-2.10	0.0383
Landholding	2.9904	0.3342	8.95	<0.0001
<b>Model summary</b>	<b>R<sup>2</sup> = 0.682; Adjusted R<sup>2</sup> = 0.653</b>			

#### 4.4 Constraint prioritisation through RBQ analysis

RBQ analysis was used to prioritise eight major constraints reported by foxnut growers. The lack of a credit facility emerged as the most severe constraint, with an RBQ score of 60.00. This finding is important because foxnut cultivation requires expenditure on pond preparation, labour, harvesting, drying, popping and sometimes lease payments. Without timely and affordable credit, farmers become dependent on informal finance or are forced to sell produce early to traders. The second-ranked constraint was lack of ownership of pond or land, with an RBQ score of 58.65. Tenure insecurity discourages investment in pond improvement, scientific water management and long-term productivity enhancement. Lack of scientific knowledge of cultivation ranked third with an RBQ score of 56.15, indicating that extension gaps remain serious even in traditional makhana-growing regions. Highly skilled operations and high labour costs both recorded RBQ scores of 55.94, indicating that labour intensity and skill dependence continue to restrict scaling and profitability. The results demonstrate that institutional and knowledge-related constraints are more critical than purely physical constraints. Credit, tenure and knowledge form the core bottleneck. This means that policy intervention should not be limited to promoting production; it must include credit

linkages, lease security, farmer training, collective marketing and local processing facilities.

**Table 6. Rank Based Quotient Analysis of Constraints Faced by Foxnut Growers**

Sl. No.	Constraint	RBQ score	Rank
1	Lack of credit facility	60.00	I
2	Lack of ownership of pond/land	58.65	II
3	Lack of scientific knowledge of cultivation	56.15	III
4	Highly skilled operation	55.94	IV
5	High labour cost of cultivation	55.94	V
6	Lack of improved variety	54.90	VI
7	Increased number of producers	54.37	VII
8	Short lease period	54.06	VIII

#### 5. Discussion

The findings confirm that foxnut growers in Bihar operate in a market environment where demand is expanding but grower-level market power remains weak. The high importance given to quality shows that farmers understand the relationship between quality and price. However, the dominance of local vendors and professional traders shows that quality

awareness alone is insufficient. Without grading units, processing support, collective aggregation and reliable price information, farmers cannot fully convert quality into higher income.

The strong role of education in explaining marketing behaviour is consistent with the broader literature, which shows that education improves information access, market awareness, and the adoption of improved practices. Sonu and Jha (2025) emphasised the need for location-specific extension programmes to reduce knowledge gaps among makhana growers. The present findings support that recommendation and suggest that market literacy should be included alongside production training. Farmers require practical information on grading, price discovery, negotiation, packaging, storage and digital buyer engagement.

Family income and landholding were significant predictors, indicating that better-resourced growers have greater capacity to participate in markets. This is a critical equity issue. If high-value foxnut markets are accessed mainly by better-resourced growers, commercialisation may increase inequality within producer communities. Therefore, collective institutions such as Farmer-Producer Organisations, cooperatives and self-help group-based processing units are necessary to include small and resource-poor growers in higher-value channels.

The constraint ranking further strengthens this interpretation. Lack of credit, insecurity over pond/land ownership, and lack of scientific knowledge are structural constraints. They cannot be solved by asking individual farmers to become more entrepreneurial. The appropriate response must involve institutional credit, transparent leasing arrangements, public extension, mechanisation support and market infrastructure. Singh et al. (2020) noted that value-chain inefficiencies reduce the benefits accruing to primary producers; the present findings show the grower-level mechanisms through which this happens.

The limited use of direct sales, despite its potential benefit, also deserves attention. Direct marketing can reduce intermediary margins, but it requires volume, consistency, quality assurance and logistics. Individual small growers cannot easily meet these requirements. FPO-based aggregation can solve this by pooling produce, standardising quality, negotiating with processors and linking growers with urban retailers or e-commerce buyers. Such institutional arrangements would also make credit delivery and training more efficient.

## 6. Conclusion

The study concludes that marketing behaviour among foxnut growers in Bihar is shaped by both individual capabilities and structural market conditions. Growers recognise the importance of quality, buyer contact and price realisation, but their actual marketing choices remain constrained by dependence on local vendors and traders. Education, marital status, family income, pond type and landholding significantly influenced marketing behaviour, indicating that socio-economic position affects the ability to participate effectively in markets. Constraint prioritisation showed that the lack of a credit facility, pond/land ownership, and scientific knowledge were the most severe constraints. These findings suggest that improving foxnut farmer livelihoods requires an integrated strategy combining credit access, tenure security, scientific extension, processing infrastructure and collective marketing institutions. The expansion of foxnut as a high-value health-food commodity will be socially meaningful only when primary growers capture a fairer share of the value chain.

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