

Supply Chain of Makhana Marketing and Processing in Bihar

SANDEEP KUMAR SOURAV,

Research Scholar,

P.G. Department of Commerce,

Bhupendra Narayan Mandal University, Madhepura, Bihar

ABSTRACT

Makhana, a GI tagged produce, also known as fox nut or gorgon nut, is an important aquatic cash crop having both nutritional and medicinal values. India produces 90 per cent of the world production, but its commercial cultivation is confined to northern Bihar. In Bihar, Makhana is mainly cultivated in the flood prone areas' of Mithilanchal, Kosi and Seemanchal regions of the state, accounting for 90 per cent of India's total makhana production. During last decade several initiatives have been made to boost makhana sector by ramping up production with marketing and strengthening the farmers. Despite all, the sector is highly unorganized and besieged with much inefficiency. Hence, the present study was conducted in two selected districts representing two different ACZs of Bihar, with a sample of 200 makhana cultivators along with a few processors and traders, as case studies. The results show that the area and production of makhana has been substantially increased during the last decade. Per acre net returns were estimated as Rs. 18093 and Rs. 21241 on production of makhana seeds in traditional and field systems of cultivation respectively. Among the constraints, the biggest were use of traditional cultivars, lack of mechanical processing and dominance of traders for production, processing and marketing of makhana respectively. The supply chain of the produce varies according to chain of intermediaries and channels. Further, the study recognizes the immense scope of development, if the identified constraints are suitably addressed.

Keyword- cultivated, production, several initiatives, traditional

Introduction

Makhana (*Euryale ferox* Salisbury), an important aquatic cash crop, is unique, highly nutritious dry fruit mainly grown in stagnant perennial water bodies; like ponds/jalkars, land depressions, oxbow lakes, swamps, ditches and low lying agricultural fields. It has tremendous potential to support the livelihood of resource poor farmers, particularly belonging to the fisherman/mallah community in the Eastern region of India, where agriculture is, by and large, complex, diverse and risk prone. It has a fair distribution in North-Eastern and Eastern Regions, Jammu & Kashmir, however, commercial cultivation is confined only in the northern part of Bihar. In order to tap the potential of seasonal water bodies of Eastern and North-Eastern regions, Makhana cultivation offers a unique opportunity. It is a cash crop and marketed in the form of popped Makhana commonly known as Makhana *lawa*. India produces 90 per cent of the world production of makhana.

In Bihar, Makhana is mainly cultivated in the flood prone areas' and is an important crop of Mithila and Kosi-Seemanchal regions of the state. Its cultivation is highly tedious, cumbersome, labour intensive and involves human drudgery. Bihar is a leading producer of Makhana, accounting for 90 per cent of India's total production. Of the 38 districts in Bihar, Makhana is largely cultivated in 09 (*nine*) districts namely; Sitamarhi (*Tirhut Division*), Darbhanga & Madhubani (*Darbhang Division*), Saharsa & Supaul (*Kosi Division*) and Araria, Kishanganj, Purnea & Katihar (*Purnea Division*). These districts are in north-eastern

part of Bihar and lie sequentially in Mithilanchal, Kosi and Seemanchal regions and Agro-climatic zones – I (North-West Alluvial Plain) and II (North-East Alluvial Plain) respectively of Middle Gangetic plain region.

Makhana is a crop that goes under 100 per cent processing and the entire system of Makhana processing is manual till date, which is carried on by the generations from time immemorial. The popping process is highly skilled, tedious, time consuming and painstaking. Most of the experts of this technology belong to the women population of a specific *Mallah* (fishermen) community of north Bihar. Natural concentration of these experts is limited to a few parts of north Bihar particularly in Darbhanga and Madhubani districts and that is why the processing of Makhana is restricted to Bihar only. After processing Makhana pops are sold to local and distant markets situated across the country. Major markets of Makhana seeds in Bihar are Darbhanga, Madhubani, Katihar and Purnea districts while the major markets for processed Makhana outside the state are in Delhi, Varanasi, Kanpur and Indore. But the Makhana supply chain is lengthy as there are many market intermediaries between the farm gates to the end product markets.

The year 2014 was a game changing year for the Makhana sector when the Prime Minister in the course of Parliamentary Election campaigning vowed to boost Makhana cultivation, processing and marketing. Subsequently initiatives made by the Government of India and Government of Bihar have helped the Makhana sector in ramping up production with marketing and strengthening the farmers. Further in 2020, out of the major economic package of INR 20 lakh crores made under the *Atmanirbhar Bharat Abhiyaan* during the COVID – 19 pandemic, a Scheme of Rs. 10,000 crores was announced for Micro Food Enterprises (MFEs) to promote ‘vocal for local with global outreach.’ Under the Scheme Makhana was one out of six selected producers. In August, 2022 Government of India awarded the Geographical Indication (GI) tag to Mithila Makhana. It led to extending of Makhana Vikas Yojana in 11 districts, spread over Kosi-Seemanchal and Mithilanchal regions of Bihar. Under the scheme, the Government of Bihar provides financial assistance @ Rs. 72750/ hectare for area expansion. All these efforts brought happiness to Makhana growers as the prices of Makhana were highly remunerative till 2021 but thereafter it again fell tremendously, calling the attention of policy makers and functionaries. Keeping this brief approach or rationale in background, this study is an attempt to study acreage, production, yield rate and extent of marketable surplus of makhana; to estimate the cost of production of makhana; to identify the supply chain of makhana marketing; to trace the methods, extent and possibility of processing of makhana; to identify the constraints in production and marketing of makhana and to review existing interventions & suggest policy measures for necessary improvement.

Methods and Coverage

The study is based on both primary and secondary data and information. Primary data was collected from two selected districts for the year 2021-22. These were from two different agro-climatic zones. These were Darbhanga from agro-climatic zone-I and Katihar from agro-climatic zone-II. Darbhanga is one, out of three potential districts in ACZ-I where cultivation of makhana is traditionally done in ponds/jalkars ecosystem and also recognized as natural adobe of makhana production. In Katihar, makhana cultivation is largely practiced in fields system and it is one out of the six makhana potential districts in ACZ-II. In fields system, makhana cultivation is carried out in agricultural fields at a water depth of at least 1 foot. Similarly from each of the chosen districts, two blocks and villages/cluster of villages were selected for in depth study. A sample of 50 makhana cultivators from each of the

selected blocks/villages randomly drawn from the composite list of growers, prepared with the help of local people and stakeholders for the purpose of study. This way a total of 200 makhana cultivator forms the size of the sample for analyzing the results. Besides, a few processors and traders were also selected for understanding the processing and marketing aspects of makhana. For measuring marketing efficiency different methods were applied. Ranking of problems of respondents was worked out by Garret's method.

Result and Discussions

Area, Production and Yield Rate

Bihar is the leading producer of Makhana, accounting for about 85 per cent of total production of India and also in the world. Out of the 38 districts of the state, it is cultivated largely in nine (09) districts namely; Sitamarhi in Tirhut division, Darbhanga & Madhubani in Darbhanga division, Saharsa & Supaul in Kosi division and Araria, Kishanganj, Purnea and Katihar in Purnea division. These districts are in the north-eastern part of Bihar and lie sequentially in Mithilanchal, Kosi and Seemanchal regions of the state. Of the nine, seven (07) districts touch the international borders of Nepal and Bangladesh. These districts lie in the state's sub-zone – I (North-West Alluvial plain zone) and II (North-East Alluvial plain zone) of the Middle Gangetic plain region. Makhana production in Bihar is limited to such areas which are flood prone having high average annual rainfall. Farmers take makhana as an aquatic cash crop in North Bihar where about 5 lakh families mostly from fishermen community are directly involved in its cultivation, harvesting and processing (ICAR, 2019).



Fig. 1 Makhana cultivation in ponds

Makhana is a minor crop with limited production and acreage. Till 1980s there was no reliable database about the area under makhana cultivation. However, as per latest available data, the area under makhana cultivation in Bihar has increased from 13000 ha in 2012-13 to 35224 ha in 2021-22, registering an increase of 170 per cent during last nine years. Similarly the seed production increased from 20800 tones to 56389 tones and pop production from 9360 tones to 23656 tones during the same period, registered an increase of 171 and 153 per cent respectively. The average yield rate of makhana seed production was estimated at around 16 qtl. per ha during the period. The recovery rate of makhana pop was found to be 41 to 45 per cent. The year wise and district wise area and production of makhana in Bihar are depicted in tables – 1 & 2.

Table 1: Area and Production of Makhana in Bihar

Particulars	2012-13	2019-20	2020-21	2021-22	% Change in 2021-22 over 2012-13
Area (ha)	13000	27887	29584	35224	(+) 170 %
Seed Production (MT)	20800	44638	47534	56389	(+) 171 %
Pop Production (MT)	9360	18048	20634	23656	(+) 153 %

Source: Bihar Makhana --- at a Glance (2023), Directorate of Horticulture, Department of Agriculture, Government of Bihar, Patna

Table 2: District wise Area, Seed Production and Makhana Pop Production in Bihar (2021-22)

SN	Districts	Area (ha)	Seed Production (tones)	Pop Production (tones)
1.	Darbhanga	4389	7421	2969
2.	Madhubani	4160	7281	3012
3.	Sitamarhi	146	277	112
4.	Purnea	5549	11653	5234
5.	Katihar	6043	11759	4858
6.	Saharsa	4443	5267	2167
7.	Supaul	5463	5183	2260
8.	Madhepura	2461	2908	1180
9.	Araria	1427	2640	1056
10.	Kishanganj	1143	2000	800
	Total	35224	56389	23656

Source: Bihar Makhana --- at a Glance (2023), Directorate of Horticulture, Department of Agriculture, Government of Bihar, Patna

Marketed Surplus

In regard to the marketed surplus, APEDA's estimates (2017), data reveals that about 50,000 MT of makhana is annually produced and out of it about 2 per cent is consumed domestically, leaving a large marketable surplus. Choudhary *et. al.* (2003) in their study estimated the yield of makhana at 1982 kg/ha and out of that 12.54 kg (0.63%) was retained for seed purpose. Out of the total quantities of makhana (1982 kg - 12.5 kg = 1969.46 kg/ha) is available for processing. On an average 826.78 kg edible popped makhana was obtained, showing thereby a recovery of 41.98 per cent. Home consumption of edible makhana accounted for 15.26 kg/ha. Thus on an average marketable surplus and marketed surplus accounted for 811.52 kg and 809.78 kg which were 98.15 per cent and 97.94 per cent respectively of total/ha edible makhana produced (826.78 kg). Being a high value cash crop marketable and marketed surplus were quite high and a very negligible quantity is retained for self consumption. Moreover, Mahawar in 2016 wrote that makhana exhibits high marketable surplus. Home consumption of edible/popped makhana accounted for 1.72 per

cent and 3.46 per cent as wastages, 3.5 per cent for payment of wages and other and the remaining 88 per cent was estimated as marketed surplus.

Socio-Economic Profile of Selected Makhana Growers

Table 3 presents a brief profile of selected Makhana growers in four village clusters spread across four development blocks of two selected districts. As mentioned earlier that 100 Makhana growers were selected from each of the sample districts representing to the different system of makhana cultivation, constituting a total of 200 makhana growers for this study. The age group classification of the sample respondents reveals that about 63.50 per cent were in the group of 36-59 years followed by 20.50 per cent in the 18-35 years' age bracket and 16.00 per cent in 60 years and above age groups. On the educational status majority of sample growers were literate and had received education up to graduation and above levels. Of the total, 47.50 per cent were just literate and 7.00 per cent illiterate followed by 23.50 per cent who had attained primary education, 14.50 per cent secondary education, 6.00 per cent higher secondary and 1.50 per cent graduation & above levels including 0.50 per cent BE degree holders at the overall level. The social classification data reveals that 70 per cent were from OBC category constituting 40.50 per cent from non-mallah and 29.50 per cent mallah (fishermen) communities followed by general (24.50%) and scheduled castes (5.50%).

Table 3: Profile of Sample Makhana Growers

Particulars		Traditional : Pond/Jalkar ACZ – I: Darbhanga (N = 100)	Field System ACZ-II: Katihar (N=100)	Total (N=200)
A	Age Group (%)			
a.	18-35 yrs	17.00	24.00	20.50
b.	36-59 yrs	68.00	59.00	63.50
c.	60 yrs & above	15.00	17.00	16.00
B.	Educational Qualifications (%)			
a.	Illiterate	9.00	5.00	7.00
b.	Literate	43.00	52.00	47.50
c.	Primary	26.00	21.00	23.50
d.	Secondary	17.00	12.00	14.50
e.	Higher Secondary	5.00	7.00	6.00
f.	Graduation & above	---	3.00	1.50
C.	Social Group (%)			
a.	Scheduled Castes	4.00	7.00	5.50
b.	Scheduled Tribes	---	---	---
c.	General	26.00	23.00	24.50
d.	OBC- Mallah	31.00	28.00	29.50
e.	OBC-Non Mallah	39.00	42.00	40.50
D.	Primary Occupation (%)			
a.	Agriculture	59.00	48.00	53.50
b.	Agri. Lab	4.00	3.00	3.50
c.	Service	9.00	2.00	5.50
d.	Business/Trade	17.00	21.00	19.00
e.	Others	11.00	26.00	18.50
E.	Secondary Occupation (%)			
a.	Agriculture	24.00	32.00	28.00
b.	Agri. Lab	17.00	9.00	13.00
c.	Service	---	3.00	1.50
d.	Business/Trade	18.00	10.00	14.00
e.	Others	4.00	3.00	3.50
F.	Avg. Size of Family (In Persons)	5.02	5.71	5.37
G.	Family Members Engaged in Makhana Cultivation (In Persons)	2.08	2.01	2.04

Source: Primary Survey.

Agriculture was the primary occupation for 53.50 per cent and secondary occupation for 28.00 per cent of the sample growers. Other primary occupations were business and trade for 19.00 per cent, others (18.50%), service (5.50%) and agricultural labour (3.50%). On an average, household size was 5.37 persons per family and of them 2.04 members per family were engaged in makhana cultivation.

Besides, on overall level, per household net operational area of the sample growers was 2.39 acres. The annual rental value of land was reported to be Rs. 16045 per acre. Major source of irrigation was bore well, largely run by the electric energy under agriculture connection. Among the crops grown by the sample farmers at the overall level, area under paddy (40.22%) was the largest followed by wheat (19.10%), maize (16.12%), rabi pulses (10.29%), vegetables (7.32%) and others (7%). Cereals accounted for nearly 76 per cent. The cropping intensity was calculated at about 146 per cent.

Households' Area under Makhana Cultivation

On an average, per household net operated area under Makhana cultivation was 2.02 acres and of it 1.84 acres (91.08%) was leased-in. It shows that Makhana cultivation is largely done by marginal and small cultivators who did not possess much of their own land rather largely depended on leased-in ponds/jalkars. The annual average rental value of leased-in area was reported at Rs. 17813 per acre (table 4).

Table 4: Holding of Makhana Area (In acre/household)

SN	Particulars	Traditional : Pond/Jalkar ACZ – I: Darbhanga	Field System ACZ-II: Katihar	Total
1.	Owned Area	0.58 (25.78)	0.36 (23.26)	0.47 (23.26)
2.	Leased-in Area	1.67 (74.23)	2.02 (113.48)	1.84 (91.08)
3.	Leased-out Area	0.01 (0.44)	0.60 (33.71)	0.31 (15.34)
4.	Net Operated Area	2.25 (100.00)	1.78 (100.00)	2.02 (100.00)
5.	Rental Value (Rs./acre)	18400	17225	17813

Source: Primary Survey.

In brackets percentage figure is shown.

Cost of Cultivation of Makhana Seeds

The average per acre cost of cultivation of Makhana seeds was Rs. 41930 in the traditional system whereas it was a bit higher estimated at Rs. 46175 in the case of the field system. This may be due to higher rental value of land and irrigation expenditures. The component/item wise data on cost reveals that harvesting of Makhana seeds is a major activity where cost was the highest among all other items. The average cost of harvesting was Rs. 19775/acre and Rs. 18842/acre in traditional and field systems respectively. These accounted for nearly 48 and 41 per cent respectively of the total costs. Generally Makhana seeds are harvested in three different phases, which are locally called as *LOUSAR* (1st harvesting), *MARKAT* (2nd harvesting) and *CHARKAT* (3rd harvesting) particularly in Kosi-Seemanchal region. In fact the harvested output declines in each subsequent phase while the cost of harvesting every unit of seed increases sharply. Hence, farmers stop harvesting seeds after the third phase, because in subsequent phases the marginal cost of harvesting becomes higher against the marginal returns. Moreover, the second major component was cost on leasing of ponds/land. It was Rs. 15935/acre and Rs. 17950/acre respectively and in terms of percentage of total costs these were about 38 almost equal on both the systems. If these two cost components are taken together, its share is about 86 and 80 per cent to total costs respectively. Among other items, irrigation cost which was Rs. 2650/acre (5.74%), is important particularly in the field system of cultivation. Makhana is an aquatic crop that

requires at least 2-3 feet standing water in the field. Generally fields are filled with water by submersible pumps run by electricity supplied by agriculture feeders. As Makhana is traditionally cultivated in flood prone districts, the demands for fertilizer and manure are relatively low, so it costs Rs. 745/acre and Rs. 932/acre respectively, accounting for about 2 per cent of the total costs of cultivation. On an average the costs of cleaning ponds and fields were Rs. 1550/acre (3.70%) and Rs. 1230/acre (2.66%) and seeds & seedlings Rs. 1210/acre (2.89%) and Rs. 1809/acre (3.92%) respectively. The costs on miscellaneous items were Rs. 870/acre (2.08%) and Rs. 912/acre (1.98%) respectively.

As regards the output, it was on an average 7.55 quintals/acre and 8.48/acre respectively and the average selling price was reported to be Rs. 7950/quintal. Though there were wide fluctuations in the selling price of Makhana seeds, which declined to even Rs. 5000 per quintal. However, the last year's peak price was reported to be Rs. 16000/quintal. Further looking at the return per acre, the gross and net returns obtained by the farmers were Rs. 60023 and Rs. 18093 respectively in case of traditional system and Rs. 67416 and Rs. 21241 in case of field system. Per quintal cost of production of Makhana seeds was calculated at Rs. 5554 and Rs. 5457 respectively. The cost-benefit ratio on production of Makhana seeds was calculated at 1:1.43 and 1:1.46 respectively (table 5).

Table 5: Per Acre Cost of Cultivation of Makhana Seeds (In Rs)

SN	Items/Particulars	Traditional : Ponds/Jalkars	Field System
1.	Leasing of Pond/Jalkar/Land	15935 (38.00)	17950 (38.87)
2.	Cleaning	1550 (3.70)	1230 (2.66)
3.	Seeds/Seedlings	1210 (2.89)	1809 (3.92)
4.	Fertilizer/Manure	745 (1.77)	932 (2.02)
5.	Irrigation	---	2650 (5.74)
6.	Weeding	1645 (3.92)	1850 (4.00)
7.	Harvesting	19975 (47.64)	18842 (40.80)
8.	Miscellaneous (Transportation, bags, storing etc.)	870 (2.08)	912 (1.08)
Total Cost (Rs.)		41930 (100.00)	46175 (100.00)
a.	Output (Qtl.)	7.55	8.48
b.	Selling Price (In Rs./Qtl)	7950	7950
c.	Gross Return (Rs.)	60023	67416
d.	Net Return (Rs.)	18093	21241
e.	Cost of Production of Makhana Seeds (In Rs./Qtl)	5554	5497
f.	C B Ratio	1:1.43	1:1.46

Source: Primary Survey.

In brackets percentage figure is shown

Cost of Processing of Makhana Seeds

The processing of Makhana involves various post harvest activities such as sun drying of harvested Makhana seeds, size grading, preheating and tempering, roasting and popping, polishing, grading and packaging. The entire system of Makhana processing is almost manual as no successful machine has been in operation till now, despite several trials and claims. However, CIPHET, Ludhiana had developed a Makhana processing machine in the last decade but the same was not in practice even after many changes. The popping process is done manually, which is highly skilled, time consuming and pain taking. Majority of the skilled labourers of this technology belonged to the limited women population of 'Mallah' community of north Bihar. The entire process is conventional, which is passed on to the generations from time immemorial. Perhaps this may be the only reason that processing of Makhana is restricted to Bihar only.

As regards the cost of Makhana processing, cost of raw seeds, labour charges and costs of fuel are the major items of processing activity. The data presented in table 3.8 shows the cost of processing of Makhana seeds. The average cost of processing incurred on per quintal of Makhana seeds was Rs. 8101 including cost of raw seeds whereas it was Rs. 2575/quintal excluding raw seeds. Cost of raw seeds constitutes a significantly larger portion of the total cost of Makhana processing. It was on an average Rs. 5526/quintal, constituting 68.21 per cent of total processing cost. Cost associated with labour charges constituted another major component, which was Rs. 1810/quintal, accounting for 22.34 per cent of the total processing cost. Puffing of Makhana requires intensive and repeated roasting of seeds. This necessitates fuel worth Rs. 289/quintal (3.56%) of the total processing cost. Transportation, packaging and other costs constituted 1.56 per cent, 0.96 per cent and 3.56 per cent respectively (table 6).



Fig. 2: Manual processing of Makhana

Table 6: Cost of Processing of Makhana Seeds (In Rs./Qtl)

SN	Items/Particulars		Cost (In Rs./Qtl)
i.	Cost of Raw Seeds (In Rs./Qtl)		
	a.	Ponds system	5554
	b.	Field system	5497
		Average Cost	5526
			5526.00 (68.21)
ii.		Fuel	289.00 (03.56)
iii.		Labour Charges	1810.00 (22.34)
iv.		Packaging	78.00 (00.96)
v.		Transportation	126.00 (01.56)
vi.		Others (Pots, storage, etc.)	272.00 (03.56)
		Total Cost	8101.00 (100.00)
		Cost of Processing of Makhana Seeds	2575.00

Recovery rate: @44.25kg/ql.
 Avg. selling price of makhana pop: @ Rs. 340/kg
 Total value of makhana pop: Rs. 15045/- (Rs. 340 x 44.25 kg)
 Net return: Rs. 15045-8101 = Rs. 6944

Source: Primary Survey.
 In brackets percentage to total shown

The net return was estimated at Rs. 6944/quintal at a recovery rate of 44.25 per cent and average selling price of makhana pop at the rate of Rs. 340/kg. So the final product fetches relatively higher net profits, provided the prices of makhana seeds and puffs do not abruptly fall, as evidenced in post-COVID-19 period.

Supply Chain and Marketing Channels

Supply chains are the routes through which produce moves from the point of production to the point of consumption. These are alternative paths and the chain of intermediaries through which Makhana passes from producers to consumers. Moreover, the survey revealed that marketing and distribution of popped makhana involve multiple intermediaries depending on time of sale and the destination market. Besides, no support either infrastructural or financial is given for makhana processing and marketing. The key players involved in supply chains are; producers, processors, commission agents, wholesalers, retailers and consumers. The marketing of makhana in the study region i.e., in local as well as distance markets is prominently reported to be carried out mainly through three different marketing channels, which are as below:

- i. *Producer --- Aggregator --- Processor (Phodia) --- Local Wholesaler/ Trader --- Distant Wholesaler --- Retailer --- Consumer.*
- ii. *Producer --- Processor (Phodia) --- Local Wholesaler/Trader/Commission Agent --- Wholesaler (Distant or Regional) --- Retailer --- Consumer*
- iii. *Producer --- Processor (Phodia) --- Trader --- Retailer --- Consumer.*

In this way, there are mainly two tracks i.e., distant and local. In channel – I, Makhana is marketed in distant markets rather in big cities across the country whereas in channel - II, selling to local or regional city markets and in channel – III is meant for local markets. So far as the disposal of Makhana through different channels is concerned, it was observed that 70-80 per cent of total Makhana was marketed through distant wholesalers in major cities i.e., channel - I, 20-25 per cent to regional markets through channel – II and 10-15 per cent sold in local markets through channel-III. The producers usually chose the channel for disposal of their produce on the basis of scale of production, location and distance of markets and financial conditions either of producers or processors or both. Moreover, Makhana is mainly cultivated in 11 districts but the major markets are Darbhanga and Madhubani in Mithilanchal and Purnea & Katihar in Kosi-Seemanchal regions. These are the places where processing of Makhana seeds are made into popped Makhana.

Price Spread

Market functionaries move the commodities from the producers to consumers. In marketing of agricultural commodities, the difference between price paid by consumer and price received by the producer, an equivalent quantity of produce has traditionally been referred to as the price spread. Table 7 presents the marketing margin in sequence.

Table : 7 Price Spread of Makhana through different Marketing Channels (In Rs./quintal of Makhana Seed).

SN	Particulars	Channel – I	Channel – II	Channel - III
i.	Net price received by the Producer for Makhana Seeds	8040 (38.19)	7952 (34.20)	7958 (40.58)
ii.	Purchase price of Aggregator	8040	---	---
iii.	Cost insured by Aggregator	152 (0.72)	---	---
iv.	Purchase price of Processor	8429	7952	7959
v.	Net margin of Aggregator	237 (1.26)	---	---
vi.	Price of Makhana Pop received by the Producer (RR @ 44.25%)	9215	9370	9382
vii.	Cost incurred by the Processor	342 (1.62)	468 (2.01)	479 (2.44)
viii.	Net price received by the processor	444	950	945
ix.	Purchase price of Makhana Pop by local wholesaler (LWS)/Trader	9547	9609	9487
x.	Cost incurred by LWS/Trader	117 (0.56)	103 (0.44)	417 (2.13)
xi.	Net margin of LWS/Trader	1830 (8.69)	2108 (9.07)	2277 (11.61)
xii.	Purchase price of distant wholesaler (DW)	11494	11820	---
xiii.	Cost incurred by distant wholesaler	667	667	---
xiv.	Selling price of distant wholesaler to retailer	16671	16997	---
xv.	Net margin of distant wholesaler	4510 (21.43)	4510 (19.40)	---
xvi.	Purchase price of retailer	---	---	12181
xvii.	Selling price of retailers to consumers	21050 (100.00) @ Rs. 475.71	23245(100.00) @ Rs. 525.31	19609 (100.00) @ Rs. 453.78
xviii.	Cost incurred by the retailer	398 (1.89)	442 (1.90)	459 (2.34)
xix.	Net margin of the retailer	3981 (18.91)	5706 (24.54)	6969 (35.54)
xx.	Producer's share in consumer's rupee (%)	38.19	34.20	40.58
xxi.	Price spread	13010 (61.81)	15293 (65.80)	11651 (59.42)
xxii.	Total cost of marketing	1676 (7.96)	1680 (7.23)	1355 (6.91)

Source: Calculated on the basis of primary data.
In brackets percentage figures are shown

The difference between price at producer's and consumer's level in a perfectly competitive market situation consists of marketing costs and margins. These are indicators of efficiency of the marketing system. Higher the difference between marketing cost and margin, the lower the efficiency and vice-versa. The absolute value of marketing costs and margins varied across channels, markets and time. The data presented in table 7 reveal many facets of price spread.

Marketing Efficiency

For measuring Marketing efficiency in Makhana, four alternate methods were worked out (table 8). The traditional method suggests that channel – II was more efficient than other channels but the price received by the producer in this channel was the lowest, so this is not suitable. In *Shepherd's method*, as suggested channel – III was more efficient but it did not consider the price received by the producer. According to the modified marketing efficiency channel – II was more efficient but the margins of market functionaries as compared to marketing cost were very high. *Acharya suggests* channel - II followed by channels I & III is more efficient.

Table 8: Marketing Efficiency of Makhana under different Marketing Channels

(In Rs./quintal of Makhana seeds)

SN	Particulars	Channel – I	Channel – II	Channel - III
1.	Retailer’s sale price or consumer’s purchase price (PC)	21050	23245	19609
2.	Total marketing cost (MC)	1676 (7.96)	1680 (7.23)	1355 (6.91)
3.	Total margins of intermediaries (MM)	11334 (53.84)	13613 (58.56)	10296 (52.51)
4.	Net price received by producers (FP)	8040 (38.19)	7952 (34.21)	7958 (40.58)
5.	Value added (1-4)	13010	15293	11651
6.	Index of Marketing Efficiency			
a.	Traditional method (TME) (3 ÷ 2)	6.76	8.10	7.60
b.	Shepherd’s method (SME) (1 ÷ 2)	12.56	13.84	14.47
c.	Modified marketing efficiency (MME) (5 ÷ 2)	7.76	9.10	8.60
d.	Acharya’s method (AME) (4 ÷ (2 + 3)	1.62	1.92	1.46

Source: Calculated from primary survey.
 Figures in brackets are percentage of items in retail price.

Borrowing Status

The figures on the borrowing status of the sample growers reveal that altogether 114 growers (57%) borrowed from different sources and average amount of borrowings and outstanding were Rs. 15893 and Rs. 10663 (67% of the borrowings) respectively. About 88 per cent of the borrowers borrowed from the non-institutional sources.

Constraints

The production related constraints (table 9), as perceived by the sample cultivators, use of traditional cultivars was the *Garret’s* first rank constraint. This was followed by uncertainties in profit due to short term settlement of jalkar and renting of field, lack of working capital due to weak economic status of cultivators, drudgerous & costly harvesting, climatic stress, lack of irrigational facilities, numerous inefficiencies in distribution of jalkar, siltation or sand filling of beds of water bodies, lack of technical interventions, health risk to women and children and infestation of aquatic weeds.

Table 9: Major Problems in Production of Makhana

SN	Problems	Garret’s Rank		
		ACZ – I: Darbhanga	ACZ – II : Katihar	Overall
i.	Distribution of jalkiar at the village level is besieged with numerous inefficiencies	II	XI	VII
ii.	Siltation or sand filling of beds of water bodies	V	X	VIII
iii.	Uncertainties in profit due to short-term leasing of jalkar and renting of field	I	VI	II
iv.	Use of traditional cultivars	III	I	I
v.	Lack of working capital due to weak economic status of cultivators	VI	II	III
vi.	Infestation of aquatic weeds	IX	IX	XI
vii.	High health wisk particularly of women & children	XI	VII	X
viii.	Drudgerous and costly harvesting	IV	V	IV
ix.	Lack of technical interventions/backstopping	X	VIII	IX
x.	Climatic stress --- Drought, percolation of water	VII	IV	V
xi.	Lack of Irrigation facilities led to problem of maintaining water level in pond/jalkar/field	VIII	III	VI

Source: Primary Survey

Among the processing constraints (table 10), lack of mechanical processing was the *Garret's* first rank constraint followed by lack of processing cluster or common facility centre, lack of ready to consume local market, drudgery activity, high dependency on traders, small size of output, low demand due to less popularity of the produce, weak socio-economic conditions of processors, lack of infrastructural facilities, migratory life and lack of subsidies on machines, etc.

Table 10: Major Problems in Processing of Makhana

SN	Problems	Garret's Rank		
		ACZ – I: Darbhanga	ACZ – II: Katihar	Overall
i.	Lack of mechanical processing as manual processing requires skilled human labour	III	I	I
ii.	Small size of output	IV	VIII	VI
iii.	Drudgery activity	II	VII	IV
iv.	Lack of subsidy on roasting and popping machines	XI	X	XI
v.	Lack of ready to consume local market	V	II	III
vi.	Lack of infrastructural support	IX	X	IX
vii.	Lack of processing cluster or common facility centre	I	III	II
viii.	Migratory mode of life	X	XI	X
ix.	High dependency on traders	VI	IV	V
x.	Low demand due to less popularity of the produce	VIII	VI	VII
xi.	Weak socio-economic condition of processors	VII	V	VIII

Source: Primary Survey

The makhana marketing system has been well organized in the hands of a few big traders, who dictated the price and earned a lot at the cost of poor farmers. Among the marketing constraints (table 11); due to lack of local demand farmers were completely dependent on organized traders for disposal of their output, followed by formation or cartel by market entities, determination of prices on will and wishes of the wholesalers, lack of makhana mandies in the state, high transportation cost lack of infrastructural support, lack of branding initiatives for makhana and its value added products, being a minor crop hindrance in export, imposition of GST and absence of terminal market in the state.

Table 11: Major Problems in Marketing of Makhana

SN	Problems	Garret's Rank		
		ACZ – I: Darbhanga	ACZ – II: Katihar	Overall
i.	Lack of Infrastructural support	V	VIII	VI
ii.	High transportation costs	IV	V	V
iii.	Cartel of market entities/monopoly position	I	IV	II
iv.	Being a minor crop, hindrance in export	IX	X	IX
v.	Lack of local demand led to dependency on organized traders	II	I	I
vi.	Imposition of GST	X	XI	X
vii.	Lack of terminal market in the state	XI	IX	XI
viii.	Absence of specified mandis in the state	VI	II	IV
ix.	Determination of price is on the will and wishes of wholesalers and not by demand & supply forces	III	III	III
x.	Lack of value added products and its promotion	VIII	VII	VIII
xi.	Lack of brand building exercise by large retail companies	VII	VI	VII

Source: Primary Survey

Conclusion and Policy Suggestions

The study recognizes the immense scope for development in production, processing and marketing of makhana and thus, on the basis of primary survey, observations and discussions with the stakeholders following interventions are required in the area of production, processing and marketing for being a 'Global Hub of Makhana' in Bihar:

- i. Popularization and availability of improved varieties of seeds (*Swarna Vaidehi & Sabour Makhana – 1*) released in 2013 & 2016 respectively for commercial cultivation should be made adequately to increase the production. At present about 400 quintals of improved seeds are produced by two prominent institutions viz., BPS Agricultural College, Purnea (BAU) and ICAR's – Research Centre for Makhana at Darbhanga at 100 per cent subsidy, provided by the Directorate of Horticulture, Government of Bihar. But, there is need for seedlings preparation at the farmers' level for replacing local/landraces from the Makhana jalkars/ponds/fields. Besides, promotion to R & D for crop improvement and harvesting machine, strict and timely adherence to Bihar Fish Jalkar Management Act (2006), cleaning of Jalkars, scientific and technical support etc. are to be ensured.
- ii. In case of processing mechanization is highly needed. This can be addressed by inventing cost effective and successful popping machine. It requires promotion to institutions like CIPHET (ICAR), BAU (Sabour, Bihar) and ICAR's – Research Centre for Makhana Darbhanga, Bihar and other interested entrepreneurs on R & D in popping, roasting and other machines. Besides above, subsidization of machines, establishment of processing clusters/common facility centres at Makhana locations, support to Makhana enterprises for value addition etc. are also required.
- iii. Creation of mass awareness about high nutritional value of Makhana by increasing participation of Makhana industries in exhibition, fair, meet/conclave etc., farmers' integration with markets (domestic & export), forming FPOs/Co-operatives, branding and certification, promoting transportation through railways etc. are the major suggestions for hassle free marketing of the produce.

References

Kumar, L; Gupta, V K; Jha, B K; Singh, I S; Bhatt, B P & Singh, A K (2011). Status of makhana (*Euryale ferox* Salisb). Cultivation in India, Technical Bulletin No. R-32/PAT-21, ICAR Research Complex for Eastern Region, Patna.

Mandal, R N; Saha, G S; Sarangi, N (2010). Harvesting and processing of Makhana (*Euryale ferox salisb*) --- An unique assemblage of traditional knowledge had skills to Indian Journal of Traditional Knowledge 9:684-688.

ICAR (2019). Mechanizing Makhana Popping--- A way to save health of millions and improve livelihood of Makhana growers. Accessed from <https://www.icar.org.in/content/mechanising-makhana-popping-way-save-health-millions> and improve-livelihood-makhana.

Pushyamitra (2021). Bihar farmers take up makhana farming to cope with weather constraints. Retrieved from [www.india.mongabay.com/dated 25 March 2021](http://www.india.mongabay.com/dated_25_March_2021).

Kumar, Anil (2021). Brics countries seek tips on Makhana cultivation, Bihar experts on job. Statement published in Hindustan Times (dailies) dated 26/06/2021.

Govt. of Bihar (2020). Model detailed project report-Makhana Processing, prepared by Directorate of Horticulture, Government of Bihar.

Govt. of Bihar (2023), Bihar Makhana--- at a Glance, Directorate of Horticulture, Patna.

Indian Express (2020). People involved in Makhana production hoping to see better days in Bihar. Published on 20th May.

APEDA (2017). APEDA Export strategy-Part-II-Focus products.

Choudhary, J N; Prakash, O; Jha, P K & Jha, O N (2003). Economic Analysis of Production and Marketing of Makhana in Bihar. Published in MAKHANA (eds) by R K Mishra, V N Jha & P V Dehadrai, ICAR, New Delhi; 2003.

Mahawar, H K (2016). Quoted in Report on Makhana (Fox nut) Production, Processing and Supply Chain from A study on Dynamics of Marketing of Selected Fruits in Bihar, Bihar Institute of Economic Studies, Patna, Bihar authored by S P Sinha (retrieved from <http://agmarket.nic.in/respro3.htm#Project5>). www.makhana.org

Kumar, Anil; Yadav, Pankaj Kumar; Nath, Paras; Patel, V B & Kumar, Rajesh (2020); Sabour Makhana – 1: A New Variety, Indian Horticulture, Vol. 65, No 2.

Patel, V B; Kumar, Anil; Patil, Shridhar; Rahman, S M (2017); An unpublished report on An Analysis of Makhana value chain to enhance farmers integration with market (submitted to NIAM, Jaipur); Bihar Agricultural University, Bhagalpur, Bihar.

Acharya, S S & N L Agrawal (2001); Agricultural Marketing in India (3rd Ed.), Oxford and IBH Publishing Company Pvt. Ltd; New Delhi.