Value Chain Analysis of Makhana

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Foreword

Makhana also known as Fox Nut or Gorgon Nut (*Euryale ferox* Salisbury) is an important aquatic cash crop with both nutritional and medicinal value. The popped Makhana is rich in carbohydrate, protein and minerals while fat content is negligible. It has good quantity of minerals like iron, potassium, calcium, phosphorus and sodium. Due to its high nutritive value and uniqueness, Makhana has emerged as potential crop for export and earning foreign exchange.

In India, it is mainly grown in North Bihar and parts of Assam, Manipur, West Bengal and Odisha. Presently, most of the farmers sell Makhana without primary processing, thereby, not getting remunerative price unlike popped Makhana which is fetching premium price in the market.

This bulletin on "Value Chain Analysis of Makhana" has covered the important aspects like production system, structural, functional and commodity flow analysis of Makhana, costs and marketing margins of different intermediaries in the marketing channels, price variation and export related information. The document will be helpful to farmers towards adoption of correct steps for better remuneration.

I appreciate the efforts of the scientists of ICAR-Research Complex for Eastern Region for bringing out this useful document in the form of Technical Bulletin. I hope, this bulletin will be useful to the planners, policy makers, researchers, farmers and students.

(S.K. Chaudhari)

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PREFACE

Makhana is an important aquatic cash crop of northern Bihar. It is a minor crop having approximately 16,000 ha area in India which yields nearly 24-26 thousand tons of Makhana seed. ICAR Research Complex for Eastern Region, Patna has developed a high yielding variety of Makhana called Swarn Vaidehi and also standardized technology for its cultivation in agricultural field along with other crops. But, there is limited adoption of these technologies resulting in poor productivity of this crop. The crop has immense potential to support the livelihood of lakhs of resource poor farmers especially from fisherman community. The seed of Makhana is processed into popped Makhana mostly by traditional method of processing which includes sun drying, size grading, pre-heating, roasting and popping of lava by the skilled people from Darbhanga, Madhubani, Purnea, Katihar, etc. This primary processing is run as a family business for thousands of farm families largely present in Makhana production areas of Bihar. They purchase seeds from producers or take it from local wholesalers and process it on contract basis. The resource poor processors as well as Makhana growers take money from private money lenders or local wholesalers in advance at higher monthly interest rate of 3-5% leading to their exploitation.

Marketing of Makhana is dominated by few large wholesalers in selected districts who purchase popped Makhana in large quantity, stock it and send it to different parts of the country on demand basis across the year. They dictate the prices of seed and popped lava in local market and due to lack of farmers organization or organized processing industry, producers or processors do not get their due share of benefit in Makhana value chain. Makhana price in national markets like Delhi, Kolkata, Kanpur, Varanasi, Mumbai, etc. are nearly double as compared to local market in production area. There are various intermediaries in value chain including producers, processors, local wholesalers, distant wholesalers, distant retailers, commission agents etc. Due to high number of intermediaries profits get distributed among many resulting in low share of producers in consumer rupees. Therefore, direct marketing is required by decreasing the number of intermediaries in value chain. Formation of Makhana based farmer producer companies will be effective strategy to enhance the profitability of producers and processors. Moreover, effective use of electronic modes of marketing *viz.* online platforms, e-NAM, etc. will allow producers to sell their product across the country.

This document is prepared on different aspects of value chain in Makhana in Bihar state. Research based findings on role of various stakeholders, mapping of value chain actors, marketing channels, margins of different intermediaries, seasonal price variations and opportunities for export of popped Makhana have been

discussed in detail. We hope that the information and findings of this study will be very useful to our planners and policy makers for devising effective strategies for improving Makhana value chain in the country. It will also help researchers, academicians and students to understand the various factors affecting value chain of Makhana and enrich their knowledge on the subject.

Patna
November, 2020 Authors

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Introduction

Makhana also known as Gorgon Nut or Foxnut (*Euryale ferox* salisb.) is an aquatic crop belonging to Nymphaceae family. It is mainly distributed in South East and East Asian countries *viz.* India, China, Nepal, Bangladesh, Japan, Russia, Korea, etc. In India, its cultivation is limited to few states like Bihar, Assam, Manipur, West Bengal, Tripura and Odisha (Kumar *et al*, 2011). Makhana is traditionally grown in stagnant perennial water bodies like ponds, land depressions, lakes, ditches or wetlands having stagnant shallow water depth upto 4-6 ft. For its proper growth and development, optimum range of temperature, relative humidity and annual rainfall are 20-35^{o}C, 50-90% and 100-250 cm, respectively (Mandal *et al*, 2010). Makhana seeds which are small and round having black to brownish outer layer are the edible part of the plant which is consumed in the form of popped lava after processing. Makhana is a highly nutritious food and a very good source of carbohydrate, protein and minerals. Popped makhana contains 12.8% moisture, 76.9% carbohydrate, 9.7% protein, 0.1% fat, 0.5% total minerals, 0.02% calcium, 0.9% phosphorus and 0.004% iron (Shankar *et al*, 2010). It is very popular among Indian households and largely consumed in the form of fried snacks, vegetable curry, sweet porridge etc. Makhana consumption increases during various festivals like Navratra, Kojagara, Eid and wedding season since it is used for various religious rituals and consumed by devotees during their fast as non-cereal food. Cultivation, harvesting and processing of makhana is a highly laborious and time consuming activity which involves a lot of drudgery as well (Khadatakar *et al*, 2015).

Fig. 1. Makhana crop in field, its seed and popped Makhana lava

Makhana Production Scenario in Bihar

Bihar is located in Eastern part of India bordering with Nepal in the north, Uttar Pradesh in the west, West Bengal in the east and Jharkhand in the South. It has an area of 93.6 lakh hectares, nearly 3% of the country's total geographical area but supports 12.63% of Indian population (Bihar Economic Survey, 2018-19). The mighty river Ganga divides the state into two parts, i.e., North Bihar and

South Bihar. North Bihar in general being flood-prone area while South Bihar being drought prone. Around three fourth of the workforce in Bihar depend on agricultural and allied activities for their livelihood. This sector contributes about 20% of state GDP which underlines the importance of agriculture in state economy. Fragmented land holding is a major challenge of agriculture in the state as about 91.2 percent of Bihar's farm households are marginal (holdings of less than 1 hectare), accounting for 57.7 percent of total land area in 2015-16 (Agriculture Census, 2016). Bihar's agricultural economy is primarily cereal based, with more than 85 percent of its gross cropped area under cereals. Rice, wheat and maize are major cereal crops of the state. The state has been divided into four agroclimatic zones (Table 1).

Table 1: Agroclimatic Zones of Bihar

Sl No.	Agro-climatic zones	Name of the Districts	Soil type	Rainfall (mm)	Principle crops
1	**Zone-I,** North Alluvial Plain	West Champaran, East Champaran, Siwan, Saran, Sitamarhi, Sheohar, Muzaffarpur, Vaishali, Madhubani, Darbhanga, Samastipur, Gopalganj, Begusarai	Sandy loam, loam	1040 – 1450	Rice, Wheat, Maize, Arhar; Horticultural crops including Litchi, Mango, **Makhana**, Water Chestnut
2	**Zone-II** North East Alluvial Plain	Purnea, Katihar, Saharsa, Supaul, Madhepura, Khagaria, Araria, Kishanganj.	Sandy loam, Clay loam	1200 – 1700	Maize, Mustard, Jute, Sugarcane; Horticultural crops including Mango, Banana, Bel, Papaya, **Makhana**, Cucurbit
3	**Zone-III A** South East Alluvial Plain	Sheikhpura, Munger, Jamui, Lakhisarai, Bhagalpur, Banka	Sandy loam, Clay loam, loam, Clay	990 – 1240	Rice, Gram, Wheat; Hort. crops including Mango, Guava, Banana, Bel, Jackfruit, Onion, Potato, Chilli, Marigold
4	**Zone-III B** South West Alluvial Plain	Rohtas, Bhojpur, Buxar, Bhabhua, Arwal, Patna, Nalanda, Nawada, Gaya Jehanabad, Aurangabad,			

Source: Department of Agriculture, Government of Bihar

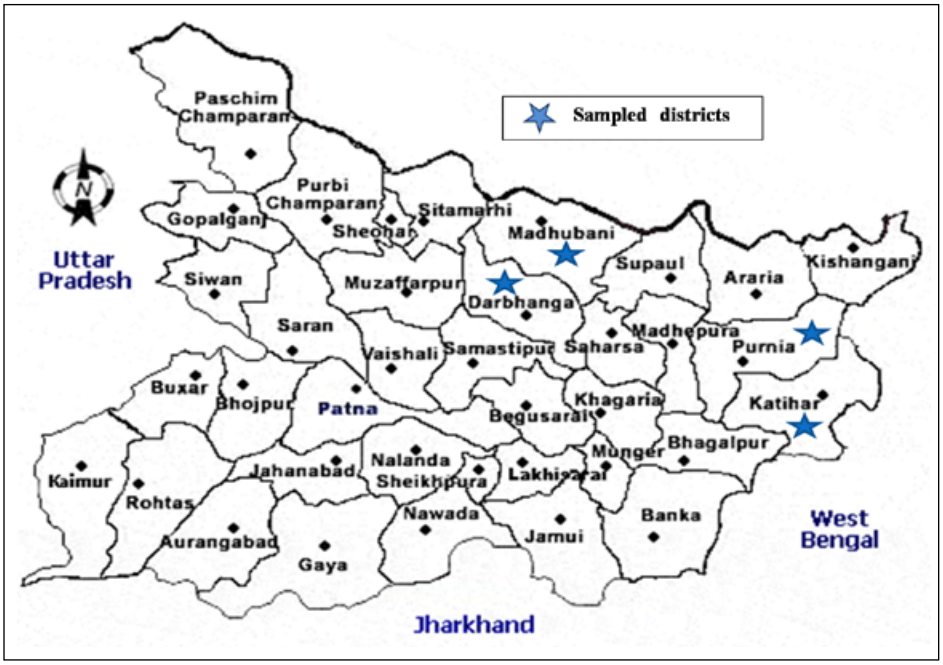

Fig. 2. Map of Bihar showing sampled districts

Bihar is also one of the largest producers of fruits and third largest producer of vegetables in India (Horticultural Statistics, 2018). Many agricultural produce *viz.* scented rice, litchi, mango, makhana etc have immense potential for their commercial exploitation in the state. Although, Makhana is grown in various North Eastern and Eastern states of India, Bihar has monopoly in its production.

As per estimates, the state alone produces approximately 90% of total Makhana production in the country. Makhana crop is grown in almost 15,000 ha area in Bihar which produces nearly 10,000 tonnes of popped Makhana. Farmers take Makhana as an aquatic cash crop in North Bihar and about 5 lakh families mostly from fisherman community are directly involved in its cultivation, harvesting and processing (ICAR, 2019). Out of 38 districts, Makhana is cultivated largely in nine districts from North Bihar namely Darbhanga, Madhubani, Purnea, Katihar, Saharsa, Supoul, Araria, Kishanganj and Sitamarhi. Current study was planned to analyze the value chain of Makhana which involves many actors like input suppliers, producers, R&D organizations, Government agencies, processors, commission agents, wholesalers, retailers, final consumers, etc. The value chain of makhana is studied tracing the value addition at different stages of the production and marketing of Makhana till it reaches final consumers.

Makhana production in Bihar is limited to such areas which are flood prone and having high average annual rainfall. Bihar has been divided into four agro-

climatic zones (Table 1). Out of these four zones, Makhana is commercially cultivated in Zone I (North Alluvial Plains) and Zone II (North East Alluvial Plains) only. Therefore, a total of four districts namely Darbhanga and Madhubani from Zone I and Purnea and Katihar from Zone II were selected for this study (Fig. 2). These four districts nearly contribute 80% of Makhana production in Bihar. Both primary and secondary data were collected and utilized for this study. A total of 12 blocks, three from each selected districts were covered for data collection from Makhana growers. Survey of Makhana growers was done in selected districts using structured interview schedule and group discussion method. Information on socio-economic status of farmers, leasing of ponds, cost of Makhana cultivation in pond and field method and profitability of farmers were assessed using suitable statistical tools.

Data were also collected from processors who are involved in processing of Makhana seeds into popped Makhana through traditional method. To study the marketing channels, market margin and value addition at each stage, local wholesalers and retailers in producing region, as well as distant wholesalers located at Delhi and Kanpur market were contacted for data collection. Marketing cost involving grading, storage and transport of Makhana was estimated at each level from production to consumption. To find out the different private Makhana industries working on value addition, its branding and export potential, data were collected from secondary sources like published literatures and websites.

Production System of Makhana

Darbhanga and Madhubani districts have a large number of ponds located in nearly all the blocks. Based on secondary data from District Fisheries Office, there were a total of 910 ponds in Darbhanga which covered an area of 2134.76 ha. These ponds were mostly Government ponds (77.25%). Similarly in Madhubani district, a total of 2111 ponds were available which covered 2097.4 ha of area. Here also, 83.4% of all ponds were from Govt. Sector. Majority of Makhana is cultivated in ponds in these two districts. In case of Purnea and Katihar, Makhana is mostly cultivated in low lying fields but pond system of cultivation is also having significant area. In both Purnea and Katihar, farmers take paddy in the same field where they grow Makhana.

Pond system of cultivation

Government ponds were given on lease basis to the fisherman cooperative society of a particular block. The lease rate of Government ponds increases every year by approximately 5 per cent. The secretary of the society then lend these ponds to a group of farmers for cultivation of makhana as well as fishes on annual rent basis. The rent per unit area taken by secretary is normally 8-10 per cent higher

than Government rate. The lease rate also varies from pond to pond based on quality of pond, depth of water etc. It was found that majority of farmers (41.7%) were given pond for a lease period of 3-4 years. However, nearly 38.3 per cent of respondents got the pond for only one year which suggested that there was no certainty of getting pond on lease next year too. Nearly half of total ponds in study area were Government ponds followed by private owners' pond (31.7%). The average annual rent paid by farmers was Rs 13,270 per ha. While 43.3% of the farmers cultivated makhana in only one pond, 25% of the households reported to cultivate it in more than three ponds. The average pond area cultivated per household was 1.45 ha and the average production per ha varied from 1.7 to 1.9 tons of makhana seeds from pond system of cultivation. This yield level was very low as compared to yield of improved makhana varieties like **Swarna Vaidehi** or **Sabour Makhana-1** which can yield 3-3.5 t/ha seed of makhana.

Field system of cultivation

In case of Purnea and Katihar, farmers cultivated Makhana in low lying fields where standing water upto 1 ft was maintained during the crop season. Nearly half of the respondent farmers cultivated Makhana on an area of more than 2.0 ha. In these districts, 3/4th of farmers cultivated Makhana on their own land and only 25% took land on lease. The average rent per ha was found to be Rs 13,000 per ha. A major difference in pond and field system was observed in terms of fertilizer application. Farmers applied 90-100 kg nitrogen, 80-90 kg phosphorus and 40-50 kg potash in the form of DAP, Urea and MOP in field system. Few farmers reported to use calcium also. However, in case of pond system farmers were not using fertilizers. The average yield level of Makhana was 2.25 t/ha in field which was significantly higher than pond system.

Fig. 3. Harvesting of makhana under field condition in Purnea

Value Added Products of Makhana

Being a nutrient rich product, popped Makhana has several uses. It is popularly used to prepare dishes like dal makhani and mixed with other vegetables as thickening agent. Raw popped makhana can be eaten directly or served with with tea or coffee after roasting with salt and ghee or other oils. Popped makhana in raw form is a bulky product which is difficult to handle. Development of processed products from it will certainly enhance the value of makhana and its consumer demand in the market. The handling becomes easy and shelf life also increases due to compact packaging. Several companies prepare makhana snacks in the form of small attractive packs or container by adding some popular flavours like chilli, onion, tomato, pudina, butter etc. Company like Shakti Sudha Industries, Patna are also offering makhana atta (Makhana flour mixed with wheat flour), Makhana bhujia, Makhana flakes, cookies etc in addition to roasted flavoured makhana pop.

ICAR RCER Research Center for Makhana, Darbhanga has also carried out some research on preparation of value added products of makhana. It has developed technology for preparation of Makhana Kheer Mix and Makhana powder. Some work on preparation of different dishes like Makhana Burfi, Makhana Kalakand, Makhana curry, Makhana chapatti etc. has also been done.

Makhana kheer mix

This technology has been standardized and patented. A ready-to-constitute milk based pudding called makhana kheer mix was developed from the popped Makhana. The mix does not require cooking and pudding can be prepared in a minute just by adding water and stirring. It is mainly constituted by makhana and milk powder, sugar and a commonly available binder. Optional ingredients are cardamom powder, raisin and cashew nut. This ready to constitute kheer mix has longer shelf life and can be transported at much lower cost as compared to raw popped makhana for better marketing and higher benefits. It also saves time and energy in preparation of makhana kheer. Few entrepreneurs have taken license for manufacturing and marketing of Makhana Kheer Mix.

Fig. 4. Ready to constitute Makhana kheer mix

Makhana powder

The good quality fully popped makhana should be used for preparation of makhana powder. The popped makhana can be heated in a microwave oven for about 2-3 minutes and kept outside the oven for tempering for about 15-20 min. Then, It is grinded in a rotary grinder for obtaining powdered form. Brownish seed coat, affects the white colour of the powder. The grinded makhana should be sieved using a fine sieve of size 0.2 mm to finally get the fine powder of makhana. The brown seed coat is partially removed during the process and a good coloured with fine textured makhana powder is obtained. This powder is packed in polypropylene envelops in a convenient size and kept for long time up to 9 months (ICAR-RCER Annual Report 2014-15). This powder with other ingredients in different proportion can be used to prepare makhana Burfi, kalakand, makhana chapatti, pakode and other delicious products.

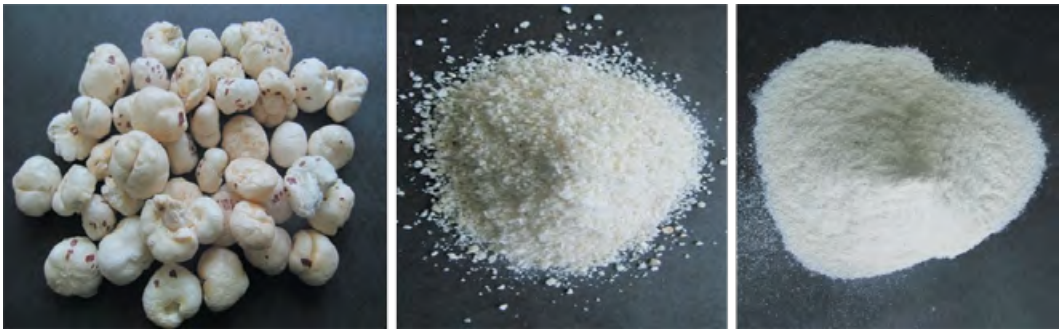

Fig.5. Raw popped makhana, coarse makhana powder and fine makhana powder

Analysis of Makhana Value Chain

Value chain is a chain of activities in which products pass through all in an order and through each activity, the product gains some value. It is defined as the full range of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use (Kaplinsky and Morris, 2000). In a typical Agricultural value chain, farmers, traders, wholesalers, retailers, big retail chains and consumers are major actors performing various roles and responsibility (Aksoy, 2005).

Makhana is an important cash crop of Northern Bihar providing livelihood to lakhs of resource poor farmers. Due to its high nutritional value and uniqueness, importance and market value of Makhana is increasing. With growing consumer awareness about the several health benefits of Makhana, its demand is also expected

to increase rapidly in near future. Despite cultivating this crop since long time, farmers are not getting their due share of benefit from it. An Integrated development of makhana value chain is important for socio-economic growth of the associated farming community in these regions. There is also scope for development and promotion of value added Makhana products that would create higher value for the produce and improve price realization at the farmer level and promote investments in Makhana industry in the region.

Structural analysis

The value chain for makhana in the selected district starts with the Makhana growers who are responsible for production and harvesting of the Makhana seed locally called *guri*. The seed is sold to primary processors (*phodi*) who convert it to popped Makhana lava by drying, roasting and popping by traditional methods.

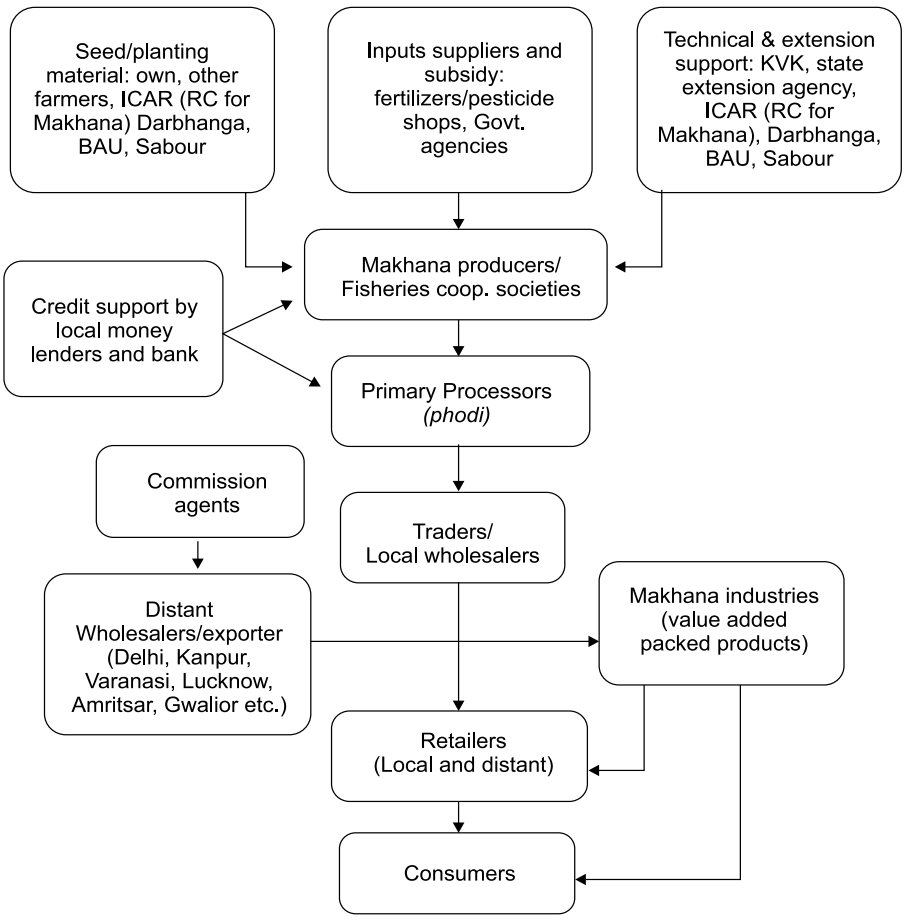

Fig. 6. Schematic diagram of stakeholders associated with makhana value chain

Local money lenders play important role in value chain since they provide credit support to both producers and processors. The popped Makhana is purchased by local wholesalers either directly or through commission agents. Major quantity of popped Makhana of the study area is sold to distant wholesalers at various cities in India after grading at local wholesalers level. Some quantity is sold at local and regional level by local wholesalers. Few Makhana industries prepare value added products for high end consumers and sale through retail outlets or online to consumers. Some of large traders export Makhana in USA, UK, Canada and Gulf countries through water ways.

Functional analysis of value chain actors

Each actors play important roles in value chain and they are interlinked with one another. Before final product reaches to ultimate consumers, these members of the value chain perform various functions related to production, processing, marketing and distribution of the product.

Table 2. Functional analysis of Makhana value chain actors

Sl. No.	Value Chain Actors	Activities	Output
1.	Input suppliers	Supply of inputs *viz.* planting material, fertilizers, pesticides etc	Quality seed and inputs
2.	Service providers (Bank, Govt. sector)	Credit, extension and advisories	Training, subsidy, enhanced production
3.	Farmers	Production of Makhana seed	Makhana seed
4.	Processors (primary and secondary)	Processing of seed into popped Makhana, preparation of value added products	Popped Makhana and value added flavoured Makhana products
5.	Traders	Grading, packaging, transport, storage and sale of makhana	Availability of Makhana to consumers

The role played by various actors of value chain is as follows:

1. **Input suppliers and service providers:** There are several actors involved in supply of input and services during Makhana cultivation. Provision of quality planting material is most important for higher production. It was found that majority of farmers used local seed which is being cultivated year after year. High yielding varieties like Swarn Vaidehi and Sabour Makhana-1 is not reaching to farmers. Local agriculture input dealers also played important role as they supplied required fertilizers and pesticides.

Government agencies like KVK, ATMA, ICAR RCER-RC on Makhana and Bihar Agriculture University, Sabour provided technical and extension support to Makhana growers in the region. Private money lenders and banks provided credit support to farmers and processors but it was observed that private money lenders exploited them by charging very high rate of interest, i.e., 4-5% monthly. Also getting loan from bank was very difficult for resource poor farmers and processors.

2. **Makhana Producers:** Makhana growers major role is cultivation of Makhana crop in pond as well as field. In case of pond system, they clean the pond from aquatic weeds and broadcast the seed. After sprouting of seed thinning and gap filling is done maintaining one metre plant to plant distance. In field system, nursery is raised before transplanting of seedling. Fertilizers are applied in field system. Harvesting of Makhana is done by specialized labours since seeds has to be collected from bottom surface of ponds/field. It was observed that operational cost of Makhana cultivation was Rs 88,300 per ha in pond system while it was higher in field system (Rs. 1,03,500/ha). In both the scenario, harvesting cost of Makhana seed contributed highest i.e more than 40% of total operational cost.

3. **Processors:** Makhana processing is highly skilled, cumbersome and time consuming process. It is small scale family based industry in which a group of highly skilled people purchase Makhana seed and convert it into popped Makhana through a series of activity (Fig. 7). Processing cost of Makhana was found to be Rs 25-30 per kg seed. The price of Makhana seed varied widely from Rs 70-100 per kg. Labour cost and cost of fuel were major contributors in the processing cost of Makhana. Processors mostly sold popped Makhana in loose form to local wholesalers directly or through some commission agents at prevailing market price which varied from Rs 300-350 per kg.

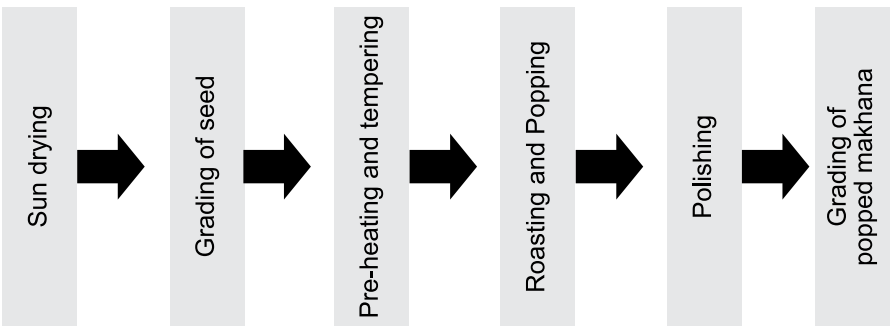

Fig. 7. Steps of Makhana processing

4. **Traders:** Local wholesalers, distant wholesalers, retailers and commission agents play an important role in distribution of produce to various locations in the country. Local wholesalers located in Makhana producing area; are most important among traders since they deal with large volumes of produce and perform various marketing functions like grading, packing, transport and storage. These functions add value to the Makhana at different stages. They sell Makhana in local area like Patna, Gaya, Siwan, Ranchi etc as well as supply them to distant wholesalers. Distant wholesalers are located in large cities across the country *viz.* Delhi, Kolkata, Kanpur, Amritsar, Gwalior, Lucknow, Varanasi etc. Being a high volume bulky produce, transport cost in Makhana is significantly higher. Commission agents are also important in Makhana marketing as they are involved both at local and major national market. They take popped Makhana from processors and sell it to local wholesalers at 2% commission. At distant markets, they take 5% commission for selling Makhana to distant wholesalers.

Fig.8. Sale of Makhana in local Market of Darbhanga

5. **Makhana industries (Secondary processors, exporters):** There are some Makhana processing companies which add value to the raw popped Makhana in the form of tomato, pudina, chilli, butter or other flavours. These fried value added snacks are packed in small attractive packs of 50 g, 100 g or 250g and sold to consumers through retail outlets of large companies like Reliance, Haldiram, etc. The products are also sold online through Amazon, Flipkart, Big Basket, Grofers, etc. to the consumers.

Shakti Sudha Industries at Patna, first started to sell value added products. Later on Makhanawala's, Maruti Makhana, Manju Makhana, Sattviko, Divinutty, etc. joined this business due to higher scope for National as well as International Market availability. Some of the firms also export Makhana to foreign countries.

Table 3. Major firms and their brands of makhana in India

Name of firms	Location	Brands
Shakti Sudha Agro Ventures Pvt. Ltd.	Patna, Bihar	Shakti Sudha
Maruti Makhana	Madhubani, Bihar	Makhana Wala's, Amrit, M.P. Gold, Hari Om
Manju Makhana Enterprises	Madhubani, Bihar	Neha, Bunty aur babli, Rangeela, Sandesh
K.K. Products	Kanpur, Uttar Pradesh	Raja Sahab , Rajdhani , Honey Chhappan Bhog, Radhe Radhe,
Sattviko	Ghitorni, New Delhi	Sattviko
Rishab Global Industries Pvt Ltd.	New Delhi	Mr Makhana
Kesharwani Makhanawale	New Delhi	Rajbhog, Badshah, Rajshahi, Shahi Bhog
Divinutty Products Private Limited	New Delhi	Divinutty
AK Makhana & Co.	Purnea, Bihar	AK Gold, AK Rasgulla

6. **Consumers:** Popularity of Makhana is limited to North Indian states. Awareness needs to be generated among masses about its nutritional value. Currently, it is mostly consumed during festivals like Navratra, Eid, Wedding seasons, etc. It should be promoted as healthy food among consumers which will enhance its demand and indirectly benefit Makhana growers.

Fig. 9. Popular brands of packed Makhana in India

Commodity Flow Analysis

The field surveys in producing region revealed that marketing and distribution of popped makhana involves multiple intermediaries depending on the time of sale and the destination market. The key players involved in supply chain are growers, processors, Commission agents, local wholesalers/retailers, distant wholesalers/retailers and consumers. The marketing of makhana in the selected districts to local as well as distant markets is predominantly observed to be carried out through three different marketing channels. The scale of production, distance from major markets and financial condition of the farmers/processors are important factors affecting the selection of marketing channels. Makhana seed is procured by the processors at a certain price (Rs 70-100/kg) which is processed into consumable product i.e. popped Makhana. Harda in Purnea district is a major hub of processing of Makhana seed into popped lava. Hundreds of families from Darbhanga and Madhubani district specialized in manual processing migrate to Purnea and Katihar during June-July and stay there till December for this work. This popped Makhana is marketed to local and distant markets using following three major marketing channels.

Channel-1

Farmers ⟶ Processors⟶ Local wholesalers⟶ Distant wholesalers⟶ Distant retailers⟶ consumers

Channel-2

Farmers⟶ Processors⟶ Local wholesalers⟶ Local retailers⟶ consumers

Channel-3

Farmers⟶ Processors⟶ Local retailers⟶ consumers

Channel 1: Selling to distant wholesalers through local traders

Nearly 70% of the total makhana is marketed through distant wholesalers located in major cities across the country. In this channel, popped Makhana is purchased by local wholesalers from processors directly or through commission agents at 2% commission. During discussion with stakeholders, it was found that Shakti Sudha Industry, Patna is a large player and it directly purchase 2500 tonnes (20-25%) of popped Makhana annually from the production area. These Makhana are mixed lava without any grading. The local wholesalers grade the Makhana at

their godown either manually or using a grader. Higher the size of pop, higher will be the value in the market. Generally, whole mixed lot is separated into four categories as per following specification.

Table 4. Classification of different grades of popped makhana

Sl. No.	Name of Grade	Diameter Size (mm)	Price (Rs per kg)
i.	Thurri	< 10 mm	40-50
ii.	Murra	10-11 mm	100-110
iii.	Olhua	11-12 mm	250-300
iv.	Lava (L-1 to L-4)	>12 mm	> 350

Fig.10. Packing of Makhana with polythene lining for distant market

Makhana is transported to long distances to large mandis at Delhi, Kanpur, Varanasi, Lucknow, Allahabad, Kolkata, Amritsar etc by the local wholesalers. For this purpose, it is packed in gunny bags of dimension 28x44 inches with thick polythene lining to protect the pop from air and moisture. This packing costs around Rs 140-150 per 10 kg of mix pop. The quantity may differ based on quality of pop. High quality makhana with large pop size can weigh only 7-8 kg while medium and low quality product will weigh around 9-10 and 12-15 kg respectively. It is then transported to large wholesale market through trucks/ trains or other large vehicles. Being a bulky product, it requires a lot of space for smaller quantity as compared to grains. Makhana price in distant market is generally 60-70% higher than local market and therefore transportation add a lot of value to the makhana. Grading, packing and transport cost up to distant market is borne by local wholesalers. Wholesalers at distant market purchase it through commission agents who charges 5% of its sale value. From distant wholesalers, retailers purchase Makhana from major mandis and sell it to consumers. Retail price of Makhana in distant markets are in the range of Rs 650-800 per kg depending on quality. Majority of farmers are not involved in processing and therefore could not get benefit of higher retail price in distant markets. In this channel, farmers generally get 27-30% of consumer price at distant market.

Channel 2: Selling to local and regional markets through local wholesalers

Another important channel of marketing is selling to local and regional markets. Almost 20-25% of Makhana is sold through this channel. Farmers sell

the Makhana seed to processors who prepared the popped Makhana and sell it to local wholesalers located at Darbhanga, Madhubani, Purnea and Katihar. These wholesalers control the price of Makhana in local or regional market. Local retailers procure smaller quantity of Makhana as per requirement and sell to consumers. These retailers are mostly grocery shops which require Makhana throughout the year. This channel does not involve long distance transport and therefore retail price of Makhana pop is lower in the range of Rs 400-450 per kg.

Channel 3: Direct selling to local retailers and consumers

Very small quantity of Makhana is sold in local market without involvement of local wholesalers. Some of the processors have linkage with retailers of the local area. Therefore, these retailers purchase Makhana from processors at lower price and sell it to consumers. This activity is limited to few months from August to November during which Makhana processing work is in full swing. Local retailers consult the processors as per requirement and purchase mix lava. No graded Makhana is sold through this channel. Due to small number of intermediaries, farmers get nearly 40% of retail price in this channel.

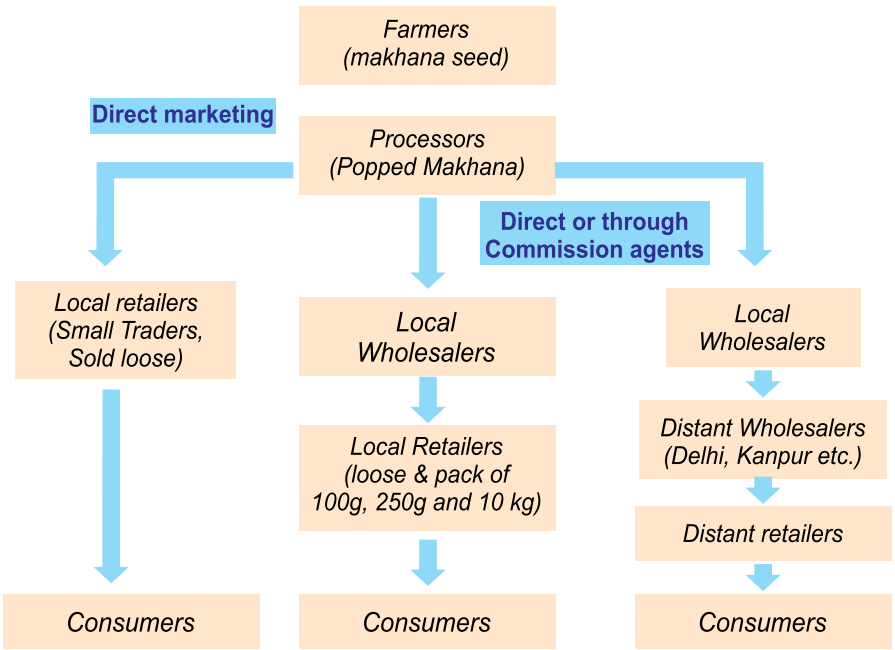

Fig 11. Flow diagram of makhana through different channels

Analysis of Marketing Cost, Market Margins and Price Spread in National Market

Survey of Makhana wholesalers and retailers at both local and national level was conducted. For distant market data was collected from wholesale Makhana market of Kharibowli, Delhi and Nayaganj, Kanpur. Based on various marketing cost borne by different intermediaries and price received, market margins were estimated for all the members of channel (Table 5).

Table 5: Market margins at different level and price spread at national market

Stakeholders	Particulars	Rs/Kg pop	% of consumer price
Farmer	Gross price received (2.5 kg @ Rs 77 per kg of seed)	192	27.62
	input cost borne by farmer	117	16.83
	Net price received by farmer	75	**10.8**
Processor	Purchase price of processor	192	27.62
	Processing and marketing cost	88	12.66
	Margin of processor	60	**8.63**
Local Wholesaler (Purnea, Katihar)	Purchase price of popped lava	340	48.92
	Marketing cost of local wholesalers	40	5.75
	Margin of local Wholesaler	35	**5.03**
Distant Wholesaler (Delhi and Kanpur)	Purchase price of popped lava	415	58.34
	Market cost of distant Wholesalers	53	5.97
	Margin of Distant wholesaler	97	**13.9**
Retailers	Purchase price of lava for retailer	565	81.3
	Market cost borne by Retailer	5.0	0.71
	Margin of Retailer	136	**19.56**
Consumer	Purchase price of popped lava	695	100
	Price spread (consumer price- farmers price)	503	72.4

The results showed that the share of farmers, processors, local wholesalers, distant wholesalers and retailers in the final consumer price was 27.62%, 8.63%, 5.03%, 13.9% and 19.56% respectively. Thus, farmers had the highest share in consumers rupee while local wholesalers had minimum share. The share of local wholesaler is less because the cost of grading, packaging and transport is borne by them. Incidentally, retailers have a healthy share of benefit in the value chain as they get nearly one fifth of consumer price. This was because their marketing cost

was minimum. In Delhi and Kanpur market, a major difference in marketing cost was implementation of market fee @ 2.5% of sale price in Kanpur. There was no market fee in Delhi. Moreover, It was observed that some firms from Delhi were exporting Makhana while none of the traders in Kanpur were involved in export.

The major marketing costs were identified in Makhana value chain and same are presented in Fig. 12. It was observed that processing cost contributed almost half of total marketing cost. Commission charges was next highest cost contributing 16.57% followed by transport cost (13.03%) and packaging cost (9.94%).

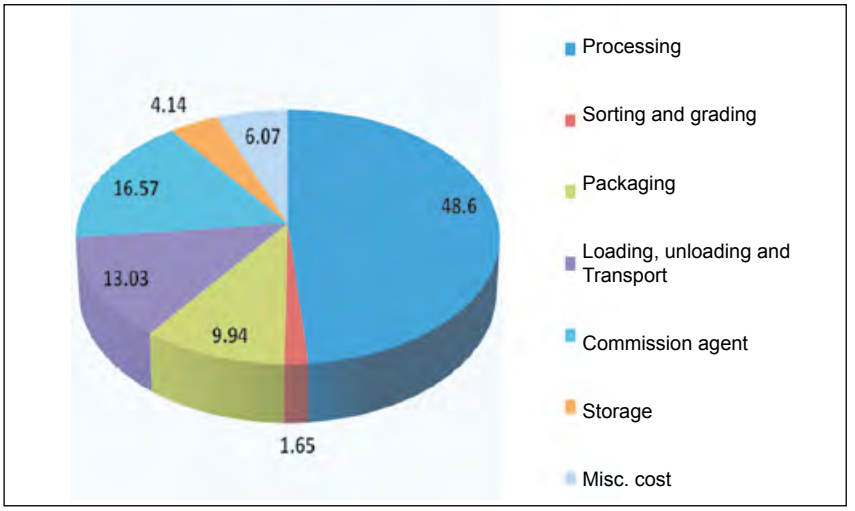

Fig. 12. Percentage contribution of different marketing functions in value chain

Price build up per kg of makhana

The cost of production of Makhana seed at field level is Rs 47 per kg while it is sold around Rs 75 to 80 per kg to processors. At a conversion rate of 40 per cent, 2.5 kg. seed will be required for 1 kg. of popped makhana. Thus, farm gate price of 1 kg. of popped Makhana was Rs. 192 which gave farmer a net income of Rs 75 per kg. The price of lava increases to Rs 340 at processor level and 415 at local wholesaler level. This price build up is normally low in local market but once it reaches to distant market of the country, price of popped Makhana increases to Rs 565 per kg in distant wholesale market and further shoots to nearly Rs 700 in distant retail market. Thus, price build up is higher in distant market due to cost of grading, transport and commission charges.

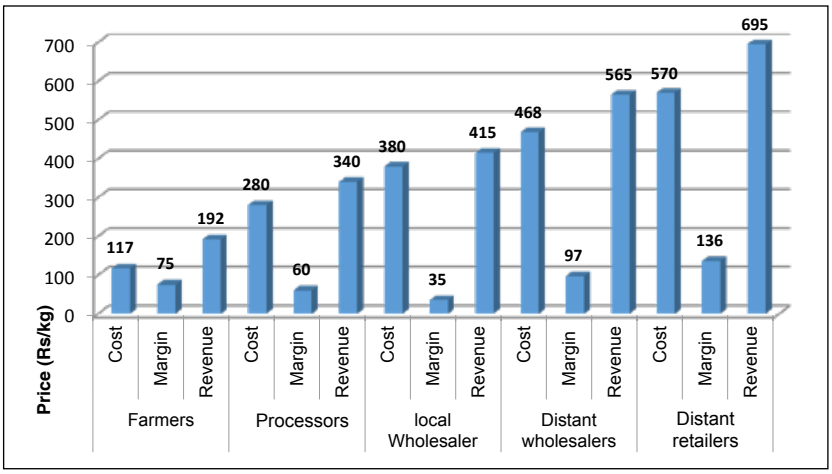

Fig. 13. Price build up at different levels in Makhana value chain

Marketing Cost, Margins and Price Spread in Local Market

Because of its popularity among public and multiple utility, nearly 10 per cent of makhana pop is consumed in producing region itself. Local wholesalers in

Table 6. Margins of different intermediaries and price spread at local market

Stakeholders	Particulars	Rs/Kg pop	% of consumer price
Farmer	Gross price received (2.5 kg @ Rs 77 per kg of seed)	192	**44.65**
	input cost borne by farmer	117	27.2
	Net price received by farmer	75	**17.44**
Processor	Purchase price of processor	192	44.65
	Processing and marketing cost	88	20.46
	Margin of processor	60	**13.95**
Local wholesalers	Purchase price of popped lava	340	79.06
	Marketing cost of local wholesalers	16	3.72
	Margin of local Wholesaler	44	10.23
Local retailers	Purchase price of mix lava	400	93.02
	Market cost borne by Retailer	4.0	0.93
	Margin of Retailer	26	**6.05**
consumer	Purchase price of popped lava	430	100
	Price spread (consumer price-farmers price)	238	**55.03**

Darbhanga, Madhubani, Purnea and Katihar districts purchase Makhana pop from primary processors, i.e., *phodi* at a price of Rs. 340 per kg. The share of farmer as well as processor increases in this channel due to involvement of less number of intermediaries. It was found that farmers share in consumer rupees was 44.65 per cent while processor received 13.95 per cent of consumer price. Consumer price in local market was Rs 430 per kg which is very low as compared to national market of Delhi or Kanpur. Local wholesalers have to bear less marketing cost since transport cost to distant place and commission charges are excluded in this channel. It was observed that local wholesalers got nearly 10 per cent of final price while local retailers got a share of 6.05 per cent. Price spread was 55.03% of consumer price.

Monthly Wholesale Price Variation in Makhana Mandi of Purnea and Katihar

Data was collected from major wholesalers of area regarding monthly wholesale price of Makhana lava in Purnea and Katihar district for the year 2017 and 2018. This was analyzed and month wise comparison was drawn for both the years which are depicted in Fig. 14. In general, wholesale price of popped Makhana was ranging from Rs 255 to 375 in year 2017 while it was higher in 2018 with price ranging from Rs 340 to Rs 550/kg. During the harvesting season of Makhana i.e July, August and September, price of popped Makhana was lowest in both the year. In the year 2017, prices during harvest season hovered around 250-280 per kg only which was very low in comparison to the year 2018 where price ranged from Rs 340 to even Rs 450 per kg. mixed lava. However, it was observed that during October, November and December, prices increased sharply due to festival season which results in increase in consumption of Makhana and thus its demand.

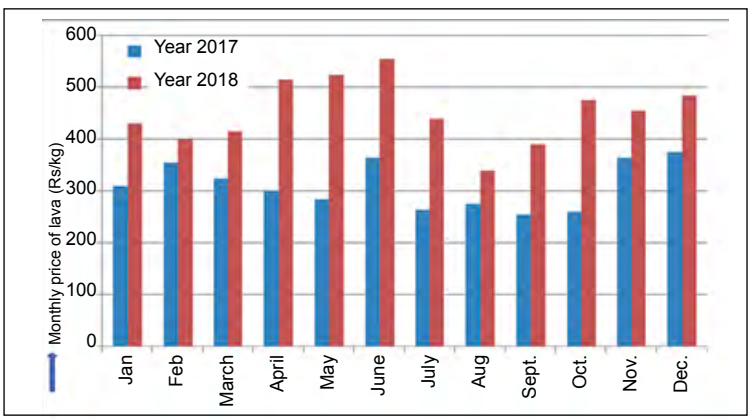

Fig. 14. Comparison of monthly wholesale price variation of popped lava during 2017 & 2018

Also, price was highest during April, May and June because of very less supply of Makhana in the market.

Makhana Export: Current Status and Future Strategies

Owing to its high nutrient value and several health benefits, the demand for makhana has increased steadily in recent times. In India, makhana is now consumed across the country. Although, commercial production of makhana is limited to selected districts of North Bihar, West Bengal, Assam and Manipur; it reaches to all major cities of the country through a chain of traders which include producers, processors, local wholesalers, commission agents, distant wholesalers, retailers and consumers. As far as export is concerned, its export potential is still untapped. Currently, India is exporting only 1.0% of its total production. Nearly 100 tonnes of popped Makhana is exported to other countries. Shakti Sudha Industries, Patna is one of the major players in export of Makhana from Bihar through its online marketing platform. Global Marketing companies like Amazon, Flipkart etc also play major role in export of Makhana. Several private firms active in big cities like New Delhi, Mumbai, Amritsar, Kolkata, Badodra, etc. are involved in export of Makhana. United States of America, United Kingdom, Australia, Banladesh, Pakistan and Gulf Nations like U.A.E, Qatar, Saudi A*rabi*a, Kuwait, Oman are the major export destinations of Makhana from India.

Being a minor crop, Government has not allocated a separate HS code for Makhana which is a major hindrance in its export. Makhana falls under HS Code: 19041090 (Other prepared foods obtained by the swelling or roasting of cereals or cereal products) and it is exported with many other products. Therefore, data of makhana export from India is not available. However, export data from APEDA for HS Code 19041090 shows trends in its export (Table 7).

During year 2019-20, India exported 11,777 tonnes of makhana along with related products worth Rs 13859 lakhs. USA was major destination with almost one third of total export was contributed by this country followed by UAE (11.54%), Nepal (9.73%), United Kingdom (5.39%) and Australia (4.81%). Gulf countries like Quatar, Saudi Arab, Oman, Kuwait, etc also listed in top destination for Makhana export.

Strategies for export promotion of Makhana

Despite having high potential, the quantity of popped makhana exported outside the country is very small as compared to many other dry fruits like almond, cashew etc. Major reason for lack of export is low production of Makhana, lack of quality produce, lack of mechanization in harvesting and processing, near absence of value addition in Makhana etc. Following strategies can be adopted for promotion of export of Makhana in the country.

Table 7. Quantity, value and major destinations for export of Makhana (including other products under HS Code 19041090) from India (2019-20)

Country	Quantity (MT)	Value (Rs lacs)	Percentage share in total export
USA	3069.21	4790.42	34.57
UAE	2090.62	1598.65	11.54
Nepal	863.52	1348.97	9.73
UK	613.21	746.67	5.39
Australia	595.44	666.49	4.81
Qatar	597.74	454.00	3.28
Bangladesh	196.81	428.98	3.10
Saudi Arab	563.13	422.25	3.05
Maldives	181.24	401.80	2.90
Canada	250.52	376.58	2.72
Oman	398.39	319.16	2.30
Kuwait	354.77	298.64	2.15
Sri Lanka	210.50	286.48	2.07
Singapore	331.35	277.95	2.01
Bhutan	353.06	258.35	1.86
Malaysia	150.41	133.06	0.96
Bahrain	156.43	118.29	0.85
Pakistan	49.40	108.08	0.78
Others	751.80	823.99	5.93
Total	11777.55	13858.81	100

Source: APEDA, 2020

Expansion of area under Makhana: Being an aquatic crop, Makhana requires ponds, chaurs and low lying fields with standing water during crop season. Therefore, more such areas can be identified for its expansion. Moreover, Makhana can also be cultivated in field condition with recommended package of practices. Bihar Govt. is extending subsidy for makhana cultivation to the extent of Rs. 13400/ha in pond system and Rs. 16000/ha in case of makhana cultivation in cropping system mode.

Adoption of high yielding varieties: For increasing productivity, adoption of high yielding varieties and new technologies by farmers is required. Research Centre for Makhana, Darbhanga has developed ***Swarna Vaidehi*** variety having higher production potential of 3.0 tons per ha as compared to traditional cultivars (1.4 t/ha). Similarly, BAU, Sabour also developed one variety called ***Sabour Makhana 1***

having yield potential of 3.5 tons per ha. Quality seeds of these varieties need to be made available to farmers in large quantity for their adoption. Farmers need to be trained on scientific package of practices for Makhana.

Mechanization for harvesting and processing: Export of any product depends on its quality. Presently, majority of Makhana is harvested and processed manually by skilled labours. There is problem of maintaining hygiene during preparation of popped Makhana. Therefore, low cost machineries need to be developed for processing of Makhana seed.

Allocation of separate HS code and Specification of product for export: Being a minor crop, Government has not developed quality specification for its export. Therefore, specification must be developed for its product. Moreover, Makhana still has no separate HS code and it falls in HS Code 19041090 which includes other products also. In order to promote its export, separate HS code should be allocated.

Support to Makhana industries involved in value addition: Lack of value added products of Makhana is a major issue in its export promotion. There is huge scope for marketing of value added makhana snacks in international market. Presently, small scale makhana processing industries are working as a highly unorganized sector. Some Makhana based Farmer Producer Companies (FPCs) should be formed for better realization of price.

Supporting Makhana growers using cluster approach: Makhana cultivation requires areas having ample number of water bodies, chaurs and low lying fields. So, a cluster based approach is required for support of Makhana growers. Such areas can be identified and promoted specially for Makhana. Farmers should be mobilised to form Farmer Producer Company for effective marketing and export.

Promoting export through branding: Scope for makhana export can be enhanced by branding of value added products. There are some makhana companies which prepare value added products by using tomato, pudina, chilli, butter or other flavours. Branding of these products by large retail sector companies like Reliance, Haldiram, Bikaji, ITC, etc. will help in export of Makhana based products across the world.

Summary and Conclusion

Makhana is an aquatic cash crop mostly grown in ponds as well as low lying fields of North Bihar. Yield of makhana seed varies from 1.8 to 2.3 tonnes/ha which is far below the potential yield of improved varieties like Swarna Vaidehi and Sabour Makhana-1.

Harvesting of makhana seed from bottom of water bodies is fully manual and it alone contributes around 40% of operational cost of cultivation. So, machine needs to be developed for harvesting which will significantly reduce cost borne by farmers.

Makhana grown in ponds is almost free from any harmful chemicals since fertilizers and pesticides are not used. Therefore, these pockets can be identified and promoted for cultivation of organic makhana which can increase their profitability.

Producers share in consumer rupees in the value chain was 27.6 per cent. But net price received by farmers was only 10.8% of consumer price at distant market. Among intermediaries, market margin of distant retailers was highest (19.56%) followed by distant wholesalers (13.9%) and processors (8.63%). Makhana price in distant market is generally 60-70% higher than local market.

Processing cost contributed almost half of total marketing cost followed by commission agent charges to the extent of 16.6 per cent**.** Price spread through entire marketing channel from producer to consumer at national level is 72.4 per cent.

Makhana pop is becoming very popular as healthy food among masses and its demand is increasing in the global market. Therefore, its production needs to be enhanced which is possible by both area expansion and adoption of high yielding varieties like Swarna Vaidehi and Sabour Makhana-1.

Price realization of popped makhana can be enhanced for farmers if they can be organized into Makhana producers group and involved in processing and sale of popped makhana instead of raw makhana seed. Efficient low cost popping machines are also required for primary processing.

There is huge scope for marketing of value added makhana snacks in international market. Presently, small scale makhana processing industries are working as a highly unorganized sector. Recently, govt. of India has announced 10,000 crores for cluster-based approach for unorganised Micro Food Enterprises related to Mango, Makhana, Turmeric, Chilli, Saffron, Bamboo shoot etc. This fund may be utilised for value added healthy snacks by creating global standard products of makhana and its branding *"Vocal for Local"* as suggested by Hon'ble PM of India.

The correct information on production status, market arrival and weekly or monthly price and export data is not available for makhana pop. National Horticulture Board, Agricultural and Processed Food Products Export Development Authority (APEDA) or State Government should work together on providing correct information on these aspects.

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