



Economic analysis of Onion production in Bihar: Insight into cost of cultivation, post-harvest management and constraint identification

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ARTICLE INFO	ABSTRACT
<p>Original Research Article Received on May 04, 2024 Revised on May 12, 2024 Accepted on June 02, 2024 Published on June 09, 2024</p> <p>Article Authors Shoji Lal Bairwa, Lokesh Kr. Meena, Meera Kumari, S. M. Rahaman, R. S. Bhawar, Ashwini Choudhary, Ranvir Kumar, Nitu Kumari</p> <p>Corresponding Author Email rsiddubhawar@gmail.com</p>	<p>Onion, a hardy cool-season biennial widely cultivated as an annual crop, holds substantial economic significance worldwide. India ranks as the second-largest onion producer globally, cultivating the crop across an area of 10.64 lakh hectares with an annual yield of 151.18 lakh metric tonnes. Among the major onion-producing states, Bihar ranks 5th in cultivation area and fourth in production volume and productivity. The state's prominent onion-growing regions, particularly Nalanda and Sheikhpura, contribute significantly to its agricultural economy. Sheikhpura's onions, known for their reddish hue, pungent flavor, and medium size, are even in demand in neighbouring countries like Bangladesh and Nepal. Bihar cultivates a diverse range of onion varieties, including Pusa Red, Patna Red, Pusa Madhvi, and Arka Pragati. Despite its rising prominence as a key onion-producing state, Bihar lacks comprehensive research on critical factors affecting onion production, such as cost of cultivation, post-harvest management practices, and marketing dynamics. These aspects are essential for understanding the constraints faced by onion growers, particularly in the state's pivotal regions. This study provides an economic analysis of onion production in Bihar, focusing on the cost of cultivation, post-harvest management, and constraints encountered by farmers. By evaluating production practices and marketing mechanisms, the research aims to identify opportunities for improving productivity, reducing post-harvest losses, and enhancing market linkages. Insights from this study are expected to contribute to formulating evidence-based strategies for sustainable onion cultivation in Bihar, addressing the challenges faced by farmers, and bolstering the state's position as a significant player in the national onion market.</p>
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Onions, a hardy cool-season biennial commonly cultivated as an annual crop, hold significant economic importance globally (Kulkarni *et al.*, 2012). This temperate crop exhibits adaptability to various climatic conditions, spanning temperate, tropical, and sub-tropical regions (Barakade *et al.*, 2011). In the global context, India stands as the second-largest producer, with an extensive cultivation area of 10.64 Lakh hectares and an annual production yield of 151.18 Lakh metric tonnes. Notably, Maharashtra, Karnataka, Madhya Pradesh, Gujarat, and Bihar collectively contribute approximately 70% of the nation's onion cultivation area. Among these, Bihar holds the fifth position in cultivation area and the

fourth position in both production volume and productivity (SFAC, 2012; Gummagolmath, 2012). Bihar's Sheikhpura region produces onions characterized by a reddish hue, pungent flavour, and medium size, garnering demand from neighbouring countries like Bangladesh and Pakistan (TOI, 2010). The cultivation in Bihar primarily encompasses red and white onion varieties such as Pusa Red, Patna Red, Pusa Madhvi, and Arka Pragati. Recent years have witnessed the emergence of Madhya Pradesh, Bihar, and Rajasthan as significant onion-producing states (Gummagolmath, 2012).

Despite Bihar's potential as key onion-producing state, comprehensive studies addressing the intricate factors influencing onion production within the state, particularly concerning the cost of cultivation, post-harvest management practices, and marketing dynamics, remain scarce. Understanding these factors is crucial for elucidating the constraints faced by onion growers in Bihar, particularly in prominent regions such as Nalanda and Sheikpura. This research aims to bridge this gap by providing insights into the production, post-harvest management, and marketing aspects of onions in Bihar, with a specific focus on Nalanda and Sheikhpura, pivotal regions in Bihar's onion cultivation landscape.

Materials and Methods

The study was carried out in the Nalanda and Sheikhpura districts of Bihar, chosen for their notable involvement in onion cultivation within the state. A structured survey instrument was devised to procure quantitative primary data from a sample comprising 120 onion cultivators. Respondents were chosen using a systematic random sampling method, ensuring a diverse representation across various onion grower categories. Additionally, in-depth interviews were conducted with a subset of onion growers to complement the quantitative findings with detailed qualitative insights. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were employed to analyze, summarize, and present the data collected through the structured survey schedule. The examination of cultivation costs employed specific cost concepts outlined in table 1.

Table 1. CACP cost concepts for Cost of cultivation

Cost A ₁	= All paid out cost+ depreciation+ interest on working capital
Cost A ₂	= Cost A ₁ + rent paid for leased in land.
Cost B ₁	= Cost A ₂ + interest on value of fixed capital excluding land.
Cost B ₂	= Cost B ₁ + rental value of owned land.
Cost C ₁	= Cost B ₁ + imputed value of family labour.
Cost C ₂	= Cost B ₂ + imputed value of family labour.
Cost C ₃	= Cost C ₂ + 10 per cent of cost C ₂ to account for managerial cost of input of farmers.

Cost of Production = Cost of Cultivation + Cost of Marketing

Cost of Production (Rs/qt.) = Total Cost (Rs/ha)/ Main Product (qt/ha)

Profitability Concept

- Net Income = Gross Income - Cost C₃
- Family Labour Income = Gross Income – Cost B₂
- Farm Business Income = Gross Income – Cost A₁

Table 2. Cost of cultivation of onion in study area (Rs./ha)

Particulars	Small	Medium	Large	Average
Cost A ₁	66458.0	64206.0	67542.0	66068.7
Cost A ₂	66458.0	64206.0	67542.0	66068.7
Cost B ₁	67151.0	64899.0	68241.0	66763.7
Cost B ₂	77151.0	74899.0	78241.0	76763.7
Cost C ₁	68971.0	65924.0	68241.0	67712.0
Cost C ₂	78971.0	75924.0	79260.0	78051.7
Cost C ₃ or Total Cost	86868.0	83516.0	87186.0	85856.7

Source: Field study, 2016

Results and Discussion

Cost of Cultivation of Onion in Study Area

The study reveals that the mean total cultivation expenses for onion cultivation among all farmer cohorts amounted to Rs. 85,856.7 per hectare. Further breakdown delineates costs of cultivation of Rs. 86,868, Rs. 83,516, and Rs. 87,186 per hectare for small, medium, and large group of farmers respectively, within the study area. These findings offer insights into the economic dynamics governing onion cultivation in the study region and underscore variations in cost structures across farmer stratifications.

Production and Returns from Onion Cultivation

The study unveils the production dynamics and economic outcomes of onion cultivation. Across all farmer cohorts, the mean net returns and gross income per hectare stood at Rs. 1, 75,890.67 and Rs. 2, 61,837, respectively. Notably, the average net income for all groups of the farmers was Rs. 1,75,980 per hectare, with large farmers attaining the highest cost at Rs. 1,96,064 per hectare, contrasting with the lowest cost among medium category farmers at Rs. 1,56,484 per hectare. Family labour income and farm business income averaged at Rs. 1,85,073 and Rs. 1,95,768 per hectare, respectively, with the largest figures recorded among large-scale farmers at Rs. 2,05,009 and Rs. 2,15,708 per hectare. The average production cost and benefit-cost ratio were Rs. 439 per quintal and 3.05, respectively, with small-scale farmers incurring the highest production cost at Rs. 483 per quintal. These findings provide critical insights into the economic viability and profitability of onion cultivation across different farmer categories.

Contribution of Different Components in Total Cost of Cultivation

The cost structure of onion cultivation comprises various components, each contributing differently to the

total expenses of cost cultivation. According to the study findings, fertilizers and manure input accounted for the highest share (14.57%), followed by land preparation (13.50%), and seed (11.25%), whereas grading, storage, and transportation constituted the lowest share (5.32%) of the average total cost. A comparative analysis with major onion-producing states like Maharashtra and Karnataka reveals similar trends. In the case of Maharashtra, the highest percentage shares was attributed to fertilizers and manure (16.34%), followed by transplanting (15.19%), while in the case of Karnataka, grading, storage, and transportation held the highest share (13.11%), followed by fertilizers and manure (12.80%). Notably, Bihar onion cultivating farmers allocated more resources to land preparation and harvesting and relatively less resources to grading, storage, and irrigation. This disparity might contribute to suboptimal onion prices for Bihar farmers, as their limited storage facilities and smaller landholdings compel immediate post-harvest sales. Improving storage infrastructure and optimizing resource allocation could potentially enhance profitability and market competitiveness for Bihar's onion farmers.

Table 3. Production and returns from onion cultivation

Particulars	Small	Medium	Large	Average
Yield (qt/ha)	180	200	206	195
Price (Rs/qt)	1457	1200	1375	1344
Gross return (Rs/ha)	262260	240000	283250	261837
Net income	175392.0	156484.0	196064.0	175980.67

Table 4. Profitability's aspect of onion cultivation (Rs/ha)

Particulars	Small	Medium	Large	Average
Net income	175392	156484	196064	175980
Family labour Income	185109	165101	205009	185073
Farm business income	195802	175794	215708	195768
Cost of production (Rs/Q)	483	418	416	439
B:C ratio	3.02	2.87	3.25	3.05

Post-Harvest Loss in Onion Cultivation
Post-Harvest Losses at Field Level

The quantification of post-harvest losses at the field level in Bihar's onion cultivation, totaling 8.56 kg/ quintal, underscores significant inefficiencies within the production process. These losses stem from various factors including harvesting injuries, inadequate de-topping, the presence of doubles and bolters, rotted bulbs, under-sized unmarketable bulbs, suboptimal

storage practices, transportation inefficiencies, and improper handling during marketing. Notably, the highest contributor to loss was improper storage, accounting for 14.75 kg/ quintal, attributed to the prevalent use of traditional storage methods among respondents. Similarly, transportation inefficiencies resulted in a loss of 1.5 kg/ quintal. The observed drying loss of 1.5 kg/quintal and the inefficiencies in de-topping leading to a loss of 0.51 kg/quintal highlight additional areas for improvement in production practices. Furthermore, the loss of 0.60 kg/ quintal due to harvesting injuries, and losses stemming from improper packaging (0.90 kg/ quintal) and marketing practices (1.4 kg/ quintal) emphasize the need for enhanced attention to detail throughout the production-to-market chain. Justifying these findings, it can be inferred that addressing these inefficiencies not only reduces physical losses but also enhances marketable yield, thereby augmenting economic returns for farmers. Investment in modern storage facilities, transportation infrastructure, and training programs to improve handling and marketing techniques could mitigate losses and bolster the economic viability of onion cultivation in Bihar.

Table 5. Contribution of different components in cost of cultivation with comparison with different major onion growing states

Particulars	Maharashtra (%)	Karnataka (%)	Bihar (%)	Cost (Rs./ha)
Land preparation	12.59	11.47	13.50	11520.23
Seed	11.19	8.90	11.25	9600.19
Transplanting	15.19	9.17	10.75	9173.51
Fertilizer/ Manure	16.34	12.80	14.57	12433.31
Pesticide	7.50	5.60	7.25	6186.79
Weeding	8.43	10.60	9.40	8021.49
Irrigation	8.80	3.86	8.50	7253.48
Harvesting	7.93	12.55	10.21	8712.70
Cleaning	8.55	2.65	5.80	4949.43
Grading and Storage	2.15	13.11	5.32	4539.82
Other factors	1.32	9.29	3.45	2944.06
Total	100	100	100.00	85335.00

Source: Various published sources and filed study, 2016

Post-Harvest Losses at Wholesaler and Retailer Level

At the wholesale level, post-harvest losses totaled 3.10 kg/quintal, while at the retail level; losses amounted to 2.75 kg/ quintal. Transit and storage inefficiencies contributed significantly, with estimated losses of 2.0 kg/ quintal and 2.1 kg/ quintal respectively. These findings underscore the need for improved logistical and storage practices to minimize losses and enhance economic efficiency throughout the supply chain.

Total Post Harvest Losses

The cumulative post-harvest loss at both field and market levels amounted to 29.16 kg/quintal, with the majority occurring at the farm level (23.31 kg/ quintal), constituting 79.36% of the total loss. This substantial farm-level loss could be attributed to the inherent characteristics of onions, such as their tender texture and high moisture content, which make them susceptible to quality deterioration during various post-harvest stages, including drying, storage, packing, and transportation. Additionally, 3.1 kg/ quintal of losses were observed at the wholesale level, accounting for 11% of the total loss, while losses at the retail level were 2.75 kg/ quintal, representing 9.64% of the total loss. The relatively higher loss observed at the wholesale level compared to the retail level underscores the importance of addressing inefficiencies in the post-harvest supply chain to minimize losses and enhance economic efficiency in the marketing of onions.

Marketing Pattern of Onion

In onion marketing, two contract types prevail: Pre-Harvest and Post-Harvest contracts. Pre-harvest agreements involve the sale of 20-30% of the marketed surplus, while post-harvest agreements see a higher proportion, at 70-80%.

The study identified three dominant marketing channels:

1. Channel 1: Farmer- Wholesaler – Retailer - Consumer (70%)
2. Channel 2: Farmers – Retailer – Consumer (10 %)
3. Channel 4: Farmers - Retailer – Consumer (20 %)

Results indicate that 70 per cent of onions are channeled through Channel 1, 10 percent through Channel 2, and 20 percent through Channel 3, emphasizing the significance of direct farmer-to-consumer transactions alongside traditional marketing routes, highlighting varied market preferences and efficiencies.

Major Constraints in Onion Production Faced by Onion Growers

From the above table 7, it is revealed that the lack of financing at reasonable interest rate was found main constraints in the production of onion which was faced by 82 farmers accounting 68.33 percent of the total farmers followed by the lack of information regarding crop cultivation (63.33%), scarcity of labour (45%), lack of technical knowledge (38.33%), problem of high infestation of different insects (38.33%), lack of soil testing, facilities (33.33%), non-availability of timely inputs (30%) and lack of adequate training facility to farmer (25%).

Table 6. Constraints Faced by Onion Farmers in Onion Production

S. N.	Particulars	No. of Farmers (n=120)	Percentage
1.	Lack of adequate training facility to farmer	30.00	25.00
2.	Non availability of timely inputs	36.00	30.00
3.	Problem of high infestation of different insects,	46.00	38.33
4.	Lack of financing at reasonable interest rate	82.00	68.33
5.	Lack of information regarding crop cultivation	76.00	63.33
6.	Scarcity of labour	54.00	45.00
7.	Lack of soil testing, facilities	40.00	33.33
8.	Lack of technical knowledge	46.00	38.33

Sources: Filed study, 2016

Table 7. Constraints in marketing and post-harvest of onion

S. N.	Particulars	No. of Farmers (n=120)	Percentage
1.	Lack of price stabilization	35.00	29.17
2.	Lack of transportation facilities	55.00	45.84
3.	Lack of standardization and grading facilities	76.00	63.34
4.	Lack of proper methods applied for harvesting of crop	12.00	10.00
5.	Market news and intelligence problems	35.00	28.00
6.	Lack of regulated and co-operative markets	50.00	41.67
7.	Lack of post-harvest management	35.00	30.00

Sources: Filed study, 2016

Constraints in Marketing and Post-Harvest Management of Onion

As depicted in table 7. The foremost constraint observed is the absence of standardization and grading facilities, affecting 63.34 per cent of producers. Subsequently, inadequate transportation facilities (45.84%) and the absence of regulated, cooperative markets (41.67%) are significant challenges reported by growers. Furthermore, deficiencies in post-harvest management practices (30%), price stabilization (29.17%), and awareness about market trends (28%) are notable constraints affecting onion producers. Additionally, inadequate harvesting methods (10%) contribute to the challenges faced in marketing and post-harvest management.

Conclusion and Way Forward

The cultivation of onions in the Nalanda and Sheikpura districts of Bihar, India, serves as a vital source of income for numerous onion growers and contributing significantly to the agricultural landscape of the state. The study result showed that majority of the respondents were identified that the lack of financing at reasonable interest rate, information regarding scientific crop cultivation, adequate training facilities, standardization and grading facilities, transportation facilities, price stabilization and frequent price fluctuations as major constraints in production, marketing, and post-harvest management in the study area. To addressing these constraints a multifaceted approach necessitates that includes improved access to high-quality seeds, enhanced pest management strategies, and the promotion of climate-resilient farming practices. The study has revealed the urgent need for improved post-harvest infrastructure, cold storage facilities, and transportation networks to minimize losses and enhance the shelf life of onions.

Moreover, the adoption of modern post-harvest technologies and practices can further reduce wastage and improve marketable yield. The marketing of onions presents its own set of complexities, with fluctuating prices, limited market access, and the influence of intermediaries affecting farmers' income. Policymakers and stakeholders must explore strategies to enhance market transparency, reduce the dependency on intermediaries, and establish better market linkages for onion growers. In light of these challenges, it is imperative that the government, agricultural institutions, and stakeholders collaborate to develop and implement targeted interventions that address the specific needs of onion farmers in Bihar. This might include the establishment of farmer training programs, the provision of access to credit facilities, and the promotion of

innovative farming techniques and technologies. The present study is restricted in two districts only and other districts may cover in future research work for better policy decisions about onion cultivation in the state.

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