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VARIETAL ADOPTION PATTERN AND ECONOMIC ANALYSIS OF POTATO PRODUCTION IN SOUTH BIHAR, INDIA

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ABSTRACT: Potato is the most important vegetable crop of India and largely grown in Eastern plains of the country. Bihar is the third largest potato producing state of India after Uttar Pradesh and West Bengal. However, productivity of Bihar is lower than many states due to prevalence of older varieties and limited adoption of improved package of practices among farmers. Current study was planned to find out the economic benefits of potato cultivation and adoption pattern of different potato varieties in south Bihar. Primary data were collected from farmers of highest potato growing districts of South Bihar i.e Nalanda and Patna using survey and personal observation method. Analysis of data revealed that Patna and Nalanda together contributed more than 15 per cent of potato production in the state. Moreover, red skinned varieties viz. Kufri Sindhuri, C-1, C-40 and Lal Gulab were mostly adopted by farmers in Patna while in case of Nalanda, white skinned variety Kufri Pukhraj was adopted by majority (80.6%) of them. Variable cost of potato cultivation was estimated to be ₹ 1.32 lakhs per ha in Nalanda and ₹ 1.06 lakhs per ha for Patna district. Cost of seed potato had contributed more than one third of total cost of cultivation. On an average, farmers earned a gross income of ₹ 1.8 lakhs/ha and net return of ₹ 61,579/- per ha from potato. The BC ratio ranged from 1.4 to 1.6 in selected districts. It can be concluded that enough scope is available for increasing productivity of potato in Bihar by large scale demonstration and adoption of high yielding new potato varieties. Moreover, farmers should be motivated to grow their own seed through organization of trainings, exposure visits and supply of breeder seed so that seed cost can be minimized to increase economic returns from potato.

KEYWORDS: Adoption, Bihar, cost of cultivation, economic analysis, potato

INTRODUCTION

The agriculture sector in India continues to play a very important role in growth and development of the country. It is the largest employment providing sector of Indian economy as 54.6% of the total workforce is engaged in agricultural and allied activities and contributed 17.1% of the country's Gross Value Added (GVA) for the year 2017-18 at current prices (DAC & FW, 2019). Still, majority live in rural areas of the country and draw their livelihood from cultivation of various crops as well as animal husbandry enterprises. As per data from census of India, 68.84% of Indian population (around 833.1 Million) live in 6,40,867 different villages distributed across the country (Ministry of Home Affairs, 2011). Total geographical area of the country is around 328.7 million hectares, of which 140.1 million hectares is the reported net sown area and 198.4 million hectares is the gross cropped area. Food grains has the highest share (63.77%) in grossed cropped area followed by total oilseeds (14.28%), total fibres viz. cotton, jute, mesta (5.7%) and total vegetables (3.35%).

Potato is considered as a highly nutritious food and it gives high productivity per unit area and time as compared to many food grains. The crop matures faster within 90 to 100 days, with short duration varieties provide good tuber yield even in just 60 days. Overall, potato production is one of the most efficient means of converting plant,

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land, water and labour into a palatable and nutritious food (Sahadevan, 2007). Due to its unique features, potato has been declared as "Future food crop" by Food and Agricultural Organization, Rome in the year 2008 (Hussain, 2016). India is the second largest potato producer in the world after China and both these countries together contribute nearly one third of total world potato production (Scott and Suarez, 2012). Among all vegetables, potato is the most important vegetable covering nearly 1% of gross cropped area of the country during 2016-17 (Anonymous, 2021). India produced a total of 50.2 million t of potatoes from an area of 2.17 million ha with an average productivity of 23 t/ha. Uttar Pradesh is the highest potato producing state of India followed by West Bengal, Bihar, Gujarat and Madhya Pradesh. These five states together contributed more than 80% of total potato production in the country. In order to solve farmers' problem, Indian Govt. has set a target of doubling farmers' income by the year 2022-23 through many welfare schemes including increase in minimum support prices (MSP) of major crops (Chand, 2017). Potato is an important cash crop for Indian famers but because of its perishable nature, Government is not providing any MSP for it. It was estimated that this country will require nearly 125 million t of potato from an enhanced area of 3.62 million ha with an average productivity of 34.5 t/ha during the year 2050 (CPRI, 2015). This is very challenging task for both farmers and policy makers.

In order to increase potato production and productivity in future, farmers must get better profit by cultivating it using high yielding varieties and scientific package of practices. But, due to highly volatile nature of its price round the year, many times farmers do not get expected return. Several studies have been conducted on economic analysis of potato production covering different parts of the country (Peer *et al.* 2013; Lal and Sharma, 2006; Durgawati *et al.*, 2005). It has been observed by various researchers that cost of seed, labour and fertilizer are major components of total cost of cultivation. (Noonari *et al.*, 2016; Peer *et al.* 2013; Lal and Sharma, 2006).

Bihar state is third highest potato producing state of India contributing almost 16% of total production. During the year 2017-18, Bihar recorded 81.54 lakh tonnes of potato production from an area of 3.22 lakh ha (Anonymous, 2021). Potato is a major cash crop for farmers of Bihar. It is grown in almost all 38 districts but districts lying in southern part of Bihar dominate in its production. It is mainly cultivated during rabi season in Nalanda, Patna, Saran, East Champaran, West Champaran, Vaishali and Samastipur districts. Keeping the importance of potato in mind, current study was undertaken to analyze the cost cultivation of potato in Bihar and its impact of farmers' income.

MATERIALS AND METHODS

Selection of study area and sampling: It was revealed from published literature that southern Bihar is hub of potato production. Therefore, this study was carried out in Nalanda and Patna districts of Bihar. Both these districts were selected purposively on the basis of maximum area and production of potato crop in whole state.

A multi-stage random sampling design was adopted for the ultimate selection of potato growers. Three blocks were selected from each districts and 15 farmers were selected randomly from each block. Thus, a total sample of 90 farmers (45 from each Patna and Nalanda) were selected for this study (Fig.1).

Fig. 1: Map of Bihar showing study area

Data collection and analysis:

Ex post facto research design was used in which investigation starts only after the event has already occurred. Personal observation and survey method of data collection was employed for collection of primary data on variables like cost components (labour, seed, fertilizers, irrigation, pesticides), yield of potato, gross income, price etc. For this purpose, a pre tested structured interview schedule was used as survey instrument during data collection from potato growers. Survey was carried out during the year 2016-17. Secondary data were also collected from Government websites and published literature on district wise area, production and yield of potato in Bihar. Collected data were tabulated and analysed using descriptive statistics *viz.* frequency, percentage etc. Inferences were drawn based on results and personal observations. The standard cost concepts approach was used to find out the costs and returns from potato production.

RESULTS AND DISCUSSION

Status of area, production and yield of potato in Bihar

Secondary data on area and production of major potato growing districts of Bihar was analyzed to find out the contribution in total potato production (Table 1). Out of

Table 1: Area, production and yield in major potato producing districts of Bihar during the year 2017-18

Name of the districts	Area (ha)	Contribution to total area* (%)	Production (t)	Contribution to total production* (%)	Yield t/ha)
Nalanda	24000	7.87	691975	8.94	28.83
Patna	17800	5.84	512394	6.62	28.79
Muzaffarpur	15408	5.06	231120	2.99	15.00
Saran	13602	4.46	353244	4.56	25.97
Gopalganj	12800	4.20	307200	3.97	24.00
West Champaran	12000	3.94	323624	4.18	26.97
Samastipur	12000	3.94	326086	4.21	27.17
Vaishali	12000	3.94	351036	4.53	29.25
Rohtas	11445	3.76	295996	3.82	25.86
East champaran	10700	3.51	299600	3.87	28.00
Madhubani	10800	3.54	289000	3.73	26.76
Darbhanga	10020	3.29	285817	3.69	28.52
Siwan	9800	3.22	291444	3.77	29.74
Others	172375	56.56	3182254	41.11	18.46
Bihar Total	304780	100.00	7740790	100.00	25.40

Source: Directorate of Horticulture, Govt. of Bihar, *Authors' calculation

38 districts, six major districts namely Patna, Nalanda, Saran, Vaishali, Samastipur and West Champaran together contributed nearly one third of total potato production of the state. Nalanda was top ranked district in terms of both area and production followed by Patna during 2017-18. The district has continuously topped in productivity also as many new reports suggested world record productivity (> 70 tonnes/ha) of potato (Anonymous, 2013).

Bihar state as a whole produced 77.4 lakh tones of potato from 3.05 lakh ha area clocking an average yield of 25.4 t/ha. This yield level is better than national average yield of around 23 t/ha but less than some states viz. Gujarat and Punjab. Still, there is a lot of scope for increasing productivity as this region has good quality soil and ample water for irrigation. Selected study area i.e Patna and Nalanda together contributed more than 15 per cent of potato production in the state. Nalanda alone had 24000 ha area under potato with production of 6.9 lakh tones while Patna is distant second placed with an area of 17,800 ha and production of 5.1 lakh tones. It was observed that districts falling in south Bihar contributed significantly in total overall potato production.

Varietal Adoption Pattern in Study Area

Survey of farmers was carried out to find out extent of adoption of different potato varieties and results of the same is presented through a pie chart (Fig. 2). It can be seen that red skinned varieties viz. Kufri Sindhuri, C-1, C-40 and Lal Gulab are very popular among farmers in Patna district. In case of Nalanda, white skinned variety Kufri Pukhraj was adopted by majority (80.6%) of farmers while varieties from Punjab S-1/S-2 also had significant area under cultivation. Although, Kufri Pukhraj was widely adopted variety in Patna too with 23.2 per cent adoption, red skinned varieties were mostly adopted with nearly 70 per cent area under its cultivation. Dominance of Kufri Pukhraj was also observed in a study where it was reported to cover maximum area in Bihar (39%) followed by red skinned Kufri Sindhuri & Bhura Aloo (Pradel *et al*, 2019).

It's a proven fact that variety alone can enhance the yield of crop by 10 to 20 per cent and same is true in potato also. Yield level in Nalanda was significantly higher than Patna since red skinned varieties (Kufri Sindhuri) are generally lower in yield as compared to white skinned variety (e.g Kufri Pukhraj).

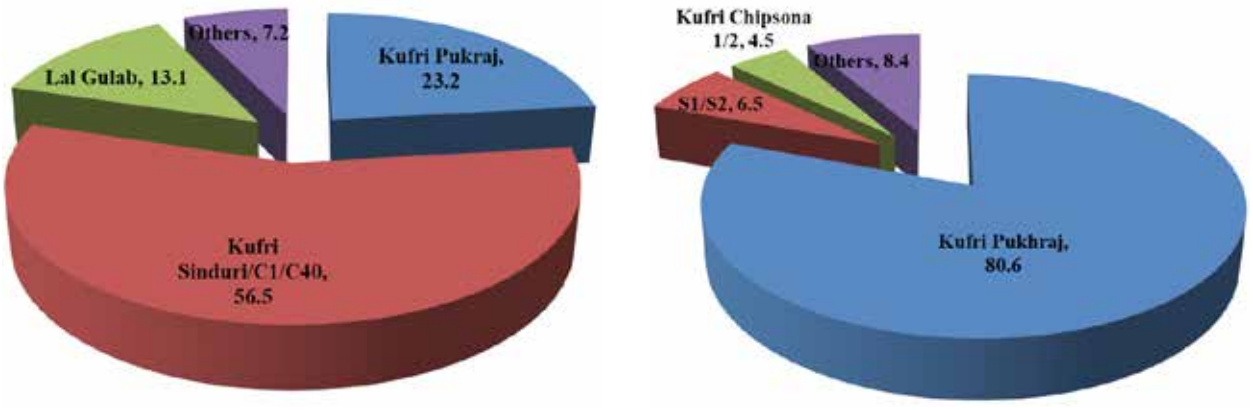

Fig. 2: Percentage area under different potato varieties in Patna (A) and Nalanda (B)

The potential yield of Kufri Sindhuri (30-35 t/ha) is lower than Kufri Pukhraj which can yield upto 40 t/ha (Kumar *et al*, 2014). There was very less presence of processing varieties like Kufri Chipsona-1 & 3 in Nalanda while in Patna, it was completely absent.

Variable cost of potato cultivation

In order to assess the economic impact of potato cultivation on farmers' profitability, it was necessary to estimate cost of cultivation. Therefore, variable cost of cultivation for potato was estimated for both the selected districts (Table 2). Results revealed that average cost of potato cultivation was found to be ₹ 131985/- per ha in Nalanda and ₹ 106083/- per ha for Patna. Pooled data for both the districts showed that cost of seed potato had the highest contribution of 35.2 per cent in total cost of cultivation (Figs. 3). It was followed by cost of human labour which contributed around one third of total cost. The average size of land holding in Bihar is around 0.39 ha which is among lowest in the country (Agriculture Census Division, 2019). This is major reason for low mechanization and thereby increase in cost of human labour in the reason.

There was not much difference in different cost components in Nalanda and

Table 2: Variable cost of potato cultivation in Patna and Nalanda districts of Bihar

N=90

Cost Components (₹/ha)	Patna ($n_{1=}$45)	Nalanda ($n_{2=}$45)	Average cost of cultivation (₹/ha)	% contribution to total variable cost
Cost of human labour	37706	39162	38434	32.29
Cost of machine labour	14004	13844	13924	11.70
Cost of seed potato	27262	56564	41913	**35.21**
Fertilizers and manure	14764	11982	13373	11.23
Plant Protection charges	6837	4407	5622	4.72
Irrigation charges	5510	6026	5768	4.85
Total cost	106083	131985	119034	100.00

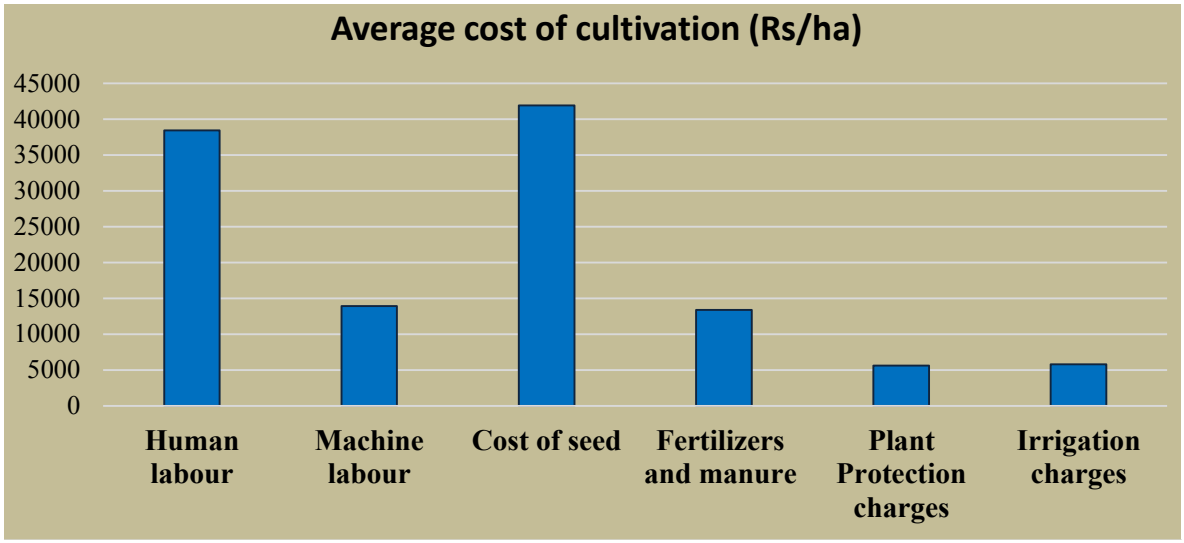

Fig.3: Graphical representation of different cost components in potato cultivation in Bihar

Patna district except cost of seed potato. It was found that seed cost was almost double in Nalanda as compared to Patna. During the survey and discussion, it was clear that majority of farmers in Nalanda purchased seed potato from Punjab at a higher cost including cost of transport. However, in Patna, most of the farmers used seed potato available in local market at low price. Cost of machine labour and fertilizer/manure cost were next important cost components which contributed 11.7 and 11.23 per cent respectively in total variable cost of cultivation.

Economics of potato cultivation

There are various parameters to analyze the economic benefits to farmers which include estimating gross return, net return and Benefit Cost (BC) ratio. Pooled average for both the districts showed that farmers earned a gross income of ₹ 180,613/- and net return of ₹ 61,579/- per ha from potato. Being a labour intensive crop, potato has higher cost of cultivation but higher yield ensures better economic return to farmers. The BC ratio revealed that farmers get ₹ 1.5 with an investment of ₹ 1.0 in potato crop.

Table 5: Economic profitability analysis of potato cultivation in Bihar

N=90

Economic Parameters	Patna (n_1 = 45)	Nalanda (n_2 = 45)	Pooled Average value
Average cost of cultivation (₹/ha)	106083	131985	119034
Average yield (t/ha)	22.34	32.16	27.25
Average selling price (₹/t)	6685	6570	6628
Gross return (₹/ha)	149400	211302	180613
Net return (₹/ha)	43317	79317	61579
Benefit Cost ratio at variable cost of cultivation	1.4	1.6	1.5
Variable cost of production (₹/t)	4748	4105	4368

When we compare the returns from Nalanda and Patna districts, this study highlighted that despite higher cost of cultivation; Nalanda recorded 41.4 per cent more gross return as compared to Patna. This was mainly possible due to more productivity in Nalanda. Comparative study of net return also showed similar trend, as it was nearly double in Nalanda as compared to Patna. Variable cost of production in terms of cost per ton of potato was found to be ₹ 4748 for Patna and ₹ 4105 for Nalanda. It was interesting to see that using early maturing improved variety i.e Kufri Pukhraj in Nalanda, farmers got higher return per unit area and time.

CONCLUSION

This study highlighted the potato economics at farmers' field in two top potato producing districts of Bihar i.e Nalanda and Patna. Being a cash crop, potato earned handsome returns to farmers per unit area and time. Study of varietal adoption pattern showed the popularity of high yielding potato variety Kufri Pukhraj in Nalanda and red skinned low yielding variety Kufri Sindhuri in Patna district. Based on the results, Government should take initiative to popularize high yielding varieties among farmers in Patna district in order to increase its productivity. The variable cost of cultivation was estimated to be ₹ 119,034/- per ha with seed component contributing more than one third of total. This seed cost can be reduced with availability of quality seed at affordable price. This is possible if farmers are motivated to grow their own seed through organization of trainings, exposure visits and supply of breeder seed. Moreover, awareness should be generated among farmers to use high yielding varieties instead of local cultivars

like C-1/C-40 etc. Because of fragmented land holding, organizing small and marginal farmers into farmers group, cooperatives or farmer producer organization will be most effective strategy for enhancing net return from potato. Group formation will not only facilitate input purchase at reasonable price but also help in marketing of final produce at decent price.

LITERATURE CITED

Anonymous (2021). Agricultural statistics at a glance 2020, Directorate of Economics & Statistics, Department of Agriculture Cooperation and Farmers Welfare, Ministry of Agriculture, Govt. of India. https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%20-%202020%20(English%20version).pdf.

Anonymous (2013) https://www.ndtv.com/india-news/bihar-potato-farmer-sets-new-world-record-513698

CPRI (2015) Central Potato Research Institute Vision 2050. Central Potato Research Institute, Shimla, Himachal Pradesh, India.

Chand, R (2017) Doubling Farmer's Income: Rationale, Strategies, Prospects and Action plan, NITI Policy paper No. 1/2017, NITI Aayog, Govt. of India.

Agriculture Census Division (2019). Agriculture Census 2015-16, All India Report on Number and Area of Operational Holdings. Agriculture Census Division, Department of Agriculture, Co-operation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India.

Department of Agriculture Cooperation and Farmers Welfare (DAC&FW). 2019. Annual Report 2018-19, Ministry of Agriculture and Farmers Welfare, Govt. of India. https://agricoop.nic.in/sites/default/files/AR_2018-19_Final_for_Print.pdf

Directorate of Horticulture (2021), Government of Bihar http://horticulture.bihar.gov.in/MainSite/Statistics.aspx

Durgawati, W, Rajput, AM and Saraf, GP (2005) Economic analysis of potato and onion in Malwa region of Madhya Pradesh. *Indian Journal of Economics and Development*, **38**(3): 7779.

Hussain T (2016) Potatoes: ensuring food for the future *Adv Plants Agric Res*. 3(6): 178-182. DOI: 10.15406/apar.2016.03.00117.

Lal, H and Sharma, KD (2006) Economics of potato production in Lahaul Valley, Himachal Pradesh. *Journal of the Indian Potato Association*, **33**(3-4): 139-143.

Ministry of Home Affairs (2011) Census of India 2011: Rural-urban distribution of population. Ministry of Home Affairs, Government of India, New Delhi, India.

Noonari, S, Hakimzadi, W, Noor, I and Ahmed, F (2016) Economic analysis of potato production in sindh Pakistan. *Journal of Biology, Agriculture and Healthcare*, **6**(5): 100-107.

Peer, QA, Ahmad, N, Kaur, J, Chesti, MH, Ahman, HS, Bhat, A and Bhat, BA (2013) Study on economics of potato growing towards livelihood security in Jammu division, India. *African Journal of Agricultural Research*, **8**(45): 5639-5644.

Pradel, W, Gatto M, Hareau G, Pandey SK and Bhardwaj V (2019) Adoption of potato varieties and their role for climate change adaptation in India. *Climate Risk Management* **23**: 114–123.

Scott, GJ and Suarez, V (2012) The rise of Asia as the centre of global potato production and some implications for industry. *Potato Journal*, **39**(3- 4):1-22.

Sahadevan, KG (2007) Advantages of Commodity Futures Trading Through Electronic Trading Platform for Farmers of Uttar Pradesh: A Study of Potato and Mentha, Multi Commodity Exchange of India Limited, Mumbai.

Vinod Kumar, SK Luthra, Vinay Bhardwaj and BP Singh (2014) Indian Potato Varieties and their Salient Features. CPRI Technical Bulletin No. 78 (revised) ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh, India.

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