



Prospects of Farmer Producer Organizations (FPOs) for Potato, Onion and Tomato: Indian Scenario

**Manoj Kumar¹, Bikram Jyoti¹, KP Saha¹, Ajay Kumar Roul¹,
Anshida Beevi C.N.² and Rahul Rajaram Potdar¹**

¹*ICAR-Central Institute of Agricultural Engineering, Bhopal*

²*ICAR-Central Research Institute for Dryland Agriculture, Hyderabad*

Received 02 August 2024; Revised 21 October 2024; Accepted 25 October 2024

SUMMARY

Vegetables are rich in vitamins, minerals, and antioxidants that are essential for human body. However, increase in urbanization coupled with improved purchasing power of consumers and enormous wastage during post-harvest handling and marketing created a huge gap between per capita demand and supply. This loss can be minimized by promoting Farmers' Producer Organisation (FPO). In the present paper, status of FPOs engaged in perishable and important vegetable crops like tomato, potato and onion in different states of India have been studied. State-wise number of FPOs for tomato, potato and onion have been assessed and compared with production level of states using a composite index known as Vegetable Production Index. The Vegetable Production Index for each state has been constructed by combining production of potato, onion and tomato using principal component analysis and the states were categorized in high, medium and low categories using 75th percentile (0.40) and 25th percentile (0.01). The constructed index showed that Uttar Pradesh ranked first in production of these vegetables, followed by West Bengal and Maharashtra. It was investigated that except for few states, the states those were under high category, also had more number of FPOs (51%) engaged in potato, onion and tomato. The study showed that there is a need to increase number of FPOs for tomato, onion and potato in Chhattisgarh, Haryana and Odisha as they still have the opportunity to enhance marketing of vegetables through FPOs matching their production level.

Keywords: FPOs; Vegetable production index; Composite index; Farmer groups and institutionalization.

1. INTRODUCTION

India is the second largest producer of fresh vegetables in the world (138 million tons), only after China in 2021. Though vegetables are very important constituent of Indian diet, it is cultivated as less preferred crop as compared to cereals, pulses and oilseeds occupying only 11.35 million hectare during 2021-22 (Agricultural Statistics at a Glance 2022). Among vegetable crops, Out of which, potato was cultivated in about 2.20 million hectare (19.4%), onion was cultivated in about 1.91 million hectare (16.9%) and tomato was cultivated in 0.84 million hectare (7.4%) as top three major vegetable crops. Tomatoes, onions and potatoes popularly known as the TOP vegetables are the three largest cultivated, produced and consumed vegetables in India (Gulati *et al.*, 2022). Increasing urbanization and people's purchasing power

have augmented the demand for vegetables. But there exists a huge gap between demand and supply due to enormous wastage during post-harvest handling and marketing. Annually post-harvest losses for potato, onion and tomato in India on an average were estimated as 16.1, 13.3 and 19.9 percent, respectively as reported in a study of National Bank for Agriculture and Rural Development (MoFPI, 2022). Hence, there is a need for deploying appropriate strategic and operating models, which will allow the efficient closure of gaps between demand and supply. Most of the time, the gaps between demand and supply are primarily due to losses caused by inefficient handling and storage of produces after harvest both at farm level and supply chains (Jha *et al.*, 2015).

In recent years, there has been a great concern regarding high and fluctuating consumer prices of

Corresponding author: Manoj Kumar

E-mail address: manoj_iasri@yahoo.com

fruits and vegetables. Due to the perishable nature of the produce, the farmers' share in the consumers' rupee is low for most of the vegetable crops. The farmers' share in consumers' rupee was estimated to be 41.1 to 69.3 percent for vegetables and 25.5 to 53.2 percent for fruits. The farmers' share reached to be 85 to 95.4 percent for vegetables, when the farmers sell their produce directly to the consumers (Gandhi & Namboodiri, 2004). Small farmers can increase their share in consumers' rupee through forming Farmer Produce Organizations (FPOs). FPO is a legal body formed by organizing primary producers as a producer company, a cooperative society or any other legal form for sharing of benefits among the members. Several steps have been taken by Government of India to promote FPOs to cope up the challenges of land fragmentation by collaborative farming.

Bisen *et al.* (2018) observed that the producers' share in the consumers' rupee increased from 43.6 percent to 51.9 percent when marketing of vegetables was done by producers directly through retail chain outlets instead of traditional route through commission agents and retailers. This indicates that the formation of FPO for price negotiation with organized retail chains will augment the producers' income. Mahapatra *et al.*, (2023) conducted a study to identify the most important success factors and constraints of FPO as perceived by the members of FPO for turmeric growers in Odisha. They reported that the most important factors contributing to success of FPOs were the better price for produce compared to local traders, good infrastructure for value addition and marketing and assistance in availing the benefits of various government schemes. However, there are several roadblocks faced by FPOs to run their business successfully. A study carried out at ICAR-Indian Institute of Horticultural Research (IIHR) to document the best practices followed by the FPOs during 2016-2020 reported that emerging challenges of the FPOs as failure to strike business partnership with input companies, failure to initiate market tie-up with big companies, managing operational costs during the initial years, non-adoption of innovative marketing strategies, lack of experience in branding and profit-making business process, lack of adequate technical manpower, failure to arrange credit and crop insurance facilities for the producer members (Venkattakumar and Narayanaswamy, 2022). Study on the impacts of FPOs indicated that there is 50.74 per cent change in income, 44.11 per cent change in saving and as a whole 24.48

per cent change in overall economic empowerment of members after joining the FPOs (Sahoo *et al.*, 2022). In a study conducted at National Institute of Agricultural Extension Management, Gummagolmath *et al.* (2022) attempted to establish the role of farmer producer organizations in empowering farmers in India. They witnessed that one FPO at Nasik district of Maharashtra having about 8000 farmer members with a capital base of rupees 128 crore engaged in marketing of fresh and processed fruits and vegetables including potato, onion and tomato as well as processing of tomato into tomato puree on a large scale (more than 55000 metric tonnes in a year). As a result, its annual turnover reached to rupees 445.3 crores in 2019-20.

In the present paper, status of FPOs engaged in vegetable crops like tomato, potato and onion in different states of India have been studied. The production index for each state has been constructed by combining production of potato, onion and tomato using principal component analysis. State-wise number of FPOs for tomato, potato and onion have been assessed and compared with production level of states using a composite index. A policy measure on FPOs has been presented based on production level of tomato, onion and potato.

2. METHODOLOGY

The secondary data on state-wise production of tomato, onion and potato for the reference year (2018) were taken from the Ministry of Agriculture and Farmers' Welfare, Government of India (Horticultural Statistics at a Glance, 2018). The data on state-wise total number of FPOs and the FPOs engaged in marketing of onion, potato and tomato including other vegetables was collected from Small Farmers Agri-Business Consortium (SFAC), Ministry of Agriculture and Farmers' Welfare, Government of India (<http://sfacindia.com/List-of-FPO-Statewise.aspx>). The methodology developed by Kumar *et al.* (2013) was used in construction of Vegetable Production Index (VPI). The same methodology was widely used in construction of composite index by different studies, Kumar *et al.*, (2015), Majumder *et al.*, (2017) and Nazir & Mehmood (2021). In this method, the variance-covariance matrix Σ is estimated as

$$\Sigma = \frac{1}{n} \sum_{i=1}^n (\mathbf{X}_i - \bar{\mathbf{X}})(\mathbf{X}_i - \bar{\mathbf{X}})' \quad (1)$$

where,

$$\mathbf{X} = (\mathbf{X}_1, \mathbf{X}_2 \dots \mathbf{X}_q)' \tag{2}$$

q: number of indicators (here, potato, onion and tomato)

$$\bar{\mathbf{X}} = \frac{1}{n} \sum_{i=1}^n \mathbf{X}_i \tag{3}$$

n is total number of observation (here, states)

The correlation matrix can be obtained as

$$\rho = (\sqrt{\mathbf{V}})^{-1} \Sigma (\sqrt{\mathbf{V}})^{-1} \tag{4}$$

where, ρ is correlation matrix and \mathbf{V} is diagonal matrix obtained from variance-covariance matrix after deleting off-diagonal elements. Now, eigenvector and eigenvalue of this correlation is matrix. In this study, PROC PRINCOMP procedure in SAS 9.3 software is used in calculation of eigenvector and eigenvalue. The principal components can be evaluated as

$$\mathbf{P}_q = \mathbf{E}_q \mathbf{Z} \tag{5}$$

where, \mathbf{P}_q is q^{th} principal components, \mathbf{E}_q is q^{th} eigenvector and $\mathbf{Z} = (Z_1, Z_2 \dots Z_q)'$; Z_q 's are standardized value of q^{th} indicator. The composite index (CI) for i^{th} state can be obtained as

$$CI_i = \frac{\lambda_1 P_1 + \lambda_2 P_2 \dots + \lambda_q P_q}{\lambda_1 + \lambda_2 \dots + \lambda_q} \tag{6}$$

where, λ 's are eigenvalues.

The VPI for each state (normalized composite index) of each state can be evaluated as given below to convert the index value between 0 and 1.

$$CI_{ni} = \frac{CI_i - \min(CI)}{\max(CI) - \min(CI)} \tag{7}$$

where,

CI_{ni} : Normalized value of composite index of i^{th} state

min (CI) : Minimum value of composite index

max (CI) : Maximum value of composite index

The λ_i 's are eigen values of correlation matrix (here, 3x3) obtained using production data on onion, tomato and potato and \mathbf{P}_q 's are principal components evaluated using standardized data on production of onion, tomato and potato.

The percentile (75th and 25th) of VPIs of the states was evaluated and the states having VPI more than

75th percentile value were kept in high production level category. The states having VPI between 75th and more than 25th percentile were categorized as medium production level group and the states having VPI less than 25th percentile were grouped in low production level group. Now, the 75th and 25th percentile of FPOs associated with vegetable marketing was evaluated and the states were categorized in to low, medium and high categories. The states having percentage of FPOs less than 25th percentile were grouped as low, between 25th and 75th as medium and more than 75th as high.

3. RESULTS AND DISCUSSION

There were 901 FPOs in India (promoted by Small Farmers' Agri-Business Consortium), out of which, 384 were engaged in potato, onion and tomato including other vegetables (Table 1). Here, percentage of FPOs for each state was estimated to know share of FPOs engaged in vegetables under study. The results showed that more than 50% of FPOs for vegetables were located in only four states (West Bengal, Karnataka, Maharashtra and Odisha) of the country (Table 2). There were around 19% of FPOs only in West Bengal followed by Karnataka (18%) and Maharashtra (9%). The 75th and 25th percentile of FPOs for vegetable were estimated to be 3.52 and 0.65 respectively, which showed that 25% of the states were having little more than 0.5% FPOs of the country for vegetables. Low percentage of FPOs for targeted produce was found in states like Arunachal Pradesh, Goa, Mizoram, Meghalaya, Jammu and Kashmir and Telangana. The states like Uttarakhand, Manipur, Punjab, Himachal Pradesh, Uttar Pradesh, Bihar and Jharkhand were having medium percentage of FPOs. Higher percentage of FPOs were found in the states like West Bengal, Karnataka, Maharashtra, Odisha, Chhattisgarh and Rajasthan. The states grouped in high category shared around 70% of FPOs for vegetables including potato, onion and tomato in the country.

Vegetable Production Index (VPI) for each state along with its ranking and categorization has been presented in Table 3. The VPIs is normalized value of composite index to convert it between 0 and 1 and ranking of the states have been done based on constructed VPI. Uttar Pradesh ranked first in vegetable production followed by West Bengal, Maharashtra and Madhya Pradesh. Arunachal Pradesh ranked last in vegetable production. The states were categorized in high, medium and low group based on percentile

Table 1. State-wise FPOs for Potato, Onion, Tomato and other vegetables

States	Potato	Onion	Tomato	FPOs (Vegetables)	FPOs
Andhra Pradesh	0	1	0	3	16
Arunachal Pradesh	2	0	2	2	6
Assam	2	2	0	4	18
Bihar	8	1	5	11	38
Chhattisgarh	3	1	9	22	26
Delhi	0	0	0	4	4
Goa	0	0	0	2	2
Gujrat	0	0	1	5	25
Haryana	13	12	14	22	23
Himachal Pradesh	1	1	5	7	8
Jammu Kashmir	2	0	2	2	2
Jharkhand	4	0	7	10	10
Karnataka	7	22	38	70	126
Madhya Pradesh	2	3	3	12	149
Maharashtra	3	30	18	38	105
Manipur	5	1	4	7	8
Meghalaya	1	0	2	2	3
Mizoram	0	0	1	1	1
Nagaland	2	2	1	4	4
Odisha	11	3	26	31	41
Punjab	0	0	1	7	7
Rajasthan	2	8	8	15	50
Sikkim	0	0	2	9	30
Tamil Nadu	0	0	0	1	13
Telangana	0	0	0	1	26
Tripura	1	0	0	7	7
Uttar Pradesh	5	2	4	8	57
Uttarakhand	5	0	4	5	7
West Bengal	40	15	14	72	89
Total	119	104	171	384	901

value of VPI. The 25th and 75th percentile of VPI were evaluated to be 0.01 and 0.40, respectively. The states having VPI values greater than 75th percentile value was grouped in high production level group.

The states with VPI greater than 25th percentile but less than or equal to 75th percentile value was categorized as medium production level and the states having VPI less than 25th percentile value was kept in low production level group. The categorization of

Table 2. State-wise percentage share of FPOs engaged in vegetables

States	% of FPOs	Cumulative %
West Bengal	18.75	18.75
Karnataka	18.23	36.98
Maharashtra	9.90	46.88
Odisha	8.07	54.95
Chhattisgarh	5.73	60.68
Haryana	5.73	66.41
Rajasthan	3.91	70.31
Madhya Pradesh	3.13	73.44
Bihar	2.86	76.30
Jharkhand	2.60	78.91
Sikkim	2.34	81.25
Uttar Pradesh	2.08	83.33
Himachal Pradesh	1.82	85.16
Manipur	1.82	86.98
Punjab	1.82	88.80
Tripura	1.82	90.63
Others	9.38	100

Table 3. Vegetable production index (VPI) of the states

States	VPI (rank)	Category	States	VPI (rank)	Category
Uttar Pradesh	1.000 (1)	High	Rajasthan	0.090 (16)	Medium
West Bengal	0.901 (2)	High	Jharkhand	0.089 (17)	Medium
Maharashtra	0.717 (3)	High	Himachal	0.073 (18)	Medium
Madhya Pradesh	0.711 (4)	High	Uttarakhand	0.035 (19)	Medium
Bihar	0.627 (5)	High	Jammu	0.016 (20)	Medium
Karnataka	0.476 (6)	High	Meghalaya	0.014 (21)	Low
Gujarat	0.414 (7)	High	Tripura	0.014 (22)	Low
Andhra Pradesh	0.400 (8)	Medium	Sikkim	0.007 (23)	Low
Odisha	0.202 (9)	Medium	Nagaland	0.006 (24)	Low
Chhattisgarh	0.199 (10)	Medium	Manipur	0.004 (25)	Low
Haryana	0.187 (11)	Medium	Mizoram	0.001 (26)	Low
Punjab	0.184 (12)	Medium	Kerala	0.001 (27)	Low
Telangana	0.167 (13)	Medium	Arunachal Pradesh	0 (28)	Low
Tamil Nadu	0.132 (14)	Medium			
Assam	0.093 (15)	Medium			

states based on percentage of FPOs for vegetable under study is shown in Table 4.

Table 4. Categorization of states based on percentage of FPOs

States	% FPOs	Category	States	% FPOs	Category
West Bengal	18.75	High	Tripura	1.82	Medium
Karnataka	18.23	High	Gujrat	1.30	Medium
Maharashtra	9.90	High	Uttarakhand	1.30	Medium
Odisha	8.07	High	Assam	1.04	Medium
Chhattisgarh	5.73	High	Delhi	1.04	Medium
Haryana	5.73	High	Nagaland	1.04	Medium
Rajasthan	3.91	High	Andhra Pradesh	0.78	Medium
Madhya Pradesh	3.13	Medium	Arunachal Pradesh	0.52	Low
Bihar	2.86	Medium	Goa	0.52	Low
Jharkhand	2.60	Medium	Jammu Kashmir	0.52	Low
Sikkim	2.34	Medium	Meghalaya	0.52	Low
Uttar Pradesh	2.08	Medium	Mizoram	0.26	Low
Himachal Pradesh	1.82	Medium	Tamil Nadu	0.26	Low
Manipur	1.82	Medium	Telangana	0.26	Low
Punjab	1.82	Medium			

Fig. 1 showed the comparison between category of production level and FPOs for each state. The three categories (Low, Medium and High) are shown on y-axis. The results showed that in 41% states of the India, the percentage of FPOs for vegetables matched with the production level and there was mismatch in 59% states. In the states like West Bengal, Maharashtra and Karnataka, the production level and percentage of FPOs both are under high category, which showed that FPOs were as per production level of vegetables and this was a result of government initiatives in promoting FPOs.

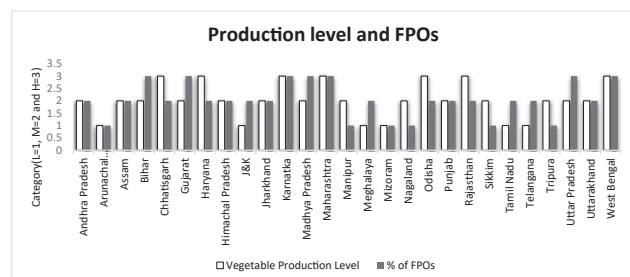


Fig. 1. States with Production level and percentage of FPOs for potato, onion, tomato and other vegetables

There were some states like Chhattisgarh, Haryana and Odisha where, production level was under high

category but the percentage of FPOs were under medium category. Thus, there is still opportunity to increase number of FPOs engaged in marketing of vegetable in these states to meet the production level. It was found that the states like Mizoram and Arunachal Pradesh were under low category both in production level as well as in number of FPOs. However, there were states like Bihar, Gujrat and Uttar Pradesh where number of FPOs were high in spite of medium production level, which further showed the commitments of Government of India in promoting FPOs in the states.

4. CONCLUSION

More than 50% of FPOs for vegetables were located in the states like West Bengal, Karnataka, Maharashtra and Odisha. The percentage of FPOs for onion potato, tomato and other vegetables were more in the states like Maharashtra, Karnataka, West Bengal, Odisha, Haryana and Rajasthan, which, all together shared around 70% of FPOs (vegetables) in the country. There were some states like Chhattisgarh, Haryana and Odisha, where, production level were under high category but the percentage of FPOs were under medium category. Thus, there is still opportunity to increase number of FPOs engaged in marketing of vegetable in these states to meet the production level. However, there were states like Bihar, Gujrat and Uttar Pradesh, where level of FPOs were high in spite of medium production level, which further showed the commitments of Government of India in promoting FPOs in the states.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the anonymous reviewers for providing suggestions and comments which led to the significant improvement in the manuscript.

REFERENCES

- Agricultural Statistics at a Glance. (2022). Economics and Statistics Division, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.
- Bisen J., Patel, R.K., Kundu, K.K. and Sanjay. (2018). Marketing Efficiency between Traditional and Modern Supply Chains of Fruits and Vegetables. *Economic Affairs*, 63(2), 441-447.
- Gandhi, V.P. and Nambodiri, N. V. (2004). Marketing of fruits and vegetables in India: A study covering the Ahmedabad, Chennai and Kolkata markets. Centre for management in agriculture, Indian institute of management Ahmedabad. IIMA working paper, 1-65.

- Gulati, A., Wardhan, H., Sharma, P. (2022). Tomato, Onion and Potato (TOP) Value Chains. In: Gulati, A., Ganguly, K., Wardhan, H. (eds) *Agricultural Value Chains in India*. India Studies in Business and Economics. Springer, Singapore. https://doi.org/10.1007/978-981-33-4268-2_3.
- Gummagolmath, K.C., Shridevi, V., Darekar, A. and Ramyalakshmi, S.B. (2022). Role of farmer producer organizations in empowering farmers: case studies from India. National Institute of Agricultural Extension Management, Hyderabad, India.
- Horticultural statistics at a glance. (2018). Horticulture Statistics Division, Government of India Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi, India. https://www.mofpi.gov.in/sites/default/files/list_of_states_districts_as_per_horticulture_statistics_at_a_glance-2018.pdf
- Jha S.N., Vishwakarma R.K., Ahmad T., Rai A. and Dixit A.K. (2015). Report on assessment of quantitative harvest and post-harvest losses of major crops and commodities in India. ICAR-All India Coordinated Research Project on Post-Harvest Technology, ICAR-CIPHET, Ludhiana, India.
- Kumar, M., Ahmad, T., Rai, A. and Sahoo, P.M. (2013). Methodology for construction of composite Index. *Int. J. Agricult. Stat. Sci.*, **9**, 639-47.
- Kumar, M., Majumder, A., Manjunatha, G.R. and Sanjeev, K. (2015). Flower production index using principal component analysis. *Journal Crop and Weed*, **11**, 54-57.
- Mahapatra, A., Nikam, V., Ray, M., Paul, S. and Mahra, G.S. (2023). Farmer Producer Organization for Turmeric Growers in Tribal Region of Odisha: Success Factors and Constraints. *Indian Research Journal of Extension Education*, **23**(2), 96-101.
- Majumder, A., Kumar, M., Nishad, D., Das, H. and Kumar, A. (2017). Composite index for cash crop production. *RASHI*, **2**(1), 98-100.
- Ministry of Food Processing Industries (2022). Study to determine post-harvest losses of agri-produces in India. Study conducted by NABARD Consultancy Services (P) Limited (NABCONS), India.
- Nazir, I. and Mehmood, M.T. (2021). Measuring Crop Productivity Index of Agro Ecological Zones of Punjab and Its Relationship with Climate Factors. *Forman Journal of Economic Studies*, **17**(1), 161-174.
- Sahoo, S.L., Das, S. and Sahoo, B. (2022). Impact of Farmer Producer Organization (FPOs) on Economic Empowerment of the Member Farmers. *Indian Research Journal of Extension Education*, **22**(2), 59-64.
- Venkattakumar, R. and Narayanaswamy, B. (2022). Emerging Challenges for Sustainability of Farmer Producers Organizations (FPOs) and the Implicative Strategies. *Indian Research Journal of Extension Education*, **22**(2), 23-28.