

Determinants of Marketing Channel for Tomato, Onion, and Potato (TOP) Producers in India: Evidence from the Large-Scale Household Survey

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ABSTRACT

Farmers' choice of marketing channel and socio-economic variables determining the selection are crucial for increasing profitability and welfare. In this context, an attempt has been made to assess the determinants of marketing channels for three vital horticultural commodities, viz., tomato, onion, and potato (TOP), through multinomial regression analysis using the national sample survey data. Research findings indicated that tomato producers prefer local markets (83.4 per cent), followed by agricultural produce market committees (APMCs) (7.9 per cent) and private processors (3.5 per cent). Onion growers predominantly use local markets (76 per cent), APMCs (15.3 per cent), and private processors (3.8 per cent). In the case of tomatoes, a high preference is for local markets (78.4 per cent), followed by government agencies (7 per cent) and private processors (5 per cent). Household size, community status, and operational area significantly influence the choice of marketing channels. In the case of tomato, household size and SC/ST affiliation negatively impact the APMC participation, whereas the operational area facilitates it. On the contrary, education and OBC affiliation positively influence the choice of marketing channels, while MGNREGA employment negatively affects APMC participation. In the case of potatoes, age positively influences participation in private processing channels, whereas household size negatively affects participation in other marketing channels. Analysis of prices indicates that APMCs often offer low tomato prices compared to the local markets, and private processors give higher prices to onion and potato producers. Participation in APMC and private processing channels generally enhances the TOP producers' financial outcome compared to the local markets. Our findings underpin the diverse impact of marketing channels on the TOP producers' economic welfare and decision-making process. We recommend policies to enhance market access, support private processors, imbibe financial literacy to farmers, community-targeted support programs, and reform markets.

Keywords: APMC participation, economic welfare, community-targeted support programmes

JEL codes: O31, Q13, Q18

I

INTRODUCTION

Horticultural commodities are highly perishable, so selecting appropriate marketing channels becomes crucial for farmers since a direct correlation exists between income and sales. The choice of marketing channel significantly impacts farmers' profitability and welfare. Efficient channels can minimize post-harvest losses and optimize price realization, enhancing farm income. During the latter half of the 20th century, the marketing channels for high-value crops, such as fresh fruits and vegetables, have diversified significantly (Nedumaran et al., 2020). For instance, many farmers now opt for contracting, where fixed prices are agreed in advance, offering protection against risks like weather, pests, diseases, and market price fluctuations (Sudha and Kruijssen, 2008). Direct marketing to consumers has also gained attraction in various regions, especially with the government's intervention. Reports indicate that

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large producers often sell their produce directly to wholesalers or processing firms in or near urban areas. Such diverse options are available to farmers to choose from multiple channels when selling their products. Apart from traditional public wholesale outlets like *mandis*, options include selling to pre-harvest contractors (PHCs) and engaging with private traders (Nuthalapati et al., 2020).

The focus on Tomato-Onion-Potato (TOP) is crucial as existing literature on marketing predominantly emphasizes food grains, particularly cereals. Insufficient marketing systems can dissuade smallholders from participating in horticultural crop production, especially for perishable commodities like vegetables (Mishra et al., 2018). While recent studies have investigated marketing strategies among grain farmers cultivating wheat and paddy (Negi et al., 2018) and in the dairy industry (Vandeplas et al., 2013), there remains a gap in understanding how government-supported marketing channels can be effectively tailored to smallholders engaged in cultivating perishable crops such as fruits and vegetables.

On the supply side, potato, tomato, and onion, with an estimated acreage of 21.17, 13.20, and 7.74 lakh hectares, respectively, are India's three widely cultivated vegetables. These vegetables occupy around 42 per cent of the total vegetable crop area in the country (Basavaraj et al., 2019). The production of TOP crops, respectively, is 204.25 lakh tonnes, 302.08 lakh tonnes, and 601.42 lakh tonnes in 2022-23 (MoA&FW, 2024). While potato production has increased, tomato and onion production has declined. The high demand and supply dependence for employability and profitability, government intervention in the market, information asymmetry, and the choices of public and private marketplaces present decision-making complexities for growers. On the research front, past studies underpin several gaps in understanding the determinants of marketing channels. Hence, analysing the choice of marketing channel from a value chain perspective for TOP growers in India becomes significant. An attempt has been made to examine how TOP producers choose their marketing channels and the subsequent impact on their well-being. Firstly, it explores the key factors influencing channel selection, such as commodity characteristics, producer resources, market dynamics, and channel features. Secondly, the research investigates how different channels affect producer welfare, considering factors like profitability, income stability, market access, bargaining power, and empowerment. Finally, it delves into the mechanisms at play, examining how the socio-economic variables contribute to the observed effects. This research aims to improve TOP producers' marketing channel choices by understanding these factors, ultimately enhancing their well-being.

II

DATA AND METHODOLOGY

The study uses the National Sample Survey Office's Situation Assessment Survey Report (77th Round), which surveyed 58035 households. In this study, households that cultivate TOP have been purposively selected for further analysis and

drawing implications. For those chosen households (Tomato: 1012, Onion: 830, and Potato: 3362), several variables have been considered (Table 1) based on an extensive literature review and data availability. A multinomial logit model (MNL) is employed to analyse the marketing channel choices of farmers in the context of selling TOP, considering various explanatory variables and welfare indicators as described in Table 1. This approach is suitable for categorical dependent variables where choices among multiple discrete outcomes are analysed simultaneously (McFadden 1986). Understanding how different marketing channels impact the well-being of TOP growers involves navigating the endogeneity challenge. The Multivalued Treatment Effect (MVT) model is a statistical framework used to estimate the causal effect of multiple treatment options or interventions on outcomes of interest. It extends traditional treatment effect models such as propensity score matching, which typically focuses on binary treatment assignments, to scenarios where individuals or units have multiple treatment choices.

In its general form, the MVT model aims to estimate the average treatment effect (ATE) or other treatment effect parameters for each possible treatment or intervention option i (where $i = 1, 2, \dots, I$). The model allows for heterogeneity in treatment effects across different choices and is particularly useful in contexts where individuals or units self-select into treatment options based on observable characteristics. Incorporating insights from Cattaneo (2010), Imbens (2000), and Wooldridge (2010), the MVT Model offers a rigorous framework for analyzing the impact of multiple treatment options on outcomes of interest.

Step 1 is to model the decision-making process of TOP growers using the Multinomial Logit Model (MNL) (Hensher et al., 2005; Ben-Akiva & Lerman, 1985). The baseline channel selected is the local market and is assigned a value of 0. The remaining market channels are assigned 1, 2, 3, 4, respectively, as given in Table 1. Each grower has a specific probability regarding market channel decisions.

The probability a grower chooses the i^{th} marketing channel is specified as:

$$P_i = \frac{\exp(\hat{Z}\beta_i)}{\sum_{k=1}^5 \exp(\hat{Z}\beta_k)}$$

This approach computes the probability P_i that a grower selects the i^{th} marketing channel, conditioned on a vector \hat{Z} of explanatory variables associated with farm welfare indicators and parameters β_i to be estimated. Consistent estimates can be obtained using the full information maximum likelihood (FIML) estimation method (Bollen & Curran, 2006; Little & Rubin, 2019). With the consistent estimates of the MNL model, the study has calculated the predicted probability of each marketing channel that a farm would choose.

Step 2 revolves around capturing the well-being indicators of TOP growers, which comprises over four indicators explained in Table 1. These metrics are observable exclusively when a specific marketing channel is chosen, introducing a layer of selectivity bias owing to the non-random nature of channel selection. To counteract this, we integrate confounding variables into our analysis. Drawing on

Cattaneo's (2010) methodological insights, our approach conditions the choice of marketing channel κ_i to estimate the farm welfare indicator ε_i . To estimate the farm welfare indicator ε_i conditional on the choice of marketing channel κ_i . The author computes the conditional expectation $\mathbb{E}[\varepsilon_i | \kappa_i = \iota]$. Here ι signifies market channel. The treatment status of each grower signifies whether a farm opts for the i -th marketing channel, ensuring that our estimation accounts for selection based on observable characteristics and maintains consistency across support conditions. By employing these innovative statistical techniques, this paper aims to uncover the true impact of diverse marketing strategies on the economic outcomes of TOP growers.

TABLE 1 LIST OF VARIABLES AND THEIR DESCRIPTION

Variable (unit) (1)	Description (2)
A. Explained variables	
Local market (per cent)	If the respondent sells TOP to the local market, it is represented by 0
APMC market (per cent)	If the respondent sells TOP to the APMC market, it is represented by 1
Government agencies (per cent)	If the respondent sells TOP to government agencies, it is represented by 2
Contract farming (per cent)	If the respondent sells TOP to contract farming sponsors/companies, it is represented by 3
Others (per cent)	If the respondent sells TOP to any other minor agency, it is represented by 4
B. Explanatory variables	
Age (years)	Household head's age in number of years.
Education (scale)	Household head's education level captured on an ordinal scale from 1 to 12
Household size (numbers)	Represents number of family members in a household.
Hindu	1 if the household is Hindu by religion, 0 otherwise
SC/ST	1 if the household is from the disadvantaged group, 0 otherwise
OBC	1 if the household is from other backward category, 0 otherwise
Operational holding (acres)	It is the total land under cultivation (includes irrigated land, unirrigated land, and land area under pre-harvest sale) of different crops for the two crop seasons.
Area under crop (acres)	Portion of the total operational holding in acres under TOP cultivation.
KCC (per cent)	1 if the household has a 'Kisan credit card', 0 otherwise
MGNREGA (per cent)	1 if the household is working under the 'Mahatma Gandhi Rural Employment Guarantee scheme', 0 otherwise.
C. Welfare indicators	
Output quantity (Q)	Quantity of tomato, onion, and potato produced in quintals
Value of output (₹)	The total amount received from tomato, onion, and potato sales in ₹ 000
Price (₹/kg)	Per kg, price of tomato, onion, and potato received as sale outcome
MCE	Monthly capital expenditure in ₹

III

RESULTS AND DISCUSSION

3.1 *Descriptive Statistics*

Tomato growers, with an average age of around 50 years, typically have a household size of about five members and moderate education levels (Table 2). Most identify as Hindu, with notable representation from SC/ST and OBC communities. Participation in government welfare schemes like MGNREGA and KCC is observed among 28 per cent and 17 per cent of tomato growers, respectively. They allocate about 36 per cent of their crop area to tomatoes and operate an average farm size of 1.75 acres.

TABLE 2. DESCRIPTIVE STATISTICS OF EXPLANATORY VARIABLES

A. Tomato growers: 1012				
Variable (1)	Mean (2)	Standard Deviation (3)	Minimum (4)	Maximum (5)
Age	50.16	13.16	21	95
Education	3.32	2.37	1	12
Household size	5.05	2.19	1	21
Hindu	0.77	0.42	0	1
SC/ST	0.44	0.5	0	1
OBC	0.33	0.47	0	1
MGNREGA	0.28	0.45	0	1
KCC	0.17	0.38	0	1
per cent Crop area	0.36	0.31	0	1
Operational area	1.75	2.33	0	30
B. Onion growers: 830				
Variable	Mean	Standard Deviation	Minimum	Maximum
Age	52.46	13.25	22	94
Education	3.65	2.65	1	12
Household size	5.17	2.46	1	18
Hindu	0.84	0.37	0	1
SC/ST	0.27	0.44	0	1
OBC	0.41	0.49	0	1
MGNREGA	0.24	0.42	0	1
KCC	0.21	0.41	0	1
per cent Crop area	0.37	0.32	0	1
Operational area	2.27	2.93	0	24.8
C. Potato growers: 3362				
Variable	Mean	Standard Deviation	Minimum	Maximum
Age	52.18	13.42	16	99
Education	3.76	2.76	1	12
Household size	5.61	2.78	1	30
Hindu	0.74	0.44	0	1
SC/ST	0.38	0.49	0	1
OBC	0.35	0.48	0	1
MGNREGA	0.29	0.45	0	1
KCC	0.24	0.43	0	1
per cent Crop area	0.37	0.32	0	1
Operational area	1.96	3.31	0	97

Source: Authors' calculation based on NSSO's 77th situational assessment survey

Onion growers, slightly older at around 52 years, share similar household sizes and education levels with tomato growers. There's a higher proportion of Hindu growers among them, with fewer belonging to SC/ST groups than tomato growers. Participation in MGNREGA and KCC schemes is slightly lower, around 24 per cent and 21 per cent, respectively. Onion growers allocate about 37 per cent of their crop area to onions and operate farms averaging 2.27 acres.

Also averaging around 52 years old, potato growers have slightly larger households and higher education levels than tomato and onion growers. Potato growers' religious and caste demographics are similar to tomato growers. Participation rates in MGNREGA and KCC schemes mirror those of tomato growers at 29 per cent and 24 per cent, respectively. Potato growers allocate approximately 37 per cent of their crop area to potato cultivation and operate farms averaging 1.96 acres.

3.2 Particulars of Producer Surplus

The findings of Table 3 show the particulars of producer surplus. Tomato growers primarily rely on local markets, which constitute 83.4 per cent of their disposal, where an average production of 2692 kg per producer is exchanged. Agricultural Produce Market Committees (APMCs) account for 7.9 per cent, with an average output of 8863 kg, showcasing structured market engagements. Participation with private processors (3.5 per cent), handling an average production of 3689 kg, highlights efforts in value-added processing.

TABLE 3. PARTICULARS OF PRODUCER SURPLUS

Commodity	Marketing channel	Total producers	per cent disposal	Average production (kg)	Average disposal (kg)
(1)	(2)	(3)	(4)	(5)	(6)
Tomato	None	208	-	93	0
	Local market	724	83.4	2692	2571
	APMC	20	7.9	8863	8831
	Input dealers	14	3.9	6270	6218
	FPOs	2	0	30	25
	Private processors	22	3.5	3689	3508
	CFS	2	0	11	11
	Others	20	1.3	1529	1500
Onion	None	267	-	312	0
	Local market	450	76	4858	5112
	APMC	69	15.3	8620	6702
	Input dealers	6	1.3	5117	6560
	Cooperatives	1	0	150	100
	Government agencies	3	0.4	4000	4000
	Private processors	18	3.8	5372	6370
	Others	16	3.3	7102	6171
Potato	None	1238	-	463	0
	Local market	1956	78.4	4527	3999
	APMC	39	4.6	12348	11866
	Input dealers	24	1.6	5674	6489
	Government agencies	6	7	117533	116483
	Private processors	49	5	12255	10246
	CFS	2	0.2	15250	11250
	Others	48	3.2	7351	6620

Source: Authors' calculation based on NSSO's 77th situational assessment survey.

Onion growers utilize local markets for 76.0 per cent of their disposal, where an average production of 4858 kg per producer is traded, indicating a solid reliance on immediate local sales. APMCs play a significant role at 15.3 per cent, handling an average production of 8620 kg, emphasizing structured market participation. Private processors (3.8 per cent), managing an average output of 5372 kg, reflect processing and value-addition efforts.

Potato growers predominantly distribute their produce through local markets, accounting for 78.4 per cent of their disposal, followed by significant involvement with government agencies (7.0 per cent) and private processors (5.0 per cent). Local markets serve as a crucial outlet where an average production of 4527 kg is traded, reflecting

immediate sales to meet local demand. Engagement with government agencies and private processors, with average productions of 117533 kg and 12255 kg, suggests strategic partnerships for broader distribution and processing capabilities. "None" represents 'subsistence production' consumed by the growers or shared with labour indulged in production or used as seeds for the forthcoming cultivation seasons. Eventually, this product will not contribute to external markets and have zero marketed surplus.

3.3 Choices of Marketing Channels

Table 4, in the context of tomatoes, indicates that household size negatively impacts other marketing channels. SC/ST community affiliation discourages growers from participating in the APMC market. However, a higher percentage of acreage under tomato and larger operational areas encourage growers to participate in the APMC marketplace. Age, education, OBC affiliations, and MGNREGA employment do not affect growers' choices in the case of tomatoes.

TABLE 4. ESTIMATES OF THE MULTINOMIAL LOGIT MODEL FOR TOMATO

Particulars	APMC		Private processors		Others	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.151	0.168	0.128	0.140	-0.031	0.086
Age square	-0.001	0.002	-0.001	0.001	0.0002	0.001
Education	-0.035	0.110	0.003	0.101	0.033	0.072
Household size	-0.243*	0.133	-0.090	0.107	-0.283***	0.103
SC/ST	-1.976*	1.151	-0.498	0.668	-0.573	0.495
OBC	0.947	0.606	0.573	0.554	0.489	0.430
MGNREGA	0.745	0.518	-0.108	0.535	0.275	0.386
per cent Tomato area	1.410**	0.687	0.135	0.695	0.323	0.523
Operational area	0.127**	0.057	0.087	0.056	0.051	0.063
Constant	-7.663	4.502	-6.658	3.764	-1.161	2.259
LR Chi ²	0.0012					
Pseudo R ²	0.080					

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent probability levels.

In the case of onions, education positively influences the choice of other marketing channels (Table 5). Households working under MGNREGA negatively impact APMC and other marketing channels at a 1 per cent significance level for APMC (Turangi, 2020). Affiliation with the SC/ST community positively affects the choice of other marketing channels, while affiliation with the OBC community positively impacts both APMC and other marketing channels. The operational area significantly and positively impacts the choice of APMC and other marketing channels. For onion market channels, age, household size, KCC, percentage of onion area, and Hindu affiliation do not affect the choice of growers.

Table 6 indicates that age positively and significantly influences the choice of private processors in potatoes. Education and employment in MGNREGA do not affect the choice of marketing channels. The size of agricultural households negatively and significantly affects the choice of other marketing channels. Farmers from the Hindu

religion are more likely to choose the APMC channel, whereas this affiliation negatively impacts their choice of other marketing channels (Iversen et al., 2014). The SC/ST community tends to choose input dealers, while their relationship with other marketing channels is negative. Growers from OBC communities show a positive preference for APMC and input dealers. KCC holders generally prefer APMC over local traders. A higher percentage of potato area and operational size positively and significantly promote the choice of APMC and private processors while positively affecting other marketing channels (Singh et al., 2018).

TABLE 5. ESTIMATES OF THE MULTINOMIAL LOGIT MODEL FOR ONION

Particulars (1)	APMC		Private processors		Others	
	Coefficient (2)	SE (3)	Coefficient (4)	SE (5)	Coefficient (6)	SE (7)
Age	-0.003	0.011	-0.003	0.021	0.010	0.018
Education	0.006	0.055	0.091	0.089	0.166**	0.071
Household size	0.006	0.056	0.131	0.096	0.059	0.085
Hindu	-0.330	0.352	0.167	0.690	0.359	0.661
SC/ST	-0.061	0.421	0.463	0.814	1.268*	0.783
OBC	0.674**	0.311	1.013	0.676	1.682***	0.652
MGNREGA	-2.232***	0.732	0.146	0.561	-1.392*	0.768
KCC	0.081	0.341	-1.511	1.054	-0.883	0.659
per cent Onion area	0.581	0.427	-1.031	0.886	-1.216	0.783
Operational area	0.088**	0.039	0.054	0.070	0.112**	0.049
Constant	-2.133	0.858	-4.488	1.635	-5.450	1.494
LR Chi ²	71.6300					
Pseudo R ²	0.0924					

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent probability levels.

TABLE 6. ESTIMATES OF THE MULTINOMIAL LOGIT MODEL FOR POTATO

Particulars (1)	APMC		Input dealers		Private processors		Others	
	Coefficient (2)	SE (3)	Coefficient (4)	SE (5)	Coefficient (6)	SE (7)	Coefficient (8)	SE (9)
Age	0.776	0.738	0.053	0.798	2.099***	0.649	0.555	0.561
Education	-0.074	0.063	0.018	0.082	0.052	0.051	0.042	0.049
Household size	-0.023	0.057	-0.033	0.086	-0.055	0.058	-0.113*	0.063
Hindu	2.111**	1.065	-0.649	0.470	0.088	0.352	-0.819**	0.323
SC/ST	-0.176	0.624	1.638**	0.800	-0.103	0.375	-0.808**	0.399
OBC	0.961**	0.403	1.507*	0.796	-0.055	0.380	0.155	0.324
MGNREGA	-2.195	1.030	-0.443	0.493	0.256	0.327	0.126	0.333
KCC	1.389***	0.372	-0.012	0.547	-0.042	0.346	0.364	0.318
per cent potato area	0.981*	0.562	-0.478	0.686	1.091***	0.446	-0.365	0.467
Operational area	0.107***	0.033	0.085	0.059	0.088***	0.034	0.110***	0.030
Constant	-9.953	3.201	-5.241	3.273	-12.731	2.673	-4.875	2.254
LR Chi ²	153.160							
Pseudo R ²	0.094							

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent probability levels.

3.4 Impact of Welfare Indicators

In the case of tomato (Table 7), the price per kilogram reveals a notable 33.6 per cent decrease (an absolute change of ₹-6.4) in the APMC channel compared to local markets. This discrepancy indicates that farmers receive significantly lower prices when they sell their tomatoes through APMCs. The 'others' category experiences a significant increase of 50.1 per cent (an absolute change of ₹9.5), suggesting that

alternative channels may offer better prices than the local market. For monthly income, the APMC channel demonstrates a significant decrease of 49.1 per cent (an absolute change of ₹3513) compared to the local market, highlighting a notable reduction in farmers' earnings. Conversely, farmers selling through the 'others' channel see a significant increase of 70.8 per cent (an absolute change of ₹5066), indicating higher profitability. Regarding the value of output, the 'others' category also experiences a significant decrease of 33.1 per cent (an absolute change of ₹11975), while private processors witness a considerable increase of 24.2 per cent (an absolute change of ₹8753), indicating that selling to private processors enhances the overall earnings from tomato sales. Lastly, for monthly consumption expenditure, the APMC channel shows a significant decrease of 12.7 per cent (an absolute change of ₹1243) compared to the local market, implying lower spending capabilities for farmers using this channel. In contrast, the 'others' category experiences a significant increase of 11.7 per cent (an absolute change of ₹1146), suggesting higher spending power for farmers engaged with alternative marketing channels.

TABLE 7. WELFARE INDICATORS ACROSS DIFFERENT MARKETING CHANNELS FOR TOMATO

Particulars (1)	Observed mean (2)	Adjusted Mean (3)	SE (4)	Absolute change (5)	per cent change (6)
Price					
Local market	19.2	19.0	0.4		
APMC	12.7	12.6	1.6	-6.4***	-33.6
Private processors	19.8	18.0	1.5	-1.1	-5.6
Others	24.7	28.6	3.5	9.5***	50.1
Monthly income					
Local market	7085	7160	538		
APMC	5138	3646	3128	-3513***	-49.1
Private processors	20898	16771	3790	9611	134.2
Others	8918	12225	4544	5066***	70.8
Value of output					
Local market	34272	36167	3259		
APMC	94530	55122	17285	18954	52.4
Private processors	72034	44920	11371	8753	24.2
Others	43424	24192	10229	-11975	-33.1
Monthly consumption expenditure (in ₹)					
Local market	9820	9791	205		
APMC	9378	8548	820	-1243***	-12.7
Private processors	8697	8477	449	-1314	-13.4
Others	9617	10937	722	1146***	11.7

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent probability levels.

For onions (Table 8), the price per kilogram varies significantly across different marketing channels. Selling onions through the local market yields an average price of ₹15.1/kg. However, prices through APMCs are notably lower at ₹11.1/kg, indicating a significant 24.9 per cent decrease (Patel & Patel, 2013). On the other hand, private processors offer a much higher price of ₹22.8/kg, reflecting a substantial 58.4 per cent increase compared to local markets. This disparity highlights the financial trade-offs onion growers navigate based on their choice of marketing channel. Regarding monthly income, onion growers earn an average of ₹5213 from local market sales. Income from

APMCs shows a stark increase to ₹11098, marking a notable 100.4 per cent increase compared to the local market. This suggests that APMCs offer significantly higher earnings potential for onion growers. Private processors, however, provide the highest income at ₹22131, indicating a substantial 297.0 per cent increase compared to the local market. This underscores private processors as a lucrative channel for onion sales, offering considerable financial gains. Regarding output value, onions sold through the local market generate a total output value of ₹45570. APMCs yield a higher output value of ₹80885, representing a 27.4 per cent increase compared to the local market. In contrast, private processors generate an output value of ₹32582, showing a marginal decrease of 1.0 per cent compared to the local market. This indicates that while APMCs enhance total revenue from onion sales, private processors maintain relatively stable output values. Monthly consumption expenditure for onion growers remains relatively consistent across most channels. Expenditure through the local market is ₹9242, slightly increasing to ₹9384 in adjusted terms. APMC expenditure is ₹11282, adjusted to ₹10899, showing a 16.1 per cent increase. Private processors' expenditure decreases to ₹8849, marking a 5.7 per cent decline, while other channels increase to ₹9761, reflecting a 4.0 per cent rise. These variations in expenditure highlight the balanced financial implications onion growers face when selecting different marketing channels for their produce.

TABLE 8. WELFARE INDICATORS ACROSS DIFFERENT MARKETING CHANNELS FOR ONION

Particulars (1)	Observed mean (2)	Adjusted Mean (3)	SE (4)	Absolute change (5)	per cent change (6)
Price					
Local market	15.1	14.9	0.46		
APMC	11.1	11.2	1.03	-3.71***	-24.9
Private processors	22.8	23.6	2.70	8.70***	58.4
Others	16.3	21.3	2.89	6.43**	43.2
Monthly income					
Local market	5213	5575	781		
APMC	11098	11172	1564	5597***	100.4
Private processors	8888	22131	2845	16557***	297.0
Others	10851	11730	3865	6155	110.4
Value of output					
Local market	45570	49251	4940		
APMC	80885	62741	12091	13490	27.4
Private processors	32582	48763	7855	-488	-1.0
Others	119245	169927	60842	120676**	245.0
Monthly consumption expenditure (in ₹)					
Local market	9242	9384	203		
APMC	11282	10899	1037	1514	16.1
Private processors	11869	8849	607	-535	-5.7
Others	10905	9761	924	376	4.0

Note: ***, **, and * indicate significance at 1, 5, and 10 per cent levels of probability.

Table 9 indicates that farmers' selling price per kilogram of potatoes to the input dealers shows a notable decrease of 17.7 per cent (around per kg decrease of ₹2) over

local market prices. This suggests that growers may receive higher prices when selling to private processors than input dealers. Regarding monthly income, measured in rupees, farmers using the APMC channel experience a substantial increase of 257.5 per cent (an absolute change of ₹8312) over the local market channel. Conversely, those selling through 'other' channels face a significant decrease of 53.6 per cent (around a loss of ₹1731), indicating that these channels might be less profitable than the local market. For the value of output, which represents the total amount received from sales, the APMC channel stands out with a remarkable increase of 211.5 per cent (around ₹69325), showcasing its effectiveness in enhancing overall earnings for farmers. Additionally, the 'others' category shows a significant increase of 44.4 per cent (around ₹14552), suggesting some potential benefits. Regarding monthly consumption expenditure, measured in rupees, farmers engaged with APMC and private processors show significant increases of 16.2 per cent (around ₹1609) and 7.0 per cent (around ₹700), respectively. This indicates that farmers using these channels may have higher spending capabilities. Similarly, the 'others' category sees a 5.7 per cent increase (around ₹570), suggesting a slight rise in expenditure for farmers using these channels.

TABLE 9. WELFARE INDICATORS ACROSS DIFFERENT MARKETING CHANNELS FOR POTATO

Particulars (1)	Observed mean (2)	Adjusted Mean (3)	SE (4)	Absolute change (5)	per cent change (6)
Price					
Local market	11.2	11.0	0.2		
APMC	7.5	9.3	1.5	-1.7	-15.6
Input dealers	11.1	9.1	0.8	-2.0**	-17.7
Private processors	10.8	12.1	1.2	1.0	9.3
Others	9.8	10.4	0.7	-0.6	-5.7
Monthly income					
Local market	3251	3228	193		
APMC	3653	11540	4700	8312*	257.5
Input dealers	5162	5062	2179	1834	56.8
Private processors	3870	4389	1520	1161	36.0
Others	1786	1497	972	-1731*	-53.6
Value of output					
Local market	30376	32785	1520		
APMC	66489	102110	19763	69325***	211.5
Input dealers	35906	38297	6541	5512	16.8
Private processors	97431	15464	21793	-17321	-52.8
Others	106880	47337	8473	14552*	44.4
Monthly consumption expenditure (in ₹)					
Local market	9862	9960	111		
APMC	12402	13278	1609	1609**	16.2
Input dealers	10913	9805	437	437	4.4
Private processors	12615	12259	700	700***	7.0
Others	12549	11062	570	570**	5.7

Note: ***, **, and * indicate significance at 1, 5, and 10 per cent levels of probability.

IV

CONCLUSION

The study provides a comprehensive overview of the socio-economic characteristics, farming practices, marketing strategies, and economic outcomes of tomato, onion, and potato growers in the context of their respective agricultural

markets. Key findings reveal distinct patterns across these crops, influenced by age, household size, education, community affiliations, participation in welfare schemes like MGNREGA and KCC, and farm size. Tomato growers predominantly rely on local markets for sales, emphasizing immediate transactions and engagement with APMCs and private processors for structured market participation. The economic analysis indicates significant price differentials across these channels, impacting farmers' monthly income and profitability. Onion growers similarly favour local markets but benefit significantly from higher prices offered by APMCs and private processors, substantially increasing their income and output values. Meanwhile, potato growers show diverse market engagements with input dealers, APMCs, and private processors, each influencing their income and expenditure differently. This bilateral relationship between growers and various value chains profoundly affects farmers' profitability and income. The strategic alignment with different market channels significantly influences the economic outcomes of tomato, onion, and potato growers, highlighting the critical role of market choice in shaping their financial success and sustainability. So, to strengthen the existing marketing performance, we recommend policy actions to enhance market access for farmers, smallholders in particular; support for private processors to reinforce the linkage between production and processing; imbibe financial literacy to farmers to understand the nuances of the market and its functions; community-targeted support programs to develop weaker and vulnerable sections like SC/ST; and reform markets with higher aid to infrastructure development and better market intelligence.

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