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Impact of e-NAM on arrival and prices of selected vegetables: A case study of Rudrapur APMC

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Abstract

Agricultural marketing plays a crucial role in shaping and enhancing farmers' income. India holds the position of the world's second-largest agricultural products market, largely attributed to the introduction of the e-NAM system in 2016. In the state of Uttarakhand, the e-NAM system has been integrated with 16 APMCs (Agricultural Produce Market Committees), providing a platform for trading 209 different commodities. The research was specifically conducted at the Rudrapur APMC, situated in the Udham Singh Nagar district. Data was collected from two groups: 40 farmers registered with e-NAM and 40 farmers who were not registered but actively involved in vegetable cultivation. The main objectives of this study is to evaluate the market dynamics and the impact of e-NAM on vegetable arrivals and prices within the APMC.

Keywords: Agricultural marketing, farmers' income, India agricultural products market

Introduction

The e-NAM (electronic National Agricultural Market) initiative, launched on April 14, 2016, was a response to the recommendation made in the Union Budget 2014-15. This initiative creates a virtual marketplace connecting the concept of "one nation, one market" with the existing physical mandis or APMCs (Chand, 2016) ^[4]. The integration of these markets with e-NAM aims to establish uniformity, streamline procedures across interconnected markets, bridge the information gap between buyers and sellers, and enable real-time price discovery based on actual demand and supply. Over time, there have been instances of unethical practices among traders and commission agents, including collusion to depress bidding prices, underweighing of produce, delayed payments, and unauthorized deductions of 10-20% of the produce's value for various charges such as market fees, commission, and handling fees. Additionally, the involvement of numerous intermediaries has been a common issue (Aggarwal, Jain, & Narayanan, 2017) ^[1]. Despite the Indian government's funding support for the establishment of assaying facilities, not all mandis connected to the e-NAM system currently possess the required infrastructure for grading and assaying. Electronic weighbridges are available in only a few of these marketplaces, and less than half of them have covered market yards for conducting auctions. The current electronic trading system lacks the necessary functionality unless there

is added mandi-specific infrastructure. The funding allocated for e-NAM only covers the essential hardware needed for the electronic platform. The standards for product quality differ significantly among states, and only a limited number of mandis have established proper facilities for sorting, grading, and quality testing. These facilities are crucial for enabling buyers to make informed bids. Moreover, there is a shortage of suitable warehouses for securely storing the sold goods. The presence of quality testing facilities in various markets is vital for the successful implementation of e-NAM, as they play a critical role in determining product quality attributes (Chand 2016) ^[4]. A strong and standardized grading system is indispensable for efficient trading in the digital marketplace. Hence, it is necessary to analyze the market characteristics of an e-NAM regulated APMC to determine whether it possesses the necessary features and facilities.

The significance of agricultural commodity arrivals and pricing cannot be emphasized enough, given their profound influence on the welfare of farmers and the overall stability of the agricultural sector. Hence, comprehending the impact of e-NAM on these pivotal factors holds immense importance for policymakers, researchers, and stakeholders engaged in the agricultural value chain. Evaluating how e-NAM influences the dynamics of commodity arrivals and prices is of paramount significance. This assessment is vital for making well-informed decisions and crafting targeted

interventions that can foster improved market outcomes. The implementation of e-NAM within existing APMCs has generated expectations of heightened commodity arrivals and enhanced pricing due to a more transparent marketing process. Furthermore, the interrelation between increased arrivals and amplified agricultural production underscores the need to examine the effects of e-NAM on the dynamics of both arrivals and prices.

Keeping the aforementioned problems in focus, this study aims to achieve the following objectives:

Objectives

- To examine the market profile and status of e-NAM of selected APMC.
- To assess the impact of e-NAM on prices and arrival of Vegetables in the selected APMC.

Methodology

The market profile and status of e-NAM in selected APMC was examined. Descriptive statistics were used to gather general information about the APMC, including its establishment year, population dependent on it, and its sub-markets. The study also analysed basic APMC characteristics such as the year of regulation and the status of e-NAM, including the number of farmers, registered traders, FPOs and online transactions. The facilities and services available in e-NAM equipped APMC were also checked.

The assessment of e-NAM's impact on the prices and arrival of specific vegetables in the APMC involved analyzing the yearly data for each chosen vegetable before and after the implementation of e-NAM. The data was divided into two distinct time periods: the years before e-NAM implementation (2013-14 to 2017-18) and the years after e-NAM implementation (2018-19 to 2022-23), with each period spanning five years.

Key statistical measures, including the average arrival, standard deviation, and coefficient of variation (%), were calculated for both periods. To evaluate the changes that occurred after e-NAM implementation, absolute and relative changes were determined. A t-test was employed to determine the statistical significance of these changes. The following formulas were used to compute the necessary information:

$$\text{Absolute change} = Y_n - Y_o$$

Where,

Y_n = Post-unification data of APMCs with e-NAM

Y_o = Pre-unification data of APMCs with e-NAM

Relative change

$$\text{Relative change} = \frac{\text{Absolute change}}{Y_o} * 100$$

Average (mean) Where, $\sum X$ = total sum of the observation
 n = total number of observations

$$\text{Mean } (\bar{X}) = \frac{\sum X}{n}$$

Standard deviation (σ)

SD was used to quantify the amount of variation or dispersion of a set of the data value in the study.

$$\sigma = \sqrt{\{(\sum X_i - \text{mean})^2 / n - 1\}}$$

Coefficient of variation (CV %)

Coefficient of variation was used to measure the magnitude of variability in each of the selected variables from 2013-14 to 2022-23. It was computed as follow:

$$\text{CV (\%)} = \frac{\text{standard deviation}}{\text{mean}} * 100$$

t-test

The pooled t-test was utilized to assess the difference in means of market arrivals and prices of selected vegetables before and after the integration of e-NAM with the sampled APMC. Since we were dealing with a two-sample situation, the pooled t-test was appropriate. The t-statistic value obtained is as follows:

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

Here, \bar{x}_1 = mean of arrivals and prices before e-NAM was integrated (2013-14 to 2017-18)

\bar{x}_2 = mean of arrivals and prices after e-NAM was integrated (2018-19 to 2022-23)

s = pooled sample variance

n_1 and n_2 = number of observations before and after e-NAM respectively

Results and Findings

The chosen APMC under examination is Rudrapur APMC, situated in the Udham Singh Nagar district. It was established in 1965 and covers an area of 15.67 acres. This APMC serves 91 villages, benefiting over 100,000 people. The market's distribution extends to nearby sub-markets including Bhurarani, Bhamraula, Bagwala, and Bhainsiya. Rudrapur APMC holds the 'A' special class mandi status, alongside Kashipur APMC. In the second phase of unification in March 2018, Rudrapur APMC, along with Bazpur, Nanakmatta, Jaspur, Rudrapur, and Khatima, was integrated with e-NAM. The essential features of the selected APMC are outlined in table below. Notably, the APMC was regulated in 1965, functioning under the Agricultural Produce Marketing Development and Regulation Act of 2011. The primary commodities traded in this market are Vegetables, Fruits, Cereals, and Wood. After being unified with e-NAM, the platform has registered 5883 farmers and 363 traders.

Table 1: Basic characteristics of Rudrapur APMC

S. No.	Particulars	Units	Rudrapur APMC
1.	Regulated/ unregulated	-	Regulated
2.	Year of regulation	year	1965
3.	Name of market legislation	-	Agricultural Produce Marketing Development and Regulation Act 2011
4.	Market holiday	-	Monday
5.	Time at which sale begin in the market	AM	6
6.	Time at which sale end at the market	PM	5:30
7.	Peak trading hours	AM	6:00 to 10:00
8.	Name of the nearest railway station	-	Rudrapur
9.	Distance of the railway station from the market	Km	3.2
10.	Mode of transportation of commodity to mandi	-	Tempo-rickshaw, tractor, truck
11.	Farmers coming to market per day	Number	200-300

Table 2: General information about the APMC

	Full Postal Address	Naveen mandi sthal, Kichha Road Bagwada. Pin-263145
1.	Email	rudrapurmandi@gmail.com
2.	Telephone Number	05944-241710
3.	Population Served	193000
4.	Geographical Area Served by Market	31 villages
5.	Name of Chairman	Mr. K. K. Das
6.	Name of Secretary	Mr. Vishwa Vijay Singh
7.	Number of Cold Storages available	0
8.	Number of Commodities notified under regulation	93
9.	System of weighment	Electronic weighbridge
10.	System of payment	Cash, Cheque, Online
11.	Information display board	Yes
12.	Public address system	Yes

Table 3: Status of e-NAM in Rudrapur APMC (Year: 2023)

S. No.	Particulars	Value/quantity
1.	Year of e-NAM regulation	2018
2.	Date of e-NAM functioning	1 March 2018
3.	Total number of farmers registered	5883
4.	Total number of FPOs registered	1
5.	Total number of traders registered	365
6.	Total arrival recorded in e-NAM	1.82 lakh quintal
7.	Total number of payment invoices	476
8.	Total value of online payment	2 crore 17 lakh rupees
9.	Total market fee collected	3 lakh 98 thousand rupees
10.	Total number of traders participated in e-auction	45
11.	Total number of farmers received digital payment	112
12.	Total awareness program conducted	42

Table 4: Facilities and Infrastructure Availability in the APMC

S. No.	Attributes	Units	Value/Availability
1.	Electricity and water supply	-	Available
2.	No. of rooms	Number	2
3.	Rest room for farmer	-	Available
4.	Godowns and Sheds	-	Available
5.	Canteen	-	Available
6.	Parking space	-	Available
7.	Assaying lab	-	Available
8.	e-Bidding Hall	-	Available
9.	Auction room	-	Available
10.	Electronic Display Board	Number	1
11.	Internet access with speed	Mbps	5-10
12.	No. of computer systems	Number	8
13.	No. of Air Conditioners in Auction Room	Number	2
14.	Projector	-	Available

Impact of e-NAM on Arrival and Prices of selected Vegetables: The collected data was used to analyse the

arrival and prices of selected vegetables before and after the integration of selected Agricultural Produce Market

Committees (APMCs) with the electronic National Agriculture Market (e-NAM) platform. The analysis covered the years from 2013-14 to 2022-23. The integration of the APMC with e-NAM occurred in 2018. The data from 2013-14 to 2017-18 is categorized as the pre-e-NAM period, while the data from 2018-19 to 2022-23 falls under the post-

e-NAM unification period.

Table 4 below illustrates the arrival data of past 10 years for selected vegetables. In table 5 the value of Average arrivals, standard deviation, relative change for each vegetable is worked out and to check the whether or not the change is significant, a t-test is also applied.

Table 5: Value of Average arrivals, standard deviation, relative change for each vegetable is worked out and to check the whether or not the change is significant, a t-test is also applied

S. No.	Vegetables	2013-14 (qtl.)	2014-15 (qtl.)	2015-16 (qtl.)	2016-17 (qtl.)	2017-18 (qtl.)	2018-19 (qtl.)	2019-20 (qtl.)	2020-21 (qtl.)	2021-22 (qtl.)	2022-23 (qtl.)
1.	Cauliflower	1465	1447	1480	1512	1725	1883	1872	1428	2365	2972
2.	Green-pea	1125	1225	1540	6048	6319	6356	10955	1655	10015	12962
3.	Potato	16402	20547	17258	21359	25227	26392	27728	8937	26477	34575
4.	Onion	8965	7425	8465	9524	10241	15395	12248	9305	17625	22075
5.	Tomato	1278	1272	1238	1255	1290	1406	1498	1326	2598	2268

Change in arrival post-unification in Rudrapur APMC of major commodities

S. No.	Vegetables	Average arrival before e-NAM (qtl)	Average arrival after e-NAM (qtl)	COV after e-NAM (%)	SD after e-NAM (qtl)	Absolute change (qtl)	Relative change (%)	F test		T test	
								F value	p value	t value	p value
1.	Cauliflower	1525.8	2104	27.92868	587.6193	578.2	37.89487	0.03	0.007	2.16	0.04
2.	Green-pea	3251.4	8388.6	53.18543	4461.513	5137.2	157.9996	0.31	0.34	2.20	0.03
3.	Potato	20158.6	24821.8	38.27	9501.355	4663.2	23.13256	0.361	0.34	1.02	0.17
4.	Onion	8924	15329.6	32.05165	4913.39	6405.6	71.77	0.04	0.011	2.84	0.02
5.	Tomato	1266.6	1819.2	31.63836	575.5651	552.6	43.62861	0.001	0.000.	2.14	0.04

Table 6 below illustrates the yearly prices data of past 10 years for selected vegetables, the value of Average prices, standard deviation, relative change for each vegetable is

worked out and to check the whether or not the change is significant, a t-test is also applied.

Table 6: Illustrates the yearly prices data of past 10 years for selected vegetables, the value of Average prices, standard deviation, relative change for each vegetable is worked out and to check the whether or not the change is significant, a t-test is also applied

S. No.	Vegetables	2013-14 (Rs./qtl.)	2014-15 (Rs./qtl.)	2015-16 (Rs./qtl.)	2016-17 (Rs./qtl.)	2017-18 (Rs./qtl.)	2018-19 (Rs./qtl.)	2019-20 (Rs./qtl.)	2020-21 (Rs./qtl.)	2021-22 (Rs./qtl.)	2022-23 (Rs./qtl.)
1.	Cauliflower	495	491.23	495.64	495.07	512.64	524.97	750.22	648.78	1307.0	1329.23
2.	Green-pea	650.48	653.72	657.25	660.25	665.64	672.59	975.3	716.01	1073.9	1187.71
3.	Potato	740	742.22	740	743.25	745.55	750.77	642.1	739.06	852.55	916.56
4.	Onion	1698	1700	1695	1700.25	1705.25	1734.21	1753.96	1750.07	1899.33	1951.08
5.	Tomato	960	975.75	966	968	970	1013.35	1084.96	1255.61	1602.17	1513.81

Change in prices post-unification in Rudrapur APMC of major commodities

S. No.	Vegetables	Average prices before e-NAM (Rs./qtl)	Average prices after e-NAM (Rs./qtl)	COV after e-NAM (%)	SD after e-NAM (Rs./qtl)	Absolute change (Rs./qtl)	Relative change (%)	F test		T test	
								F value	p value	T value	P value
1.	Cauliflower	497.916	912.058	41.58	379.28	414.14	83.17	0.0004	0.000	2.44	0.03
2.	Green-pea	657.468	925.10	24.23	224.22	267.63	40.70	0.0009	0.000...	3.73	0.01
3.	Potato	742.204	780.208	13.66	106.60	38.004	5.12	0.000.	0.000...	0.79	0.23
4.	Onion	1699.7	1817.73	5.50	100.07	118.03	6.944	0.001	0.000...	2.63	0.02
5.	Tomato	967.95	1293.98	19.97	258.46	326.03	33.6	0.0000.	0.0000.	2.81	0.02

Summary and Conclusion

In Rudrapur APMC, a total of 5883 farmers and 363 traders registered under e-NAM. Only one FPO was registered. When looking at specific crops:

- **Cauliflower:** After integrating with e-NAM, there was a significant increase in arrivals by 578.2 quintals (37.89% relative change). Prices also notably rose by 414.14 Rs/Qtl. (83.17% relative change). Both changes were statistically significant at a 5% level.
- **Green-pea:** Arrival of green-peas saw a substantial increase of 5137.2 quintals (157.99% relative change).

Prices rose significantly by 267.63 Rs./Qtl. (40.7% relative change). Both changes were statistically significant at 5% and 1% levels.

- **Potato:** Arrival of potatoes increased by 4663.2 quintals (23.13% relative change), with a slight rise in prices by 38.004 Rs/Qtl. (5.12% relative change). However, these changes were not statistically significant, suggesting no substantial impact on potato prices, but potential for price discovery in e-NAM.
- **Onion:** After e-NAM integration, onion arrivals showed a notable increase by 6405.6 quintals (71.77%

relative change). Prices rose by 118.03 Rs./Qtl. (6.94% relative change). Both changes were statistically significant at a 5% level.

- **Tomato:** Tomato arrivals increased significantly by 552.6 quintals (43.62% relative change) after e-NAM integration. Prices also notably rose by 326.03 Rs./Qtl. (28.43% relative change). Both changes were statistically significant at a 5% level.

Enhancing facilities for grading, storage, and assaying is crucial, particularly for perishable items like fruits and vegetables. Prioritizing the installation of cold storage within the APMC can greatly benefit these items. Currently, only one FPO is registered with Rudrapur APMC. FPOs are essential for supporting small farmers with loans, resources, and technical assistance. APMCs should actively encourage more FPO registrations to provide greater support to marginal and small farmers. Among the five selected vegetables, four showed significant changes in both arrival and prices after e-NAM integration, resulting in improved returns for the farmers. To ensure equitable benefits, government policies and interventions should focus on aiding potato farmers as well, for them to achieve better price realization.

Directions for future research: Study can also be done on other districts of Uttarakhand and other crops can also be included according to the production and marketing statistics. The study would be of great help to the policy makers to enhance the working efficiency of e-nam and making this marketing system more viable.

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