

SMALLHOLDER TURMERIC FARMERS' PARTICIPATION IN ELECTRONIC NATIONAL AGRICULTURAL MARKET (e-NAM): EVIDENCE FROM INDIA

K. NIRMAL RAVI KUMAR^{A*}, A. CHANDANA^B AND K. VISWANATHA REDDY^C

^{a*} Professor & Head, Department of Agricultural Economics, Agricultural College, Bapatla, ANGRAU, 522101, India.

^b Department of Agricultural Economics (M. Sc.), Agricultural College, Bapatla, ANGRAU, 522101, India.

^c ICAR-CTRI, Rajahmundry, 533105, India. *Corresponding Author e-mail: drknrk@gmail.com

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India is a leading producer and exporter of turmeric in the world. The Government of India introduced e-NAM in 2016 with the aim of networking the existing mandies on a common online platform as 'One Nation One Market' for agricultural commodities. Accordingly, the same was introduced in 2017 in Duggirala market in Andhra Pradesh with a view to ensure competitive prices for turmeric farmers. The study applied Probit and Tobit analyses to analyze the e-NAM participation decision of smallholder farmers (MPDe-NAM) and extent of turmeric transacted through it in Duggirala market respectively. The relevant data are collected from 500 small-holder (< 2 ha land) turmeric farmers. They are broadly categorized into e-NAM participating farmers (178) and farmers selling turmeric in physical market (322) and the sample is drawn based on probability proportion to size. The findings revealed that quantity of turmeric produced, selling price, education and trainings imparted to sample farmers are the major factors that promote the MPDe-NAM and extent of turmeric transacted through e-NAM in the study area. The findings also highlighted that the non-e-NAM participants were constrained in terms of low access to institutional credit, lack of off-farm income, low-scale production, dependency on local commission agents and traders for financial requirements etc., thereby, making them inflexible to commercialize the marketing transactions of turmeric. Thus, to ensure more MPDe-NAM of turmeric farmers, boosting the productivity and production of turmeric, capacity building on the importance and benefits of e-NAM, lowering transaction costs through networking of market players in the supply chain, liberal disbursement of institutional credit etc., should deserve special attention. A close look at these results further indicate that the Government should focus on enabling environment, institutional roles and functions and management instruments to popularize e-NAM transactions for turmeric in the State.

INTRODUCTION

In the agrarian country like India, pushing up the farm prices especially for smallholder farmers is vital to sustain them in farm business. In this context, alternative marketing mechanism like participation in electronic-National Agricultural Market (e-NAM) deserve special mention, as it ensure both dynamism and efficiency in marketing transactions. The Government of India has enacted several marketing laws right from 1960s to bring radical changes in the marketing process of agricultural commodities. The Agricultural Produce Marketing (Regulation) Act (APMRA) brought during 1960-70 has led to radical changes and significant improvement in almost all aspects of marketing of farm produce. Later, the Government appointed an Expert Committee in 2000 to bring stringent controls on the storage and movement of several agricultural commodities. However, these restrictions were acting as a disincentive to farmers, trade and industries. Accordingly, Inter-Ministerial Task Force in 2001 suggested various reforms, policies and programs and accordingly, Model Act called the State Agricultural Produce Marketing (Development and Regulation) Act was passed in 2003. This provided the scope for establishment of private markets/yards, direct purchase centers, consumer/farmers markets for direct sale, promotion of Public Private Partnership (PPP) and strengthening of marketing infrastructure. In the year 2016, the Government introduced 'e-NAM' concept as an alternative marketing mechanism to facilitate online transactions, assaying, grading, storage, dispute settlement etc. With the advent of Covid pandemic, on 2nd April, 2020 the Government has introduced two trading modules from e-NAM viz., warehouse-based trading module and FPO-based trading

module with the objectives of decongesting mandies as well as maintaining the supply chain of agricultural commodities. The former facilitate the farmers and traders to perform trade operations through e-NAM from the premises of warehouses through availing electronic Negotiable Warehouse Receipt (e-NWR). The FPO-based trading module enable the farmers gain access to the e-NAM platform from the Farmer Producer Organizations (FPOs) collection centers. Both these modules These modules.

e-NAM in India is being implemented by Small Farmers Agribusiness Consortium (SFAC) and as on 1st April 2022, 1,000 wholesale mandies, located in 18 States and 3 Union Territories (UTs) got integrated with the e-NAM (Table 1). This module enjoy user base of 167 lakh farmers, 0.84 lakh commission agents, 1012 FPOs and over 1.45 lakh traders (<https://eNAM.gov.in/web/dashboard/stakeholder-data>). A total of 175 commodities,

including food grains, oilseeds, fibers, vegetables and fruits, are being traded on e-NAM. This e-trade is gaining more popularity being scale neutral and in providing wide range of services like dissemination of market related information, quality assaying, competitive bidding, electronic payment settlement directly into farmers' accounts, reduced transaction costs, bridging information asymmetries, helping expansion of market access for farmers and other stakeholders etc.

In Andhra Pradesh, e-NAM was first launched in Hindupur, Kalyandurgam, Kurnool, Adoni, Emmiganuru, Kadapa, Guntur, Duggirala, Eluru and Anankapalle market committees in 2016. As on today, 33 markets and 1.66 crore farmers in Andhra Pradesh have registered with this digital platform. Andhra Pradesh also declared 23 warehouses in the State to conduct trading activity from the warehouse-based e-NAM trading module. The FPO-based trading module introduced in e-

Table -1: Number of APMC mandies of 18 States and 3 UTs doing online trading (e-NAM)

S.No	State/UT	Mandies integrated to e-NAM
1	Andhra Pradesh	33
2	Chandigarh	1
3	Chhattisgarh	14
4	Gujarat	122
5	Haryana	81
6	Himachal Pradesh	19
7	Jammu And Kashmir	2
8	Jharkhand	19
9	Karnataka	2
10	Kerala	6
11	Madhya Pradesh	80
12	Maharashtra	118
13	Odisha	41
14	Puducherry	2
15	Punjab	37
16	Rajasthan	144
17	Tamil Nadu	63
18	Telangana	57
19	Uttar Pradesh	125
20	Uttaranchal	16
21	West Bengal	18
	Total	841

Source: <https://eNAM.gov.in>

NAM has enabled these organizations to upload their produce from their premises or collection centres for bidding. They can even upload the assaying report and picture of the produce and quality parameters to help bidders, even outside the State, to see the produce before bidding. The farmers especially small holders are among those happy about the changes ushered in by e-NAM in transacting their produce — such as curbing trade cartels, transparency in auction and weighment, and immediate settlement of payments.

Turmeric is an important spice crop cultivated in India in general and Guntur district of Andhra Pradesh in particular. In Andhra Pradesh, during the year 2020-21, area covered under turmeric was 0.18 lakh ha and it occupied 0.42 per cent under total food cropped area (Statistical Abstract of Andhra Pradesh, 2021). In Andhra Pradesh, Guntur and Kadapa are the leading turmeric cultivating districts accounting for 63.31 per cent of total turmeric area in the State (0.12 lakh ha) in 2020-21 followed by Krishna (0.02 lakh ha) and Kurnool (0.01 lakh ha) districts. In Duggirala market, e-NAM was launched in May 2017 for turmeric trade and it enjoys the reputation of country's oldest turmeric market. This has set an example for other markets in the State as well as those across the country with the quick acceptance of the online platform and payment. So, introducing the e-NAM trading portal in the Duggirala mandi is an ample compensation, as the farmers are getting greatly benefitted through inducing healthy competition. The pace of growth of e-NAM transactions for turmeric in Duggirala market is the motivation for this study to examine the factors influencing Market Participation Decision of farmers in e-NAM transactions (MPDe-NAM) and the extent or level of participation in terms of quantity of turmeric transacted through e-NAM. The findings from this study will enable the Government to formulate effective policy measures to promote e-NAM in a sustainable development framework towards enhancing the smallholders' participation in transacting turmeric in Duggirala market.

There are very few exploratory and some empirical studies which examined the MPD of farmers in trading agricultural commodities.

According to Abbott, 1987, agricultural marketing incorporate both the supply of inputs for production to farmers and sale of output in the market (Abbott, 1987). The production decisions of commercialized farmers are largely influenced by market information, while the same for subsistence farmers are influenced by subsistence requirements (Pingali, 1995). One of the most important factors that influence the adoption of alternative marketing mechanism among the farmers is 'education'. This is so because, it helps to create a promising rational attitude for the acceptance of new practices, especially information-intensive and management-intensive practices (Waller *et al.*, 1998; and Caswell *et al.*, 2001). Rogers (1995) and Ehler and Bottrell (2000) stated that technology difficulty has a negative effect on adoption and this could only be deal with complete education. Furthermore, access to credit is expected to increase the probability of adoption.

In the modern era of agri-business, it is essential to modernize agricultural markets for boosting economic growth and poverty reduction (Abbott, 1987). This will be ensured through better farmer-market linkages and consequent increase in marketed surplus. So, increased market participation of farmers is both a foundation and an outcome of economic development (Reardon and Timmer, 2005). As smallholder farmers have low marketable surplus, their market participation intensity is relatively poor and thus, affecting their economic prosperity (Mathenge *et al.*, 2010). Majority of the factors viz., age, sex, education level, household size, livestock ownership, distance to nearest market place, transport facilities, marketing experience, price information, access to extension and credit services, contract marketing etc., influence the market participation decision of farmers (Bellemare & Barret, 2006; Omiti, 2009; Goetz, 1992; Rios *et al.*, 2008). According to Jean and Antoine (2017), marketable surplus, marketing experience and open market price are the major influential factors that contribute to MPD of farmers. They also opined that farmer's participation in output market is a function of farm productivity too.

From the previous discussion, it is concluded that though a number of research studies have

been conducted on technology adoption, there is a no adequate literature on the specific factors that influence participation of farmers in e-NAM transactions, especially among smallholder farmers. In this context, this study is certainly a contributing one.

Data and Research Method: As turmeric is the major crop cultivated in Guntur district and Duggirala market enjoys national reputation in handling turmeric since 1984, the same were considered for this in depth study. In this market, the e-NAM was implemented from May 2017 and considering its importance in providing fair and competitive trade to the turmeric farmers, the factors influencing their MPDe-NAM and extent of participation is very important. So, the target population of the study was the smallholder farmers transacting turmeric in Duggirala market. The sample required to collect the requisite data was drawn in accordance with the formula proposed by Yamane (1967):

$$n = \frac{Z^2 P(1-P)}{e^2} = \frac{(1.96)^2 0.5(1-0.5)}{0.05^2} = 16$$

where, Z is the significance level of 95 per cent, the value of the distribution table Z = 1.96, 'p' is the estimate of the correct prediction of n for P = 0.5, e is the sampling error allowed with +/-0.05 (5%). The data collected included, among them, household characteristics, socio-economic aspects, institutional characteristics and market aspects.

From Guntur district, the top five mandals viz., Kolluru, Kollipara, Bhattiprolu, Tadepalle and Tenali in terms of turmeric cultivated area are purposively selected (Handbook of Statistics, Guntur district, 2020). From each mandal, 100 farmers are selected at random in consultation with local Agricultural Officers, thus making a sample size of 500 farmers. Two sampling frames were considered comprising the list of farmers transacting through e-NAM and through physical market. Thus, the farmers were stratified into two categories based on MPDe-NAM. After data cleaning, a representative sample of farmers with MPDe-NAM (n = 322) and transacting turmeric in physical market (n = 178) during 2021 are selected

based on probability to proportional to size. Structured schedule was used to collect requisite data on covariates and outcome variables (Table 2).

Both descriptive and econometric analyses are employed for analyzing the collected data. Probit regression model was employed to study the determinants for MPDe-NAM transactions and Tobit model was then used to study the determinants for extent of e-NAM participation (proportion of output transacted through e-NAM). The decision to either participate in the e-NAM or not and the extent of participation were treated as dependent variables in Probit and Tobit models respectively and are estimated independently.

3.2. Farmer's MPDe-NAM transactions: Probit model was employed to estimate the factors influencing MPDe-NAM of selected turmeric farmers in the study area. According Egbetokun and Omonona (2012), this model is computed from the standard normal cumulative distribution function. The probability Pi of choosing e-NAM market over not choosing it can be expressed as in (2), where 9 represents the cumulative distribution of a standard normal random variable:

$$P_i = \text{prob} [Y_i=1 | X] = \int_{-\infty}^{x'_i \beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt$$

$$= \Phi(x'_i \beta)$$

Considering the variables selected (Table 2), the Probit model formulated in this study is as given below:

$$P(0, 1) = \text{MPDe-NAM} = \beta_0 + \beta_1 \text{FE} + \beta_2 \text{SLH} + \beta_3 \text{DTM} + \beta_4 \text{TP} + \beta_5 \text{SEX} + \beta_6 \text{EDU} + \beta_7 \text{OFI} + \beta_8 \text{ATIC} + \beta_9 \text{Tr} + \beta_{10} \text{AT} + \varepsilon_i$$

where, MPD = Market Participation Decision of the farmer to participate in e-NAM transaction of turmeric, which can take the value of '1' if the farmer participated or '0' if he do not.

The marginal effects of the selected continuous explanatory variables can be derived as follows:

$$\frac{\partial P_i}{\partial x_{ik}} = \Phi(x'_i \beta) \beta_k$$

Table 2: Description of the variables in the empirical models

Variable	Variable Name	Variable type	Variable measurement
Dependent Variables			
MPDe-NAM	Market Participation Decision in e-NAM	Dummy	1 if farmer participated in e-NAM transaction, 0 otherwise
QTT	Quantity of turmeric traded	Continuous	Quantity of turmeric transacted through e-NAM in quintals
Quantitative Variables			
FE	Farming Experience	Continuous	Number of years of experience in crop production
SLH	Size of land holding	Continuous	Number of acres of land cultivated under turmeric
DTM	Distance to market	Continuous	Distance (kms) of farm gate to Duggirala market
TP	Turmeric Produced	Continuous	Quantity (qtls) of turmeric produced
PTT	Proportion of Turmeric Traded	Continuous	Percent (of marketable surplus) of turmeric traded through e-NAM
SP	Selling price of turmeric	Continuous	Selling price in Rs/qlt
Qualitative Variables			
SEX	Sex of sample farmer	Dummy	1 if farmer is male, 0 otherwise
EDU	Education of the sample farmer	Dummy	1 if sample farmer is educated (>10 th class), 0 otherwise
OFI	Off-farm income	Dummy	1 if farmer has OFI, 0 otherwise
ATIC	Access to Institutional Credit	Dummy	1 if farmer has ACTI, 0 otherwise
TR	Trainings	Dummy	1 if farmer received trainings on e-NAM, 0 otherwise
AT	Access to transport facilities	Dummy	1 if farmer enjoy good access for transport of produce, 0 otherwise

Source: Author's definitions

where Φ represents the probability density function of a standard normal variable.

The marginal effects on dummy variables should be estimated from the following equation:

$$\Delta = \Phi(x\beta, d = 1) - \Phi(x\beta, d = 0)$$

PTT through e-NAM: To analyze the factors affecting the extent or level of market participation

(PTT), the following Tobit regression model was employed:

$$PTT = \beta_0 + \beta_1 FE + \beta_2 SLH + \beta_3 DTM + \beta_4 EDU + \beta_5 OFI + \beta_6 ATIC + \beta_7 TR + \beta_8 AT + e_i$$

This section is dealt in three sub-sections. The first subsection provides the descriptive statistics of the selected sample with reference to socio-economic and demographic characteristics focusing on the variables of interest for the Probit and Tobit model

analyses. The second and third sub-sections provide details about the analytical results from Probit and Tobit models respectively.

Descriptive statistics of Sample Respondents:

Table 3 summarizes the socio-economic and demographic profiles of the sample respondents, who make decision in transacting turmeric either through e-NAM or in physical market. According to this table, 81 per cent of total sample farmers are male and only 19 per cent are female. Around 45 per cent of the farmers are between the ages 36 - 50 years, 33 per cent between the ages 21 - 35, and 11 per cent each among aged less than 20 and over 50 years of age. Educational attainment was classified into four categories, illiterate (13%), High school (56%), graduates (26%) and post-graduates (4%). Around 51 per cent of the respondents are with annual income ranging between Rs.50,000 to Rs.1,00,000 and around 70 per cent of the sample farmers have good access to off-farm income. The average household size was

3.95 people that is lower than the average household size (4.30 people) of Guntur district (Handbook of Statistics, Guntur district, 2020). The most frequent household size is 3-4 people with 60.4 per cent.

Around 67 per cent of the sample farmers were received trainings about the importance and benefits of transacting turmeric through e-NAM. Additionally, 77 per cent of the farmers, both participants and non-participants of e-NAM, were headed by men. Other characteristics of the sample respondents in the survey are presented in Tables 4 and 5. Table 5 indicates that farmers who have favorable resources are more likely to participate in e-NAM transactions than farmers without such facilities.

Factors Affecting MPDe-NAM for transacting Turmeric: The likelihood ratio statistic (χ^2) of binary probit model is significant ($P < 0.0409$) indicating that the model parameters were jointly

Table 3. Socio-economic and Demographic characteristics of sample farmers (n = 500)

Characteristic	Frequency	%
Gender:		
Male	407	81.4
Female	93	18.6
Age:		
Under 20	54	10.8
21 - 35	167	33.4
36 - 50	224	44.8
> 50	55	11
Educational Background:		
Illiterate	67	13.4
High School	281	56.2
Graduate	131	26.2
Post-graduate	21	4.2
Annual Income (Rs):		
< 50,000	56	11.2
50001 to 1,00,000	257	51.4
1,00,001 to 1,50,000	119	23.8
>1,50,000	68	13.6
Household size:		
1-2	28	5.6
3-4	302	60.4
4-6	128	25.6
>6	42	8.4

Table-4 : Descriptive statistics about sample data (All Farmers - Quantitative variables)

Characteristic	Min	Max	Mean	SD
FE (years)	4	31	17.06	7.89
SLH (ha)	0.5	1.8	2.83	1.32
DTM (kms)	2	107	56.32	29.91
TP (qtls)	12.5	164.5	82.97	39.68

Raw Data Source: Data collected from the sample farmers

Table-5: Comparisons of the means of explanatory variables among e-NAM vis-a-vis Physical market participants

Variables	Participant Farmer (Turmeric transacted through e-NAM)	Non-Participant Farmer (Turmeric transacted in Physical market)	P value	
			F Test	τ
FE (years)	21.09	17.01	0.811	—
SLH (ha)	1.14	1.12	0.634	
DTM (kms)	78.49	52.34	0.000	
TP (qtls)	93.84	81.37	0.517	
SEX	0.70	0.34		0.001
EDU	0.74	0.40		0.012
OFI	0.70	0.77		0.417
ATIC	0.75	0.41		0.03
TR	0.71	0.32		0.002
AT	0.67	0.33		0.041

Raw Data Source: Data collected from the sample farmers

significant in explaining the dependent variable. The McFadden's Pseudo R^2 was 0.39 implying that the model was well-specified with a good fit (Hensher *et al.* (2005). Training received (TR) regarding e-NAM, farming experience (FE), distance to market (DTM), quantity of turmeric produced (TP), education of the farmer (EDU), off-farm income (OFI) source and access to institutional credit (ATIC) have exerted positive and significant influence on the probability of MPDe-NAM. However, other factors like size of land holding (SLH), sex of the farmer and access to transport

facilities (AT) had no significant relevance regarding the probability of MPDe-NAM.

Trainings (TR): The TR imparted to the farmers on the benefits of e-NAM has influenced their MPD positively (+0.2409**) and in terms of marginal effect (0.0874), their MPDe-NAM would increase by 8.74 percent. It is known that the TRs will motivate the farmers for intensive adoption of e-NAM technology. Similar findings are noticed in the studies conducted by (Polson and Spencer, 1991; Lawal and Oluyole; Nkonya *et al.*, 1997 and

Table 6: Probit model results for factors influencing MPDe-NAM

Variables	Coefficient	SE	Marginal effect (dy/dx)	Z	P > z
FE	0.0017**	0.0006	0.006	2.99	0.0028
SLH	-0.1315	0.1627	-0.0487	-0.81	0.4190
DTM	-0.0039*	0.0020	-0.0014	1.99	0.0470
TP	0.0051*	0.0024	0.0019	2.08	0.0366
SEX	-0.1680	0.1249	-0.0614	-1.34	0.1790
EDU	0.2041*	0.0983	0.0744	2.08	0.0375
OFI	0.2314*	0.1029	0.0837	2.25	0.0244
ATIC	0.1698*	0.0799	0.0637	2.12	0.0340
TR	0.2409**	0.0472	0.0874	5.11	0.0000
AT	0.0926	0.1233	0.0344	0.75	0.4530
Constant	0.4854	0.3177		1.53	0.1270

LR χ^2 (10) = 18.95**

Prob > χ^2 = 0.0409

Log likelihood = -58.892

Pseudo R^2 = 0.39

Note: (**) and (*) denote significance at the 1% and 5% levels, respectively

Onu, 2006) in case of adoption of production technologies by the farmers.

Farming Experience (FE): Like TR, 'farming experience (FE)' also had positive and significant influence on MPDe-NAM (+0.0017**) and its marginal effect (0.006) imply that for every one year increase in FE will enhance improve the marketing experience and hence, increases the probability of the farmer to participate in the e-NAM market by 0.60 percent. So, the long-term FE reduces the probability of being a subsistence farmer, as improves access to alternative markets like e-NAM. This finding is in line with the findings of World Bank's study (2007) that FE contributes towards commercialization of agriculture especially in case of smallholder farmers. However, this finding is in contrast with earlier studies of Alene *et al.* (2008) and Heltberg (2002).

Off-farm activities (OFI): As expected OFI had positive impact on MPDe-NAM and its marginal effect showed that the probability of e-NAM participation increases by 8.37 percent. This finding is encouraging as it makes the farmer overcome distress sales of produce and thus enable him to focus on price trends of turmeric in the e-NAM market. This finding is in contrast with the

earlier findings of Gebremedhin and Jaleta (2012) in Ethiopia, Martey (2012) in Ghana.

Education (EDU): As expected EDU showed positive and significant (at 5% level) impact on the farmers' MPDe-NAM and its marginal effect highlight that an increase in one year of education of farmer would increase his probability of participation in e-NAM transactions of turmeric by 7.44 per cent. This is because, EDU enable the farmers to accept the modern marketing technologies to earn remunerative prices for their produce. These findings are in consistent with the earlier studies (Feder *et al.*, 1985; Awe 1999) in southwestern Nigeria and Berkeley, USA, respectively.

Access to institutional credit (ATIC): This factor influenced positive and significant (at 5% level) impact on the farmer's MPDe-NAM and in terms of marginal effect. It will increase the probability of market participation by 6.37 percent. This is because, with increase in ATIC, the farmers can procure quality inputs in right quantity and time, thereby realize higher production and marketable surplus. This finding is in tune with Randela (2008) with reference to cotton market participation in South Africa. The discussions held with the local

Agricultural Officers also revealed that when the farmers depend on non-institutional sources for credit, the probability of MPDe-NAM declines, as they have to resort to distress sale of produce in the local (physical) market to clear-off their prior debts borrowed at higher rates of interest.

Turmeric quantity produced (TP): A unit increase in the TP will increase the probability of MPDe-NAM by 0.19 per cent and it is found significant at 5 per cent level ($P = 0.0366$). This is in line with the findings of Jean and Antoine (2017) in Rwanda.

Distance to Duggirala market from farm gate (DTM): As expected, DTM exerted negative and significant (at 5% level) influence on the of MPDe-NAM and its marginal effect showed that with increase in DTM by one kilometer from farm-gate, the probability of farmer's participation in the e-NAM transactions decreases by 0.14 per cent. This is in line with the findings of Eskola (2005), as he opined that DTM influences the farmers' degree of commercialization in Tanzania.

Contrarily to expectations, variables viz., size of land holding (SLH), sex of the individual and

access to transport (AT) have not exerted significant influence on the MPDe-NAM. In addition, the direction of the effect of SLH was found to be opposite to earlier expectations ie., it is with unpredicted negative sign. The possible justification may be low productivity of turmeric in the study area.

4.3. Factors influencing Extent of e-NAM Participation of Farmers:

The likelihood ratio statistic (χ^2) of Tobit model (Table 7) is highly significant ($P < 0.0000$) suggesting that it has strong explanatory power. The findings showed that most of the explanatory variables had the expected signs. However, only TP, EDU, TR and SP have exerted positive and significant influences on the extent of market participation. SLH showed non-significant (positive) influence on the extent of market participation. FE and AT have expected positive signs, but they were statistically insignificant. On the other hand, DTM had expected negative sign but found statistically insignificant. Contrary to the expectations, sex of the individual, OFI and ATIC have negative signs, but they were also found statistically insignificant.

Table 7: Tobit model results for factors influencing the extent of market participation

Variables	Coefficient	SE	Marginal effect (dy/dx)	Z	P > z
FE	0.0289	0.3153	0.0215	0.09	0.927
SLH	0.1639	0.0839	0.5313	1.96	0.051
DTM	-0.5657	1.2588	-0.1215	-0.45	0.653
TP	0.8184**	0.2288	0.6064	3.58	0.000
SEX	-0.2283	1.2430	-0.2765	-0.18	0.854
EDU	0.0508*	0.0207	0.2129	2.45	0.015
OFI	-0.1276	1.3101	-6.5346	-0.10	0.922
ATIC	-0.5236	1.3736	-6.0990	-0.38	0.703
TR	0.1827**	0.0262	0.0849	6.97	0.000
AT	0.7595	1.2746	1.9635	0.60	0.552
SP	0.03501**	0.0006	0.0261	61.97	0.000
Constant	-225.5846	5.0762		-44.44	0.000

LR χ^2 (10) = 102.92**

Prob > χ^2 = 0.0000

Log likelihood = -1900.6586

Pseudo R^2 = 0.4193

Note: (**) and (*) denote significance at the 1% and 5% levels, respectively

Quantity of turmeric produced (TP): TP exerted positive and statistically significant (at 1% level) influence on the PTT through e-NAM ($P = 0.000$). Its marginal effect indicated with increase in TP by one unit (quintal), the extent of e-NAM transactions increases by 61 per cent. This was eventually expected, as the farmers with higher output will enjoy higher marketable surplus. This outcome is in line with the findings of Reyes *et al.*, (2009) in Angola. Rios *et al* (2008) also conclude that the farmers with more production enjoy more marketed surplus, *ceteris paribus*.

Trainings (TR): TR imparted to the farmers on the mechanism and benefits of e-NAM transactions have exerted positive and significant influence on the extent of e-NAM turmeric transactions in Duggirala market. This shows that when farmers are trained enough, the quantity of produce transacted through e-NAM has increased significantly. In this study, each training imparted on the farmer would increase the turmeric transacted through e-NAM by 8.5 per cent. Thus, imparting good number of training programmes will enable the farmers to adopt e-NAM transactions for their produce.

Education (EDU): As expected EDU on the part of the farmers positively influenced their PTT through e-NAM and in terms of marginal effect, it is 21 per cent. This is because, more educated farmers enjoy modern or alternative marketing opportunities like e-NAM. Matungul *et al.*, (2001) and Makhura (2001) found similar findings and they emphasized about the importance of EDU in reducing farmers' marketing costs in South Africa.

Selling price (SP): This factor exerted positive and significant influence on the extent of e-NAM participation by turmeric farmers and its marginal effect is 2.61 per cent. This is because, lucrative and competitive prices offered by the e-NAM attract the turmeric farmers to avail modern marketing technology. These findings are in line with *a priori* economic theory and also in tune with Mas-Colell *et al*, 1995 and Goetz (1992).

Conclusions and Suggestions: Since majority of the farmers in Guntur district are smallholders, the policies formulated by the Government must ensure competitive prices for their produce. The

introduction of e-NAM technology has brought radical changes in the marketing process and enabled the turmeric farmers to transact their produce through online. Hence, the study on MPDe-NAM and the extent of turmeric transactions through e-NAM deserves special mention to identify the drivers for commercial agriculture. The findings regarding determinants for MPDe-NAM and extent of turmeric transacted through e-NAM among smallholder farmers include: quantity of turmeric produced, selling price, education and trainings imparted to sample farmers. The analytical results further highlighted some differences between e-NAM participants and non-e-NAM participants. The non-e-NAM participants were constrained by various factors such as low access to institutional credit, lack of off-farm income, distant location of farms from Duggirala market, low-scale production, dependency on private money lenders for financial requirements etc., making them inflexible to commercialize the marketing transactions of turmeric. So, this study highlights the following recommendations for better MPDe-NAM in transacting turmeric in Duggirala market:

- As quantity of turmeric produced is among the leading significant drivers in MPDe-NAM and extent of turmeric transacted through e-NAM, efforts should be intensified to boost the production abilities among smallholder farmers.
- Capacity building of smallholder farmers on the importance and benefits of e-NAM should be intensified.
- Both Probit and Tobit models revealed non-significant contribution from the size of land holding and this might be due to low productivity of turmeric in the study area. In this context, efforts should be intensified to improve the productivity of the existing land under cultivation.
- Since SP of turmeric is one of the important incentives to attract farmers to participate in e-NAM transactions, the supply chain should be made agile with proper coordination among various market players.
- The Government should intensify the credit disbursement to smallholder farmers through institutional sources (at lower rates of interest)

and link credit with e-NAM marketing transactions.

When the trade areas are not restricted due to e-NAM and with the introduction of AIF Scheme, there is immense scope to popularize the e-NAM concept. As Agricultural Marketing is a State subject, the enabling environment (Figure 2) in the country in general and in Andhra Pradesh in particular pose a favourable picture towards popularizing the e-NAM concept. Even the institutional roles and functions and management instruments ensure positive picture to realize the true benefits of e-NAM. So, this policy should be viewed in a broader perspective to further gear up the agricultural market reforms. However, the fruits of e-NAM intervention in Duggirala market can be better realized in the near future, if the State Government develop its own contextualized

strategies to popularize it among the turmeric farmers and other stakeholders.

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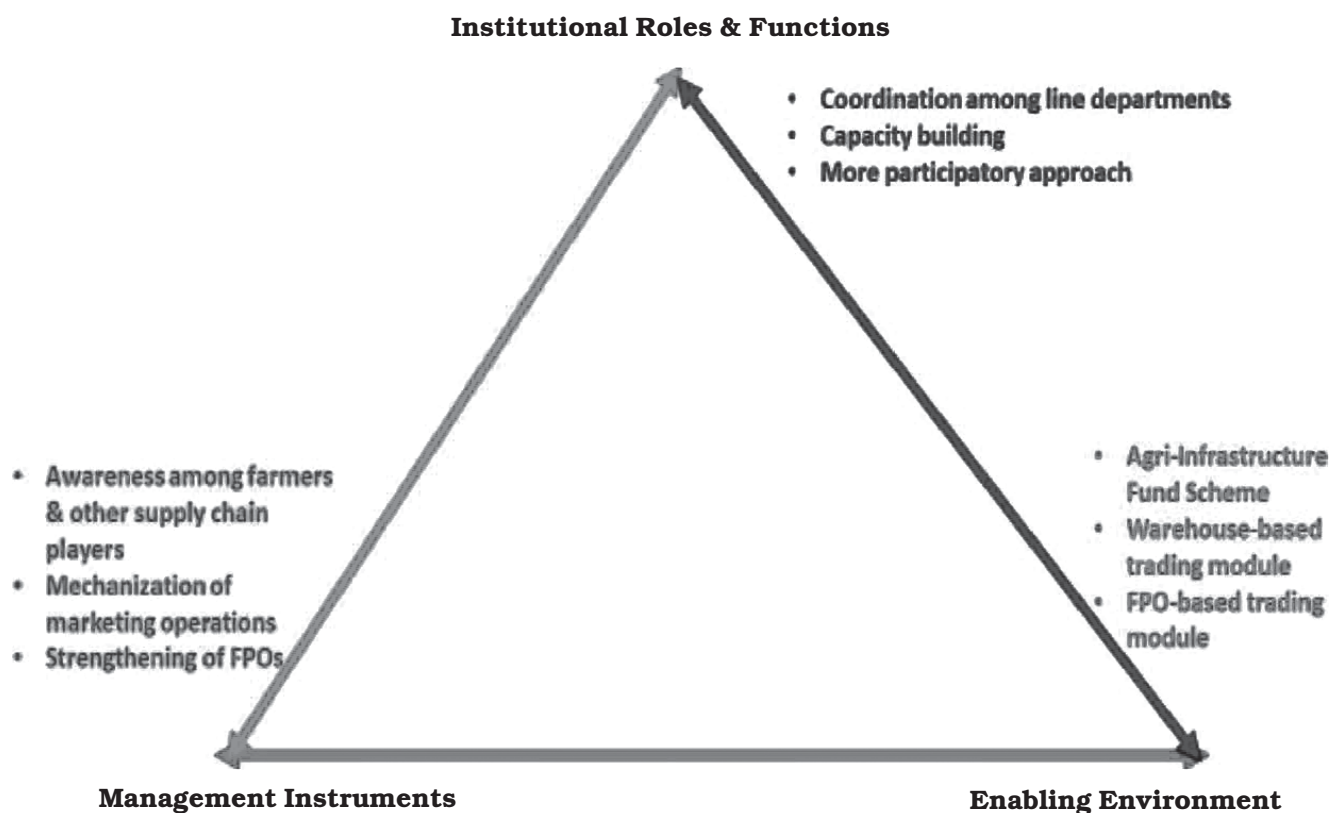


Figure h Broaderswpeta popularize e-NAM for transacting turmeric

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