Impact of Marketing Information System (MIS) on Prices Realization of Minor Forest Produce (MFP) in High Altitude and Tribal (HAT) Zone of Andhra Pradesh

ABSTRACT

This study mainly focused on impact of MIS on prices realization of selected minor forest produce (MFP) *viz*., honey (*Apis dorsata*), hill broom (*Thysanolaena maxima*), Naramamidi bark (*Litsea deccanensis*), Seeded Tamarind (*Tamarindus indica*), Marking nut (*Semecarpus anacardium*) and Myrobalan (*Terminalia chebula*). Propensity Score Matching (PSM) technique was employed to analyse impact of market information on price realization of MFP. Primary data was collected from 360 farmer respondents from HAT zone in Andhra Pradesh state. The Probit regression results indicated that considered variables has positive significant association and influenced to access market information in the study *viz.*, experience, frequency of visit to Girijan Primary Co-operative Marketing Society (GPCMS), access to mobile phone, education and trainings on the importance of MIS in accessing market information from GPCMS and Primary Procurement Centres (PPCs). Access to market information by the tribal farmers revealed significant impact (P<0.001) on treated, as the impact indicator (prices) is higher for them compared to untreated. The treated were significantly benefited from market information by 15.19 per cent for honey, 37.95 per cent for hill broom and 89.16 per cent for Naramamidi bark, 60.27 per cent for seeded tamarind, 115.45 per cent for Marking nut and 133.34 per cent for myrobalan.

Key words: MIS, MFP, Probit regression, HAT zone and Propensity Score Matching

1. INTRODUCTION

While most of the country is galloping towards commercialization, tribes of India, who constitute 6.6 percent of its population, still limp in terms of economic growth. Their degree of association with the outside world is hanging by the thread, evidenced by poor physical and virtual connectivity to the extent that they remain oblivious to the vast demand in the markets for the produce collected from the forests they live in, and its untapped potential. Most of them also remain oblivious to the fact that their MFPs hold great medicinal and commercial utility. They fall prey to the middlemen in their marketing chain, whose endeavours seem exploitative as they reap a sizable portion of the final consumers' rupee, leaving the tribal farmer with a meagre share.

This scenario has been regulated to some extent with the introduction of Information Communication Technologies (ICTs) among the tribal farmers, through which critical market information dissemination contributed to the sustainability and competitiveness of the forest sector (Chandra and Sharma, 2019). Several forms of electronic media were used to bridge the communication gaps between farmers, traders and consumers and ensure transparency, with mobile phones, television and radio being the most prominent ones in recent times (Mwombe *et al.*, 2014). Indian MFP markets are characterized by a vast pool of sellers and buyers, latter of which are placed at a relative advantage in terms of information awareness. Despite the best efforts to help them, the organizations responsible are also severely inhibited by the lack of reliable and accurate market data, owing to the persistent lacunae in the existing MIS, effects of which ultimately reflect on the price realization of the farmers. In India, it is disheartening to say that availability of reliable market data continues to be an issue; even the statistics for demand, supply and trade related to timber, which is a major produce from the forests, are not reliable and accurate (ITTO, 2003). Similarly, there is non-availability of reliable statistical data on MFP. The state of Andhra Pradesh, which stands eighth among the states with tribal population, is no exception to this.

So, it falls to this study to observe whether the existing MIS has the potential to ensure better price realization for MFP farmers in the accessible and inaccessible High Altitude and Tribal (HAT) Zones of Andhra Pradesh.

2. DATA AND METHODOLOGY

For the present study primary data was collected through multi-stage sampling design *i.e.* Division level, GPCMS level and shandy (local village markets) level during 2020-21. The tribal farmers generally transact their MFP in shandies, to either GPCMS or private traders or both depending upon the relative prices offered by these two market players. Accordingly, two samples were drawn for each MFP transacted by the tribal farmer. Twenty four sample farmers per each Division under GCC, who transact selected MFP with GPCMS and again 12 sample farmers/shandy transacting MFP with private traders per each Division under GCC were selected randomly. Thus, 120 farmers from 10 GPCMS (across five Divisions) and 240 farmers from 20 shandies were selected. So, in total, five Divisions of GCC, 10 GPCMSs, 20 shandies and 360 sample farmers (120 sample farmers transacted produce to GPCMS/PPCs and 240 sample farmers transacted produce to private traders in shandies) were selected for this in depth investigation.

2.1Tool for impact of MIS on price realization

At the first stage, two sampling frames from HAT zone were collected comprising the list of farmers transacting MFP through market information received from GPCMS/PPCs (treated, n = 120) vis-à-vis farmers transacting MFP in shandies collecting market information from unofficial (private) sources *viz.*, co-farmers, traders in shandies, friends, relatives *etc.* (untreated, n = 240). Thus, the farmers in this zone were classified into treated and untreated based on the access to market information from GPCMS officials. Thus, a representative sample of 360 farmers (comprising of 120 treated and 240 untreated) were selected from HAT zone. Across the selected MFPs, the treated and untreated categories of farmers are presented in Table 1.

Table1. Sample distribution across selected MFP

Name of MFP	Treated farmers	Untreated farmers
Hill broom	61	178
Honey	71	203
Marking nut	64	187
Myrobalan	70	196
Naramamidi bark	61	181
Seeded tamarind	69	189

PSM technique was employed to analyse the impact of MIS on prices realized by tribal farmers for selected MFPs. In this technique, each farmer of treated category is matched with an untreated farmer based on the observable covariates (Table 2). This will facilitate to assign the treatment randomly across the two categories to analyse the average differences in prices. The PSM can be expressed as:

$$p(X) = \Pr[D = 1|X] = E[D|X]; \; p(X) = F\{h(X_i)\} \qquad (1)$$

where p(X) is a propensity score and ‘Pr’ is the probability of receiving market information (treated farmer will receive the value of ‘1’. ‘0’, otherwise) conditional on the vector of covariates mentioned earlier. Probit model (Equation 2) was employed to estimate the predicted probabilities (propensity scores) of receiving market information (Greene, 2003; Verbeek, 2008; Willy *et al.* 2014):

$$\Pr(D = 1|X) = G(z) = {}^{X'\beta}_{-\infty} \emptyset(z)dZ = \phi(X'\beta) \qquad (2)$$

where, $G(z)$ is a function taking values between 0 and 1, $\emptyset$ is the standard normal probability density function, z is the vector of covariates and ϕ is the standard normal cumulative distribution function.

Table 2. Variable types and definitions for PSM

Variable type	Abbreviation	Variable definition	Variable type
Outcome Variable	Price (Rs/kg)	Price realized for MFP (Rs/kg)	Continuous
Treatment variable	Source of market information	Access to market information collected by the farmers from GPCMS/PPCs in transacting selected MFP	Dummy (1=Yes, 0 =No)
Covariates	DTM	Distance to GPCMS/PPCs /shandy from point of collection of MFP (km)	Continuous
	EXP	Experience in transacting MFP (years)	Continuous
	FREQ	Frequency of visits to GPCMS/PPCs or shandy	Quantitative variable (number)
	AMP	Access to mobile phone	Dummy (1=Yes, 0=No)
	TRG	Trainings received on MIS	Dummy (1=Yes, 0=No)
	EDU	Education status of tribal farmer	Dummy (1=Yes, 0=No)

The computed probabilities are used for matching treated and untreated categories of farmers by employing three matching algorithms (Samuel and Beza, 2019) *viz.*, Nearest Neighbour Matching (NNM), Kernel-Based Matching (KBM) and Radius Matching (RM). From these matching methods, Average Treatment effect on the Treated (ATT) was computed. Further, Rosenbaum bound test was computed to analyse the sensitivity of the estimated ATT to unobserved confounders (Rosenbaum, 2002 and Rosenbaum and Rubin, 1983).

3. RESULTS AND DISCUSSION

PSM technique was employed to know the impact of MIS on price realization of selected MFP across treated and untreated categories of farmers. STATA 13 software was used for the analysis. The total numbers of matched pairs are presented in Table 3.

Table 3. Number of matched pairs across treated and untreated categories of farmers transacting selected MFP

MFP	Treated farmers	Untreated farmers	Matched Pairs
Hill broom	61	178	n = 61 matched pairs
Honey	71	203	n = 71 matched pairs
Marking nut	64	187	n = 64 matched pairs
Myrobalan	70	196	n = 70 matched pairs
Naramamidi bark	61	181	n = 61 matched pairs
Seeded tamarind	69	189	n = 69 matched pairs

Source: Field survey

The results obtained from the Probit analysis and the variables that used in the matching procedures are reported in Table 4. Results explained that, there is a positive and significant association between the selected variables *viz.*, frequency of visit to GPCMS/PPCs, experience, trainings on the importance of MIS in accessing market information from respect GPCMS and PPCs in the study area. The experience of tribal farmers in transacting MFP and their frequent visits to shandies/PPCs enabled them to gain good access to GPCMS/PPCs officials for useful and timely market information for selling the MFP through at higher prices. This finding is in line with the findings of (World Bank 2007) that experience and skills are the fundamental factors in commercializing the Agriculture. Further, the trainings received by the tribal farmers through GPCMS officials enabled them to gain knowledge about various level of sources of market information and their importance for transacting MFP timely in the market. This is in consonance with the similar phenomenon observed by (Mahalakshmi *et al.*, 2015), in their ICT-based Dissemination System for Aquaculture clientele of coastal KVKs. The marginal effects of experience, frequency of visits to

GPCMS/PPCs and training revealed that the shift from lack of these factors would enhance the probability of access to market information from GPCMS/PPCs with regard to transactions of all the selected MFP.

Further, farmers who enjoy access to mobile phone in the study area receive market information from time to time with respect to minimum, maximum and modal prices, grading standards *etc.*, this finding is in line with the findings of (Zanello *et al.*, 2014) and hence, exerted positive and significant influences on the access to market information from GPCMS/PPCs regarding prices of Naramamidi bark, honey and seeded tamarind. Similarly, the education background of tribal farmers has contributed positively in accessing marketing information with respect to honey, hill broom, seeded tamarind and Naramamidi bark, this finding is in line with the findings of (Mittal and Mehar 2015 : Bello *et al*, 2020). However, distance to market has exerted significant negative influence on the access to market information from GPCMS/PPCs in transacting myrobalan and marking nut due to higher transaction costs. Thus, the findings suggest that importance of all the explanatory variables in influencing the farmers to accessing market information from GPCMS and PPCs in the HAT zone.

Table 4. Marginal effects for determinants of access to market information

Variables	Hill broom	Honey	Marking nut	Myrobalan	Naramamidi bark	Seeded tamarind
DTM	-0.0114	0.2386	-0.2385**	-0.198*	-0.0269	-0.1299
EXP	0.0244**	0.0375**	0.0299*	0.0371**	0.0353**	0.0388**
FREQ	0.8764**	0.2756*	0.4488**	0.5014**	0.4055**	0.3954**
AMP	0.2095	0.397**	0.1297	0.3467	0.2679**	0.3421**
TRG	0.7964*	0.7049*	0.6062*	0.2331*	0.4143*	0.1299*
EDU	0.7227**	0.4347*	0.1912	0.3094	0.7508**	0.4561**
Constant	2.0401	1.7502	1.148	2.0621	2.5768	2.0278
Pseudo R^2	0.2429	0.1832	0.2176	0.2369	0.3106	0.2863

Note: ** & * indicates significance at 1 and 5 percent probability levels respectively
Raw Data Source: Field Survey. DTM - Distance to market, EXP – Experience, FREQ – Frequency of visit to GPCMS/PPC, AMP – Access to Mobile Phone, TRG – Trainings, EDU – Education Background

a. Estimation of ATT - Matching Algorithms: The empirical results of the impact of market information received from GPCMS/PPCs on the prices of selected MFP are presented through Tables 5 to 8 by employing NNM, KBM and RM methods. All the results were based on implementation of common support and caliper, so that the distributions of treated and untreated were located in the same domain. As suggested by (Rosenbaum and Rubin, 1983) a caliper size of one-quarter of the Standardized Difference (SD) of the propensity scores was used. Bootstrap standard errors based on 100 replications are reported.

It was found from the results that the market information received from GPCMS has exerted positive and significant impact on prices of selected MFP for treated compared to untreated counterpart. This indicates the average change in value of the outcome brought about by the MIS of GPCMS. The ATT of the market information on prices was around Rs. 44.05 for hill broom, Rs. 165.88 for honey, Rs.15.19 for markingnut, Rs.17.09 for myrobalan, Rs.27.16 for Naramamidi bark and Rs.41.66 for seeded tamarind (average of three matching methods). However, picking any farmer at random, the Average Treatment Effect (ATE) was found to be Rs. 4.30 for hill broom, Rs. 9.79 for honey, Rs.8.92 for markingnut, Rs.7.95 for myrobalan, Rs.12.35 for Naramamidi bark and Rs.5.22 for seeded tamarind (average of three matching methods). This implies that if any tribal farmer in the sample enjoys access to market information from GPCMS (treated), he/she will realize higher prices for all the selected MFP compared to untreated counterpart.

Thus, the access to market information by the tribal farmers revealed significant impact ($P<0.001$) on treated, as the impact indicator (prices) is higher for them compared to untreated. The treated were significantly benefited from this technology by 37.95 per cent for hill broom, 15.19 per cent for honey, 115.45 per cent for markingnut, 133.34 per cent for myrobalan, 89.16 per cent for Naramamidi bark and 60.27 per cent for seeded tamarind (average of three matching methods) compared to untreated. This clearly indicates to strengthen MIS in the study area, as for all the selected MFP, the treated are enjoying higher prices compared to untreated, especially for markingnut and myrobalan. This result corroborates with the findings of Wordofa *et al.* (2021), who in his Eastern Ethiopian study found that adoption of improved Agricultural technology had a strong and significant impact on household income.

Table 5. Average impact estimates of PSM (NNM) on prices of selected MFP

MFP	Sample	Treated	Control	Difference	SE	t-stat
Hill broom (n = 61 matched pairs)	Unmatched	44.6	26.49	18.11	1.09	16.52
	ATT	44.6	33.28	11.32	3.76	3.01**
	ATU	26.48	12.88	13.60	.	
	ATE			9.94	.	
Honey (n = 71 matched pairs)	Unmatched	164.82	134.47	30.35	1.87	16.21
	ATT	164.82	143.3	21.52	8.8	2.45**
	ATU	134.44	113.68	20.76	.	
	ATE			15.02	.	
Markingnut (n = 64 matched pairs)	Unmatched	15.34	7.97	7.37	0.49	14.86
	ATT	15.34	7.42	7.92	1.26	6.29**
	ATU	7.92	-3.6	11.52	.	
	ATE			10.44	.	
Myrobalan (n = 70 matched pairs)	Unmatched	16.94	7.21	9.73	0.61	15.97
	ATT	16.94	7.31	9.63	1.34	7.19**
	ATU	7.16	4.07	3.09	.	
	ATE			5.02	.	
Naramamidi bark (n = 61 matched pairs)	Unmatched	27.13	15.76	11.37	0.77	14.75
	ATT	27.13	15.32	11.81	2.14	5.52**
	ATU	15.72	6.06	9.66	.	
	ATE			10.29	.	
Seeded tamarind (n = 69 matched pairs)	Unmatched	41.01	26.5	14.51	1.15	12.62
	ATT	41.01	25.38	15.63	4.79	3.26**
	ATU	26.48	3.56	22.92	.	.
	ATE			15.41	.	.

Note: *** indicates significant at 1 per cent

Table 6. Average impact estimates of PSM (KBM) on prices of selected MFP

MFP	Sample	Treated	Control	Difference	SE	t-stat
Hill broom (n = 61 matched pairs)	Unmatched	44.62	26.48	18.11	1.09	16.61
	ATT	44.16	32.47	11.69	4.81	2.43**
	ATU	36.81	42.68	5.87	.	
	ATE			1.9	.	
Honey (n = 71 matched pairs)	Unmatched	164.83	134.44	30.35	1.87	16.23
	ATT	166.94	141.78	25.16	7.74	3.25**
	ATU	149.54	159.64	10.09	.	
	ATE			7.85	.	
Markingnut (n = 64 matched pairs)	Unmatched	15.34	7.92	7.37	0.49	15.04
	ATT	15.01	6.77	8.24	1.26	6.54**
	ATU	7.27	15.01	7.73	.	
	ATE			8.13	.	
Myrobalan (n = 70 matched pairs)	Unmatched	16.91	7.16	9.73	0.6	16.22
	ATT	17.36	7.3	10.06	1.4	7.19**
	ATU	7.27	15.21	7.94	.	
	ATE			9.56	.	
Naramamidi bark (n = 61	Unmatched	27.11	15.72	11.37	0.77	14.77
	ATT	27.22	13.84	13.38	2.09	6.40**
	ATU	15.03	28.67	13.67	.	

matched pairs)	ATE			13.45	.	
Seeded tamarind (n = 69 matched pairs)	Unmatched	41.12	26.48	14.51	1.15	12.62
	ATT	42.36	26.69	15.67	4.85	3.23**
	ATU	36.81	42.39	5.58	.	
	ATE			0.45	.	

Note: *** indicates significant at 1 per cent

Table 7. Average impact estimates of PSM (RM) on 'Prices' of selected MFP

MFP	Sample	Treated	Control	Difference	SE	t-stat
Hill broom (n = 61 matched pairs)	Unmatched	44.63	26.48	18.11	1.09	16.61
	ATT	43.39	30.17	13.22	3.85	3.43**
	ATU	38.88	42.59	3.7	.	
	ATE			1.07	.	
Honey (n = 71 matched pairs)	Unmatched	164.82	134.44	30.35	1.87	16.23
	ATT	165.89	147.07	18.82	5.1	3.69**
	ATU	152.22	160.82	8.59	.	
	ATE			6.49	.	
Markingnut (n = 64 matched pairs)	Unmatched	15.34	7.92	7.37	0.49	15.04
	ATT	15.21	6.98	8.23	1.3	6.33**
	ATU	7.22	15.27	8.05	.	
	ATE			8.18	.	
Myrobalan (n = 70 matched pairs)	Unmatched	16.91	7.16	9.73	0.6	16.22
	ATT	16.96	7.36	9.6	1.5	6.40**
	ATU	7.22	15.46	8.24	.	
	ATE			9.27	.	
Naramamidi bark (n = 61 matched pairs)	Unmatched	27.12	15.72	11.37	0.77	14.77
	ATT	27.14	14.01	13.13	2.17	6.05**
	ATU	14.44	28.31	13.87	.	
	ATE			13.31	.	
Seeded tamarind (n = 69 matched pairs)	Unmatched	41.04	26.483	14.51	1.15	12.62
	ATT	41.6	25.92	15.68	4.93	3.18**
	ATU	38.88	42.86	3.97	.	.
	ATE			-0.215	.	.

Note: *** indicates significant at 1 per cent

b. Rosenbaum sensitivity test: This test was employed to know whether the results of PSM are robust to unobservable or confounding variables. Since the outcome variable (Price) is continuous in nature, Hodges-Lehmann point estimates were computed (Watkins *et al*, 2014). The findings from Table 4.26 revealed that the outcome variable still remained significant at different levels of Gamma and this implied that the estimated outcome is robust to unobserved characteristics (Becker & Ichino, 2002; Rosenbaum, 2002 and Rosenbaum and Rubin, 1983).

Table 8. Rosenbaum sensitivity test for upper bound significance level

MFP	Gamma*	Significance level		Hodges-Lehmann point estimate		Confidence interval (95%)	
		Upper bound	**Lower bound**	**Upper bound**	**Lower bound**	**Upper bound**	**Lower bound**
Hill broom (n = 61 matched pairs)	Γ = 1	5.4e-10	5.4e-10	12.50	12.50	10.00	15.00
	Γ = 2	8.1e-06	0.0000	10.00	15.00	7.50	17.50
	Γ = 3	0.0003	0.0000	7.50	15.00	5.00	17.50
	Γ = 4	0.0014	0.0000	7.50	17.50	5.00	20.00
	Γ = 5	0.0037	0.0000	7.50	17.50	2.50	20.00
Honey (n = 71 matched pairs)	Γ = 1	5.5e-10	5.5e-10	12.50	12.50	12.00	15.00
	Γ = 2	8.2e-06	0.0000	8.50	12.50	5.00	11.50
	Γ = 3	0.0002	0.0000	7.50	12.50	5.00	15.00
	Γ = 4	0.0015	0.0000	5.00	12.50	5.00	15.00
	Γ = 5	0.0034	0.0000	5.00	12.50	2.50	20.00
Marking nut (n = 64 matched pairs)	Γ = 1	4.6e-10	4.6e-10	7.50	7.50	7.50	10.00
	Γ = 2	7.5e-06	0.0000	7.50	10.00	5.00	10.00
	Γ = 3	0.0002	0.0000	5.00	10.00	5.00	12.50
	Γ = 4	0.0011	0.0000	5.00	10.00	2.50	12.50
	Γ = 5	0.0030	0.0000	5.00	12.50	2.50	12.50
Myrobalan (n = 70 matched pairs)	Γ = 1	5.3e-10	5.3e-10	10.00	10.00	7.50	10.00
	Γ = 2	8.0e-06	0.0000	7.50	12.50	5.00	12.50
	Γ = 3	0.0002	0.0000	7.50	12.50	5.00	15.00
	Γ = 4	0.0011	0.0000	5.00	12.50	2.50	15.00
	Γ = 5	0.0031	0.0000	5.00	12.50	2.50	17.50
Naramamidi bark (n = 61 matched pairs)	Γ = 1	5.6e-10	5.6e-10	12.50	12.50	10.00	15.00
	Γ = 2	8.3e-06	0.0000	10.00	15.00	7.50	17.50
	Γ = 3	0.0002	0.0000	7.50	15.00	5.00	17.50
	Γ = 4	0.0011	0.0000	7.50	17.50	5.00	20.00
	Γ = 5	0.0032	0.0000	7.50	17.50	2.50	20.00
Seeded tamarind (n = 69 matched pairs)	Γ = 1	5.3e-10	5.3e-10	10.50	10.50	7.50	12.00
	Γ = 2	7.5e-06	0.0000	7.50	10.00	7.50	15.00
	Γ = 3	0.0002	0.0000	5.00	10.00	5.00	12.50
	Γ = 4	0.0013	0.0000	5.00	10.00	2.50	12.50
	Γ = 5	0.0030	0.0000	5.00	12.50	2.50	12.50

Note: * - Gamma - log odds of differential assignment due to unobserved factors

4. CONCLUSIONS

Most of the explanatory variables in the study were found to influence the farmers' access to market information from GPCMS and PPCs in the HAT zone and there is a positive significant association between the selected variables *viz.*, frequency of visit to GPCMS, experience, trainings on the importance of MIS in accessing market information from respect GPCMS and PPCs. Distance to nearest market was found to have significant negative influence on prices of Myrobalan and markingnuts, which are found in the remotest parts of HAT zones. This indicates that road connectivity to such areas must be given priority in the list of policies aimed at MIS improvement. Other recommendations include strengthening of infrastructure for mobile telecommunications, and organize training programmes directed towards its usage. This might yield positive results, since educated farmers could assimilate it much faster and direct their efforts and intellect towards increased price realization. The market information received from GPCMS/PPCs has exerted positive and significant impact on prices of selected MFP for treated compared to its untreated counterpart, which is a good sign. Yet, the monopoly of GPCMS over market information might lead to mistrust in the face of any errors or delays in dissemination, and the policies aimed at timely dissemination or establishing a parallel information agency has the potential for augmenting the existing MIS is suggested. On their implementation, one might look into a future where existence of MIS, which ensures maximum transparency and efficiency, might become a reality, serving as a cornerstone in the MFP economy of the nation, contributing to tribal upliftment.

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