MARKETING INFORMATION SYSTEM AND ITS APPLICATION FOR MINOR FOREST PRODUCE IN HIGH ALTITUDE AND TRIBAL AREA ZONE OF ANDHRA PRADESH

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M.Sc. (Ag.)

DOCTOR OF PHILOSOPHY IN AGRICULTURE
(AGRICULTURAL ECONOMICS)

ANGRAU

2022

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By

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M.Sc. (Ag.)

THESIS SUBMITTED TO THE
ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

DOCTOR OF PHILOSOPHY IN AGRICULTURE

(AGRICULTURAL ECONOMICS)

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GUNTUR, ANDHRA PRADESH-522 509

2022

DECLARATION

I, **CHITTAPULI SATISH KUMAR**, hereby declare that the thesis entitled **"**MARKETING INFORMATION SYSTEM AND ITS APPLICATION FOR MINOR FOREST PRODUCE IN HIGH ALTITUDE AND TRIBAL AREA ZONE OF ANDHRA PRADESH**"** submitted to Acharya N. G. Ranga Agricultural University for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE (AGRICULTURAL ECONOMICS)** is a result of original research work done by me as **Ch. Satish Kumar, K. Nirmal Ravi Kumar, K. Solmon Raju Paul, P. V. Sathya Gopal and V. Srinivasa Rao, 2022**, Impact of Marketing Information System (MIS) on Prices Realization of Minor Forest Produce (MFP) in High Altitude and Tribal (HAT) Zone of Andhra Pradesh, Asian Journal of Agricultural Extension, Economics & Sociology (AJAEES), 40(1): 48-55.

I also declare that the thesis or part thereof has not been published earlier elsewhere in any manner.

Date: **(CHITTAPULI SATISH KUMAR)**

Place: Bapatla **ID. No. BAD-18-22**

CERTIFICATE

Mr. CHITTAPULI SATISH KUMAR has satisfactorily prosecuted the course of research and that the thesis entitled **"**MARKETING INFORMATION SYSTEM AND ITS APPLICATION FOR MINOR FOREST PRODUCE IN HIGH ALTITUDE AND TRIBAL AREA ZONE OF ANDHRA PRADESH**"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by his for a degree of any university.

Date :

Place: Bapatla

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CERTIFICATE

This is to certify that the thesis entitled **"MARKETING INFORMATION SYSTEM AND ITS APPLICATION FOR MINOR FOREST PRODUCE IN HIGH ALTITUDE AND TRIBAL AREA ZONE OF ANDHRA PRADESH" submitted** in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE (AGRICULTURAL ECONOMICS)** of the Acharya N.G. Ranga Agricultural University, Guntur is a record of the bonafide research work carried out by **Mr. CHITTAPULI SATISH KUMAR** under our guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of investigation have been duly acknowledged by the author of the thesis.

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ACKNOWLEDGEMENTS

In everyone's life, the day arises when one has to shape ones feelings in words. Though only my name appears on the cover of this thesis, a great many people have contributed to its production. I owe my gratitude to all those people who have made this thesis possible and because of whom my PhD experience has been one that I will cherish forever.

I humbly place on record my respect and profound sense of gratitude to the esteemed Chairman of my advisory committee, ***Dr. K.N. Ravi kumar*** *Professor and Head, Department of Agricultural Economics, Agricultural College, Bapatla for his keen interest, scholarly counsel, constructive suggestions, boundless help and indefatigable guidance which provided me commendable encouragement and shaped my efforts into a successful research work. His indefatigable patience, outspent efforts, hand and cuff approach and consistent efforts during the thick and thin of my work deserve high extolment.*

I deem it a great pleasure to exhibit inexplicable gratitude to ***Dr. K, S. R. Paul,*** *Senior Scientist (CCS) Agricultural College, Bapatla Member of my advisory committee, for her encouragement in conducting research, valuable comments and meticulous reasoning to refine the dissertation to recon with set standards during the course of investigation and preparation of the thesis and expeditious co-operation during the whole course of my research work.*

I deemed it a great pleasure to exhibit my inexplicable gratitude to ***Dr. P.V. Satya Gopal****, Professor and Head, institute of agribusiness management, S.V. Agricultural college, Tirupati member of my advisory committee, who showed expeditious co-operation during my research work.*

I express my deep sense of gratitude to ***Dr .V. Srinivasa Rao,*** *Professor and University Head,(BOM), Department of Statistics and Computer Applications, Agricultural College, Bapatla member of my advisory committee for sparing his precious time and giving pragmatic suggestions during the course of my research work, which helped a lot in bringing the thesis to the present format.*

I deem it a great privilege to express my gratitude to ***Dr. Y. Radha****, Professor & University Head, Director (P&IM CELL) Department of Agricultural Economics, Guntur Lam for her unstinted attention, constant encouragement, valuable suggestions and generous help during my PhD study and research work.*

I sincerely owe my deep sense of gratitude to distinguished faculties of our department, ***Dr. K Suseela, Dr. V. Sitaram Babu and Dr. B.Aparna*** *Dept. of Agricultural. Economics, and* ***Dr. Ramesh , Dr. K.N Sreenivasulu****, faculty at Department of Statistics and Computer Applications, Agricultural College, Bapatla for their suggestions & co-operation extended to me during the course of my study.*

I highly express my gratitude and thanks to ***Dr. D. Vishnusankar Rao****, Professor, (Retd.),* ***Dr. D.V. Subba Rao****, Professor (Retd.),* ***Dr. G. Sunil kumar babu*** *Dept. of Agricultural. Economics for their valuable suggestions and constant guidance during my course of investigation*

I take this opportunity to acknowledge ***Rambabu, Simhachalam Bhargav, Anil, Srinu, Ashok ,Ramesh babu, Pawan, Murali, Madan,Dorrababu, SSV, GL Puram friends Agricultural, GCC and forest department friends, staff members of HAT zone*** *for providing the timely help to carry out my research work successfully.*

From my mere existence on earth to the present situation, my every step of life is moulded mud by father ***Sri. Eswara rao padal*** *and my mother* ***Smt. Hymavathi*** *for their love, affection and their unceasing support which elevated me to the present position. Their parenting brings every time the best in every effort of my venture.It is the time to express my warm love on my brothers* ***Vikash padal*** *and* ***Narendhra padal*** *to meet it as a means of reciprocating their unmatched fondness and for being my moral support to build up my academic career.*

Heartful thanks to my seniors Many thanks are due to my senior friends ***Saidhar, Vykhaneswari, Shwetha Soju,*** *the much needed moral support and help during the course of my study. I place my sincere thanks to my colleagues* ***Areef, Bharath,*** *and junior friends* ***Siddu,Githa, Gowtami, Mohan rao, Anthony, Prathyusa, Vyshnavi, Soorya, Ayodhya, Jasmi priya, Malliswari,Meghana, Pavani, Teju, Prasanthi, Arjun, Heera, S.Mitra, Chandana, gyanprakash, S.neelima, M.Sharon, Govind, Arun, Chinni, Viswateja, Venu, Janardhan, Vihari, Shanmukh, and friends Appu, Balu, Leela, Sarath, Suri, Siva, Manoj, Aliveni, Ramana, Tilak, Nagarjuna, Pedda China Rajsekhar ,Sai Pratap, Harisha, Chaitu, V reddy, UB*** *for always being beside me in difficult times during my course of study and giving constant motivation.*

I am very much thankful to record assistants, ***Smt. Saraswathi*** *&* *attenders* ***Smt. Kalyani*** *and* ***Smt. Venkateswaramma,Yedukondalu*** *for their help during my PhD programme in the department.*

I am thankful to our College Librarian and other Library Staff for providing necessary facilities.

I humbly thank the authorities of Acharya N.G. Ranga Agricultural University, Government of Andhra Pradesh for availing me the opportunity to do my PhD programme in this prestigious institution.

I am thankful to Eswar Digitals and Computers for the neat typing and execution of my thesis. While travelling on this part of education, many hands pushed me forth, learned hearts put me on the right track. I ever rest ***THANKS*** *to all of them.*

Last but not the least, I thank ***Almighty*** *for blessing, protecting and guiding me throughout this period.*

Any omission in these brief acknowledgements doesn't mean lack of gratitude.

Place: ***Bapatla***

Date: ***(Chittapuli Satish Kumar)***

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
$\bar{R}^2$	:	Adjusted R- Squared
/	:	per
@	:	At the rate of
∞	:	Infinity
A	:	Intercept
AIR	:	All India Radio
ATE	:	Average Treatment Effect
ATT	:	Average Treatment effect on the Treated
ATU	:	Average Treatment effect for the Untreated
CGRs	:	Compound Growth Rates
DSO	:	District Statistical Officer
e.g.	:	for example, for instance
et al.	:	and others
etc.	:	and so on; and other people/ things
FAO	:	Food and Agricultural Organisation
Fig	:	Figure
FPOs	:	Farmer Producer Organizations
GCC	:	Girijan Co-operative Corporation
GPCMS	:	Girijan Primary Co-operative Marketing Society
HAT	:	High Altitude and Tribal zone
i.e	:	that is
ICT	:	Information and Communications Technology
ITDA	:	Integrated Tribal Development Agency

KBM	:	Kernel-Based Matching
Kg	:	Kilogram
Km	:	Kilometre
MFP	:	Minor Forest Produce
MIS	:	Marketing Information System
MIS_U	:	Use of MIS
MLRM	:	Multiple Linear Regression Model
Mm	:	Millimetre
MSP	:	Minimum Support Price
MTs	:	Metric tonnes
NNM	:	Nearest Neighbour Matching
No	:	Number
NS	:	Non-significant
Ø	:	Latin small letter O with stroke
PPP	:	Public Private Partnership
PA	:	Public Addressing
PPCs	:	Primary Procurement Centres
PSM	:	Propensity Score Matching
R	:	Multiple Correlation Co-efficient
r^2	:	Co-efficient of determination
R^2	:	Co-efficient of Multiple Determinations
RM	:	Radius Matching.
Rs	:	Rupees
r	:	Correlation coefficient
SAP	:	Surplus Agricultural Produce
SD	:	Standardized Difference

SEs	:	Standard Errors
SMS	:	Short Message Service
VAA	:	Village Agricultural Assistant
VDVK	:	Van Dhan Vikas Kendras
viz.,	:	Namely
β	:	Regression coefficient
Γ	:	Gamma
ε	:	Error term
π	:	Pi
Φ	:	Phi
χ^2	:	Chi Square
TRIFED	:	Tribal Co-Operative Marketing Development Federation of India Limited

ABSTRACT

Name of the Author	:	**CHITTAPULI SATISH KUMAR**
Title of the thesis	:	**MARKETING INFORMATION SYSTEM AND ITS APPLICATION FOR MINOR FOREST PRODUCE IN HIGH ALTITUDE AND TRIBAL AREA ZONE OF ANDHRA PRADESH**
Degree	:	**DOCTOR OF PHILOSOPHY IN AGRICULTURE**
Discipline	:	**AGRICULTURAL ECONOMICS**
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Year of Submission	:	**2022**

In High Altitude and Tribal (HAT) zone of Andhra Pradesh, Minor Forest Produce (MFP) is an important livelihood source for several communities, particularly those living in forest fringe villages. However, it is disheartening to note that until the last decade and half, the transactions of MFP in tribal areas has been very poor due to lack of necessary infrastructure and technology, especially Marketing Information System (MIS). So, by strengthening MIS, marketing of MFP becomes more transparent so that stakeholders can make informed choices about collection and sale decisions. Hence, the present research study on **Marketing Information System and its application for Minor Forest Produce in High Altitude and Tribal Area Zone of Andhra Pradesh** was considered for in depth investigation with a view to explore the existing MIS in HAT zone, pattern, dissemination and utilization of MIS by different stakeholders, growth trends in market arrivals and prices of selected MFP, determinants for strengthening MIS, market arrivals and prices of MFP, impact evaluation of MIS on prices realized for MFP, and need-based policy suggestions for effective implementation of MIS among stakeholders in HAT zone.

MFP like hill broom (*Thysanolaena maxima*), honey, markingnut (*Semecarpus anacardium*), myrobalan (*Terminalia chebula*), naramamidi bark (*Litsea deccanensis*) and seeded tamarind (*Tamarindus indica*) were purposively selected for this study, as they together accounted for nearly 85 per cent share of total value of MFP procured by Girijan Primary Co-operative Marketing Societies (GPCMS) in the HAT zone of Andhra Pradesh (average of 2011-2018). A sample of 240 farmers from 20 shandies; 120 farmers from 10

GPCMS, 120 traders and all the Managers working in GPCMSs and five Divisional Managers of Girijan Cooperative Corporation (GCC) are randomly selected to elicit requisite information. The major findings of the study revealed that 57 per cent of selected tribal farmers are women involved in collection and transacting MFP in HAT zone and remaining 43 per cent are men. Major source of market information to farmers and traders at village level and market level are SMS messages and display boards in Primary Procurement Centers (PPCs)/GPCMS respectively. Unlike farmers, traders are highly aware about prices, quality and grades of MFP. Compared to market arrivals, prices of selected MFP showed significant positive growth rates in GPCMS/PPCs. It was found interesting that the major influential factors for strengthening of infrastructure (MIS) in GPCMS/PPCs are arrivals and funds received from GCC for MFP in GPCMS/PPCs. Similarly, prices, timely market information and prompt payment of sales proceeds had shown significant influence on market arrivals of MFP in GPCMS/PPCs. Access to market information and availability of storage and investment on MIS in GPCMS/PPCs are the major influential factors for realizing higher prices to MFP. Propensity score matching technique revealed that MIS contributed to higher prices realized by the treated farmers compared to untreated counterpart for all the selected MFP. Mobile network issue is the top most prioritized constraint expressed by the tribal farmers in HAT zone. Formation of farmers cooperatives/FPOs, strengthening of wireless telecommunication infrastructure, improving road connectivity, strong coordination among Government departments like Integrated Tribal Development Agency (ITDA), GCC, Banks, Andhra Pradesh Forest Department etc., should deserve special attention to promote efficient transactions of MFP in HAT zone.

Chapter – I

Introduction

Chapter I

INTRODUCTION

India in general and Andhra Pradesh state in particular is predominantly an agri-based economy, having rich natural resources, suitable climatic conditions, deep soils, favorable topography and water resources. Andhra Pradesh possesses 18.28 per cent of the total area under forest cover in India. Narrowing down, the forest area of the state constitutes around 22.51 per cent of its total geographical area of 162,975 km^2, amounting to 36,685.67 km^2. Out of this, HAT zone forests cover a sizable portion of 32.49 per cent. In Andhra Pradesh, the High Altitude and Tribal (HAT) zone produces a wide range of Minor Forest Produce (MFP), and their prominence in local, national and global economies, their contribution to the food security and significance to the biological diversity gained widespread recognition during the past decade. MFP serve as vital sources of food, flavorings, perfumes, beverages, polishes, construction materials, spices, medicines, paints and extracts used in the chemical industry (Arnold and Ruiz Perez, 1998). According to Forest Stewardship Council, "*All forest products, except timber, including other materials obtained from trees such as resins and leaves, as well as any other plant and animal products*" are considered as MFP (Ministry of Environment and Forests, 1999). For several communities in Andhra Pradesh, particularly the inhabitants of forest fringe villages, MFP are a vital source of livelihood. Till now, the State has recorded 33 major tribes residing in different forest areas, with 27 of them inhabiting the forests of Eastern Ghats in the districts of East Godavari, Visakhapatnam, Vizianagaram and Srikakulam. Girijan Cooperative Corporation (GCC), since 1956, has assumed the responsibility of collection and marketing of MFP in the role of the State Corporation, with socio-economic upliftment of the tribes as the core objective. Currently, GCC holds monopoly towards procurement of 25 MFP throughout the state.

In the year 1991's advent of Globalization in India ushered in a new set of liberalistic economic reforms, which have been constantly amended to suit the requirements of various categories of citizens. So, in transacting MFP as well, the role of market information cannot be over emphasized in enhancing the agricultural development. Market information is crucial for timely collection, improving marketing and distribution strategies (Oladele, 2006). In order to compete at global level in transacting MFP, the tribal farmers should have latest information regarding new techniques of collection, quality promotion, Government policies, domestic and export competitiveness deserve considerable attention. Due to the unprecedented crisis caused by drastic fall in prices of MFP, the lives and livelihoods of people across all segments and in particular, the disadvantaged tribals, across the country have been severely disrupted. At such a time, the 'Mechanism for Marketing of MFP through Minimum Support Price (MSP) & Development of Value Chain for MFP' scheme (2011) has come as a beacon of change. Conceptualized and implemented by Tribal Co-Operative Marketing Development Federation of India Limited (TRIFED) of Ministry of Tribal Affairs, Government of India in association with State Government agencies across 21 states of the country, this scheme has emerged as a source of great relief for tribal gatherers injecting more than Rs. 3000 crores directly in the tribal economy since April 2020. This has been possible mainly due to the Government push and active participation from the States and has provided much needed liquidity in the tribal ecosystem, much needed in the adverse times. Through this scheme, the Central Government had introduced a MSP for a select list of MFP to provide a social safety net to the underprivileged forest dwellers, and to aid in their empowerment. The Van Dhan tribal start-ups, also a component of the same scheme, further complements MSP beautifully and has emerged as a source of employment generation for tribal gatherers and forest dwellers and the home-bound tribal artisans. Together, these two initiatives offer a comprehensive development package for tribals through promoting employment, incomes and entrepreneurship. Table 1.1 and Figure 1.1 shows the procurement of average quantity of arrivals and valuation of MFP of selected states across India under

this Scheme. It was found that, Chhattisgarh recorded the highest arrivals of MFP (17684.79 M. Tonnes), constituting 76.74 per cent of that of the nation. Odisha recorded the second highest average MFP arrivals of 4106.91 M. Tonnes, comprising 17.82 per cent of the nation's total. In terms of value, Chhattisgarh and Odisha recorded Rs.4062.99 and Rs.839.77 lakhs respectively. It is disheartening to say that Andhra Pradesh's contribution pales in comparison to both those States, with arrivals of 122.76 M. Tonnes amounting to Rs. 45.41 lakhs. As one takes note of the fact that the percentage share of Andhra Pradesh regarding quantity of MFP was a meagre 0.53 per cent (0.85 per cent of the total value) when compared with other states, it is a sign to the Andhra Pradesh Government to prioritize the trade of MFP and the welfare of its producers.

Table 1.1. State-wise average procurement of MFP under the Scheme of Mechanism for Marketing of MFP through MSP & Development of Value Chain for MFP' scheme in India (Average of 2014 to 2020)

S. No.	State	Average of MFP		Share (%)		Rank	
		Quantity (MTs)	Valuation (Lakhs)	Quantity (MTs)	Valuation (Lakhs)	Quantity (MTs)	Valuation (Lakhs)
1	Andhra Pradesh	122.76	45.41	0.53	0.85	5	5
2	Chhattisgarh	17684.79	4062.99	76.74	76.32	1	1
3	Gujarat	912.59	153.99	3.96	2.89	3	4
4	Jharkhand	65.18	175.95	0.28	3.31	6	3
5	Maharashtra	138.83	39.29	0.60	0.74	4	6
6	Odisha	4106.91	839.77	17.82	15.77	2	2
7	Rajasthan	12.53	6.25	0.05	0.12	7	7
	Total (India)	23043.58	5323.65	100.00	100.00		

Source: Indiastat

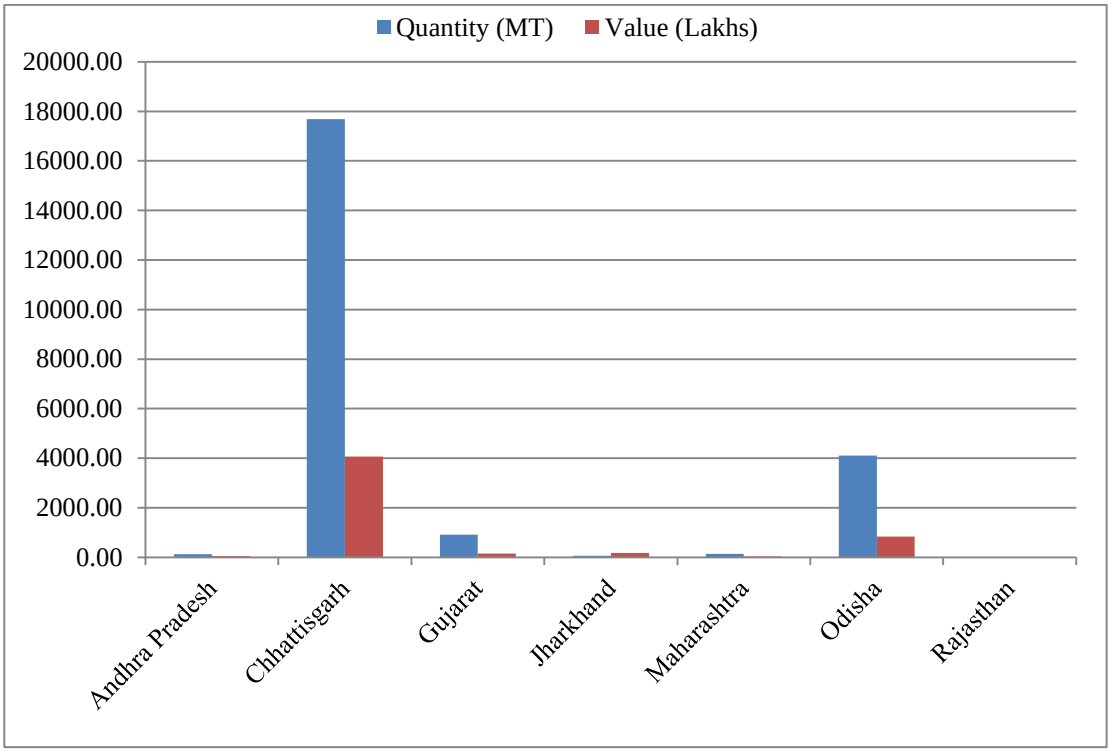

Fig. 1.1. Selected state-wise average arrivals and valuation of MFP in India (Average of 2014 to 2020)

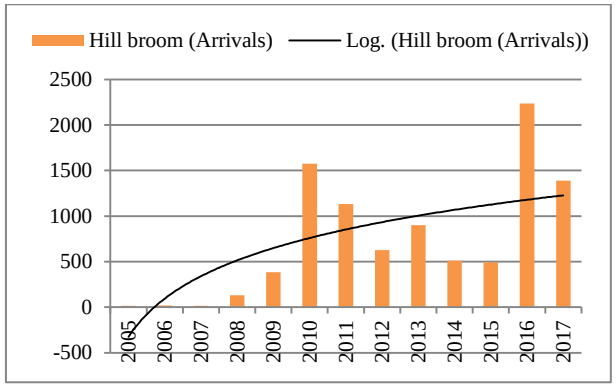

Fig.1.2. Hill broom arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

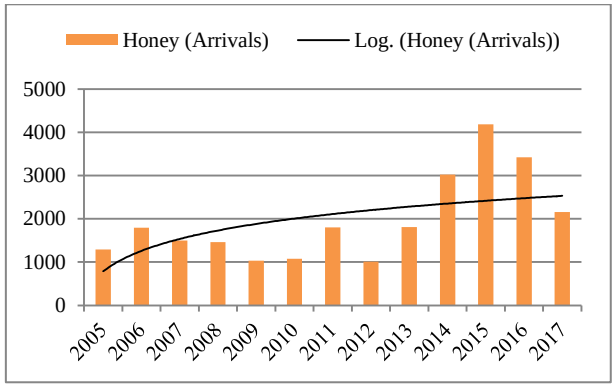

Fig.1.4. Honey arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

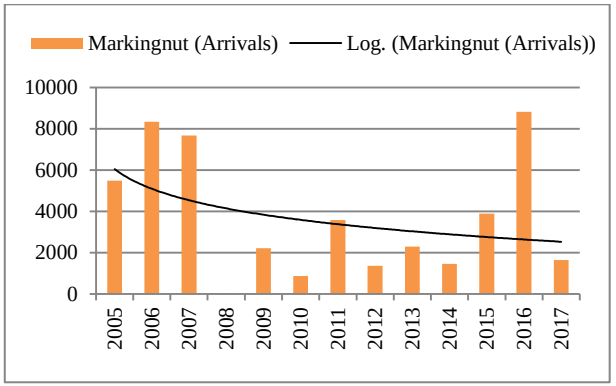

Fig. 1.6. Markingnut arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

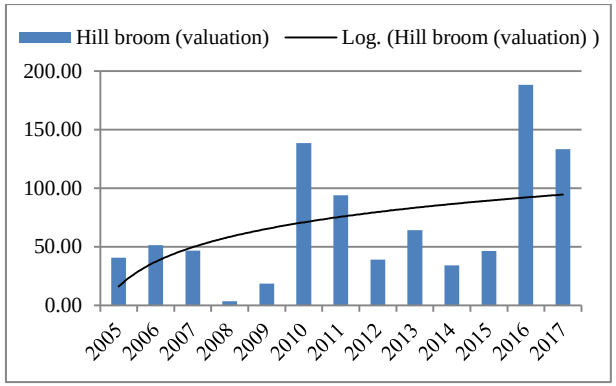

Fig. 1.3. Hill broom valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

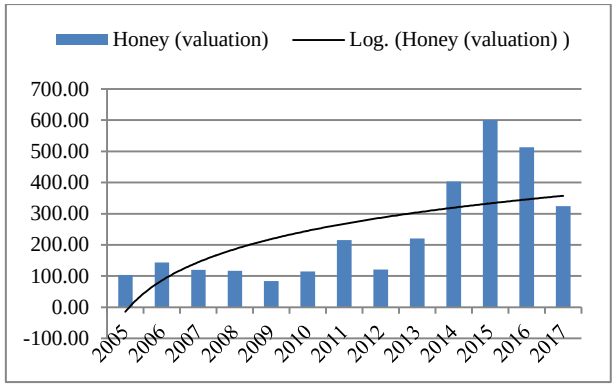

Fig. 1.5. Honey valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

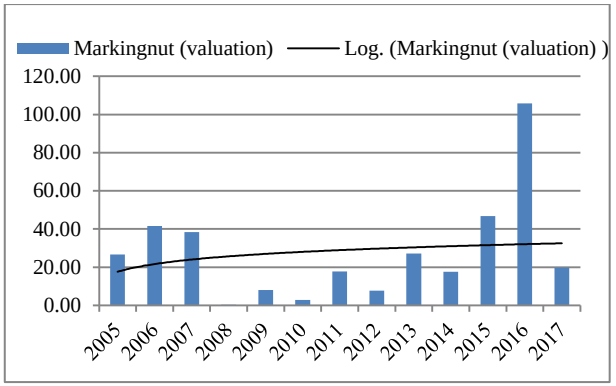

Fig. 1.7. Markingnut valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

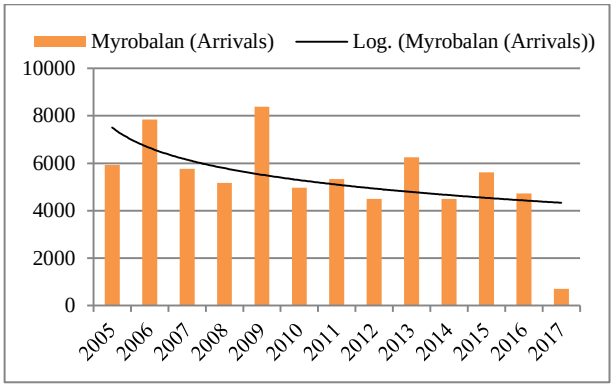

Fig. 1.8. Myrobalan arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

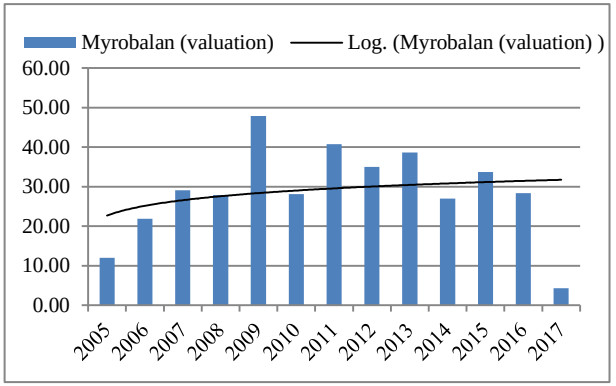

Fig.1.9. Myrobalan valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

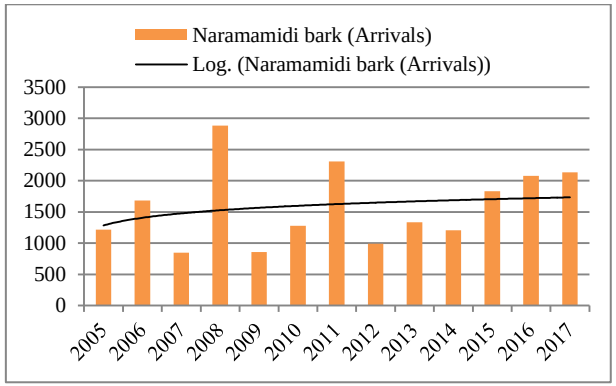

Fig.1.10. Naramamidi bark arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

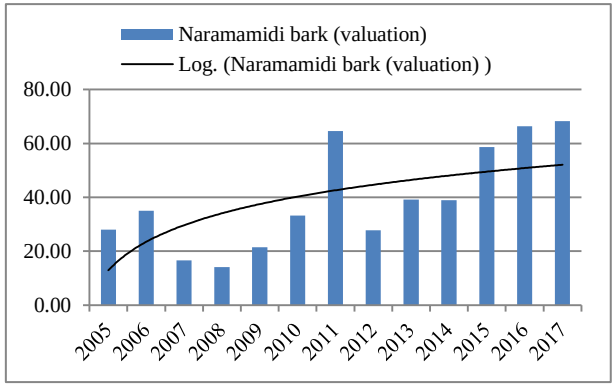

Fig.1.11. Naramamidi bark valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

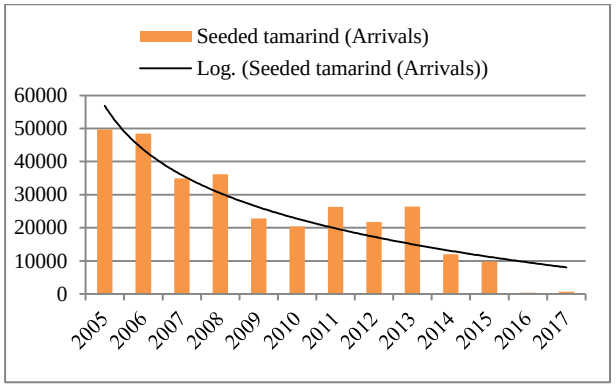

Fig. 1.12. Seeded tamarind arrivals (quintals) in HAT Zone of Andhra Pradesh (Average of 2005-17)

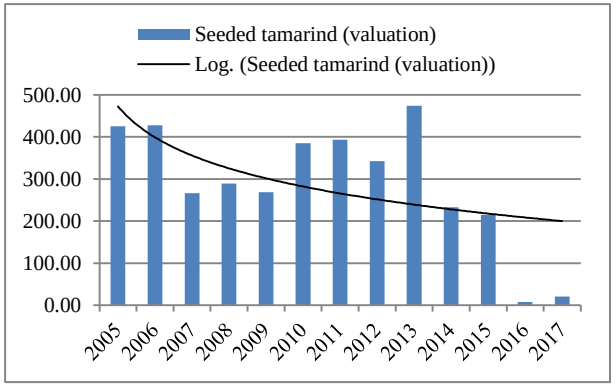

Fig.1.13. Seeded tamarind valuation (Rs. Lakh) in HAT zone of Andhra Pradesh (Average of 2005-17)

The Figures 1.2 to 1.13 illustrate the status of arrivals and valuations of the six commodities hill broom *(Thysanolaena maxima)*, honey, markingnut (*Semecarpus anacardium*), myrobalan (*Terminalia chebula*), naramamidi bark (*Litsea deccanensis*) and seeded tamarind (*Tamarindus indica*) under study from 2005 to 2017 in Andhra Pradesh. Logarithmic trend lines were plotted for each of these graphs to highlight the importance of interventions for increasing the revenue from each of these products in the near future. For instance, hill brooms showed an increase in arrivals over the years, and have achieved a relative stability in 2017. Valuations of hill broom have a steep increase. A similar pattern was observed in case of naramamidi bark. This indicated that arrivals may fall owing to the increase in alternatives such as cheaper brooms from plain areas (replacing hill brooms) and allopathic medicinal practices (replacing use of naramamidi bark). Myrobalan and markingnut showed declining trends of arrivals and a slight increase in valuation over the years. Seeded tamarind recorded a steep decline in both arrivals and valuation. Honey showed gradual increase in both arrivals and valuation, as its demand is ever-increasing. Based on this, one can appreciate immediate efforts being made on marketing of myrobalan, markingnut, naramamidi bark and honey. These points out an opportunity of increasing demand for medicinally valuable forest products in the future. Hill broom and seeded tamarind were found even in upland plains, and it could be speculated that their market forces could control the prices of those found in HAT zones, and have an indirect influence over their supply.

Collection and marketing of MFP is the backbone of tribal economy in Andhra Pradesh. Until the last decade and half, the transactions of MFP in tribal areas had been very poor due to the subsistence and traditional system. This is because, MFP sector had not been adequately supported with necessary infrastructure, technology, appropriate extension and market information. Though significant number of tribal development programs were implemented in Andhra Pradesh, none of them came up with significant change in the lives of the tribal people and in the economy at large. So, it was strongly felt by the

GCC in Andhra Pradesh that, promotion of collection and marketing of MFP is difficult in the absence of adequate, accurate, relevant and timely information (Samarakoon and Shamil, 2010). So, realizing the lacunae in the traditional market information and assimilating the novel information technologies into their efforts, the GCC has made considerable efforts to disseminate the market information to tribal farmers and other market players.

The year 1956 marked the establishment of "Andhra Scheduled Tribes Finance & Development Corporation Ltd.", and then State Government's initiative aimed at improvement of the living conditions of Scheduled Tribes and protects them against exploitation by the more affluent sections of the society. It was renamed to GCC in 1970, headquartered at Visakhapatnam. The aims and objectives of GCC include:

- Procurement of MFP collected by the tribes, duly compensating them for their produce with remunerative prices and thereby safeguarding them from unfair trade practices by private traders and middlemen.
- Ensuring constant supply of reasonably-priced essential commodities and other daily requirements to the tribal consumers through a network of depots.
- Provision of loans extended towards seasonal agricultural operations for the tribal farmers.
- Undertaking activities such as processing and grading for the collective benefit of the corporation and its affiliated societies and their members and making available the necessary infrastructure for the purpose.
- Ensuring the promotion of economic interests and welfare of the scheduled tribes by undertaking other relevant activities conducive to the attainment of the objectives above.

Currently, GCC possesses a vast network comprising of 26 affiliated Girijan Primary Cooperative Marketing Societies (GPCMS), and serves as a funding agency to its societies for MFP procurement. GPCMS procure the MFP through Primary Procurement Centers (PPCs) at the door steps of the tribals, at constantly updated prices fixed and declared by GCC and deliver the

produce to GCC periodically or occasionally. So, GPCMS are designated as agents to GCC for the procurement of MFP and Surplus Agricultural Produce (SAP) from the tribals in their respective areas of operation. A commission @ two per cent is paid by GCC to the GPCMS on the value of the produce purchased and handed over to it.

In the tribal areas of Andhra Pradesh, the GCC/GPCMS and PPCs has been charged with the responsibility to disseminate market information among tribal farmers (Magesa *et al.,* 2014). It is known that Marketing Information System (MIS) as a process of gathering, processing, storing and using information to make better marketing decisions and to improve marketing exchange (Nickels, 1986). So, access to MIS is very crucial towards stabilizing the annual income of tribal farmers through realizing higher prices for their MFP. This is important in the sense of contributing towards more efficient marketing, particularly improved spatial distribution of MFP. Both tribal farmers and traders are the beneficiaries for increasing their access to more market opportunities. The statistics of arrivals, sales and prices are generally maintained by GPCMS/ PPCs. So, the dissemination of market information is an important function of GPCMS/PPCs, which is performed through displaying of the prices prevailing in the market on the notice boards and broadcasting through SMS, television, All-India Radio (AIR) and other media. This information is also supplied to State and Central Government about important markets.

PROBLEM STATEMENT

In HAT zone of Andhra Pradesh, the important sources of marketing information for farmers and other stakeholders include, display boards at GPCMS/ PPCs, mobile phones, television, newspapers, radio and magazines *etc.*, and these enable the farmers to take right decisions at right time for collection and transacting their MFP. However, the raw data of market prices of MFP will not be directly useful for farmers and stakeholders in going for decision making, unless it is processed, analyzed and projected. However, the

past studies (Amrutha and Hugar, 2010; Kumar, 2012) revealed that the situation to systematic dissemination of MIS to tribal farmers in Andhra Pradesh is not well-developed and could generally be concluded that there is no adequate system that manages the gathering, processing and dissemination of timely information. Further, (Shreshtha, 2003; Kshirsagar, 2006; Rajendran and Karthikesan, 2014) has also tried to indicate some of the limitations and weaknesses of MIS in tribal areas *viz.,* poor data processing and data management practices, lack of standardized formats for data collection, lack of well documented instructions necessary for data collection; and insufficient co-operation among data collectors and data processors (at different levels). Further, the limitation of extension personnel in providing market information is one of the major difficulties for providing consistent, accurate and timely information in a systematic, coordinated and sustainable way to address the wide ranging needs of the tribal farmers and other stakeholders. So, these calls for improvement in the present MIS system in tribal areas of Andhra Pradesh to enable farmers to take market based decisions and benefit other market users as well.

No systematic studies were conducted earlier regarding the influence of MIS on marketing of MFP in HAT zone of Andhra Pradesh. Further, no detailed analysis was also done in the past to highlight the impact of MIS on prices realization of MFP and no quantification had been done to know constraints of MIS to be accessed by the tribal farmers in the study area. So, with this background, the present study is focused to analyze the present utilization, contributions of MIS towards better marketing of MFP in HAT zone of Andhra Pradesh. That is, keeping the above issues in view, the present study on **Marketing Information System and its application for Minor Forest Produce in High Altitude and Tribal Area Zone of Andhra Pradesh** is an attempt to analyze the following aspects in an integrated manner.

OBJECTIVES

1. To study the existing MIS for MFP in HAT zone
2. To study the pattern and extent of the dissemination and utilization of MIS by different stakeholders in transacting MFP in HAT zone
3. To estimate the growth trends in marketing arrivals and prices of MFP in HAT zone
4. To analyze the determinants of strengthening marketing infrastructure, market arrivals and prices of MFP in HAT zone
5. To prioritize different price information sources among the farmers, identify the constraints and suggest appropriate policy measures for effective implementation of MIS among stakeholders in HAT zone.

SCOPE OF THE STUDY

The outcome of the present study helps to identify existing MIS in HAT zone of Andhra Pradesh. It aimed to analyze the utilization pattern of different sources of MIS and the determinants of utilization of MIS by tribal farmers. Additionally, this study examines the determinants for strengthening of infrastructure (MIS), arrivals and prices of MFP and the impact of MIS on price realization of selected MFP. Lastly, this study prioritized the constraints in the present MIS in tribal areas and accordingly suggested relevant policy implications.

LIMITATIONS OF THE STUDY

The present study was particularly restricted to HAT zone in Andhra Pradesh hence, the conclusions drawn are applicable to that area and the areas with similar nature. This study was limited to six MFP *viz.,* hill broom, honey, markingnut, myrobalan, naramamidi bark and seeded tamarind on the basis of their respective shares in total value of market arrivals of MFP in the selected GPCMS/ PPCs.

PRESENTATION OF THE THESIS

The study outputs were presented in five chapters.

CHAPTER I: Introduction - General introduction about the importance of MIS in HAT zone of Andhra Pradesh, objectives of the study, need and its scope including limitations.

CHAPTER II: Review of literature –Studies conducted in the past which are relevant to the objectives of the study are presented.

CHAPTER III: Material and methods - The methodology, analytical tools and terms and concepts used in the study are presented.

CHAPTER IV: Results and discussion - The results of the analysis are presented and discussed.

CHAPTER V: Summary and conclusions - The summary and conclusions of study with suitable policy measures are presented.

Chapter – II

Review of Literature

Chapter II

REVIEW OF LITERATURE

The prime focus of the chapter is to analyse theoretical and empirical studies concerning the present study of MIS for transacting MFP. Review of available literature is essential as it provides a strong foundation for scientific investigation. An acquaintance with the earlier studies has been felt necessary to develop better understanding of the present study and to formulate appropriate research methodology. It paves the way for the better understanding and through some ideas for the interpretation of findings. Keeping this in view and based on the objectives set forth in this study an attempt has been made in this chapter to review the earlier studies and they are presented under the following headings.

2.1 Studies related to need and sources of MIS for transacting agricultural produce

2.2 Studies related to determinants for utilization of MIS for transacting agricultural produce

2.3 Studies related to growth trends in marketing arrivals and prices of agricultural commodities

2.4 Studies related to determinants of strengthening MIS, market arrivals and prices of agricultural commodities

2.5 Studies related to impact evaluation of modern agricultural technology

2.6 Studies related to constraints to implementation of MIS

2.1 STUDIES RELATED TO NEED AND SOURCES OF MIS FOR TRANSACTING AGRICULTURAL PRODUCE

Chandra and Sharma (2019) investigated the need of market information among the primary producers of medicinal and aromatic plants in Uttarakhand and offered a comprehensive marketing information system that could be

linked to the sustainability and competitiveness of the sector. The marketing information system framework allowed policy makers, responsible authorities and businesses in devising sustainable business interventions and policy to support the sustainability, competitiveness in the sector and the economy of the primary producers.

Sachan *et al*. (2019) concluded that enhancement of Indian agricultural market information services was essential for national market efficiency and to assimilate national agricultural market with regional and international market for sustainable growth of agriculture sector and to guarantee India's long run food security. Also stated price information was sent to newspaper, All India Radio (AIR), TV, District Information Office (DIO) and District Statistical Officer (DSO) on regular basis whereas, the yearly reports were being distributed to the Zilla Panchayat, Agricultural Research Stations, Deputy Commissioner and the State Marketing Board.

Suriyapriya *et al.* (2018) found that 80.00 per cent of the Farmers Producer Organization (FPO) farmers expressed that the information provided was highly relevant, followed by reduced pest & disease incidence (70.00%), increased the yield (66.67%) and increased the price of produce (61.67%).

Rawal and Bhatta (2017) in their study, they did series of discussion with the usufructs to know the practice of market price information of non-timber forest products and found that still price was being decided from the negotiation process of sellers and buyers. The formal channels of market price information system were reported not so effective to ensure the reliability of information published in website or displayed in notice board. Majority reported that they tried to find out the appropriate buyers or sellers through individual contact. Almost 100 per cent respondents suggested to update the information time to time and should give the real information as in market.

Ali and Rao (2016) stated that marketing information system is widely used for decision making, saved time and prevented rework, as it provided information to all marketing activities regarding planning, promotion, sales of

goods and services for both customer satisfaction and organizational goals. In addition, the new software eased the retrieval of stores information, and with the presence of highly secured systems the industries ‘management is not afraid to store all kind of information on the system. New Technology of Marketing information system was available with high grade and affects the decision making process because the hardware and the software were the components of the new technology.

Hatai (2016) concluded that empowering farmers with relevant, accurate and timely information about prices being quoted in the market place can help the farmer to take appropriate production related decisions as well as strengthening his bargaining power. Also stated sources of agricultural market information at household level were radio, newspaper and television for small farmers.

Dagar (2015) studied that market information was an important facilitating function in a marketing system. An efficient marketing information system can manage timely delivery of product, reduce marketing costs and increase production and productivity and make the market healthy. The existing practices of marketing information systems generally emphasized only the collection of selling price of different agricultural commodities, volume of arrival and source of origin.

Hatai and Panda (2015) explained that, necessary to ensured flow of regular and reliable data to producers, traders and consumers to derive maximum benefit of their sales and purchases. The Agricultural Market Information (AMI) should be deliver fast, reliable and accurate information in a user friendly manner for utilization by the farmers and other stakeholders in order to facilitate the farmers to decide what and when make crop and marketing planning, how to cultivate, when and how to harvest, what post-harvest management practices to follow, when, where, how to sell etc. of the agricultural produce in the study area.

Mahalakshmi *et al.* (2015) studied that coastal Krishi Vigyan Kendras (KVKs) in India are electronically connected through internet facilities for sharing the information among all stakeholders.

Bissa and Vyas (2014) stated that electronic medium had been used for transmission of information in various industries. However, their use in Agricultural markets was relatively low. Markets of some States were linked with National Informatics centre Network (NIC-NET) to provide the speedy and timely dissemination of market information to the growers. Under the scheme 736 Agriculture Marketing Information Network (AGMARKNET) nodes had been promoted which serves 10 per cent of regulated Agricultural markets of the country. Besides above telephones and mobiles were also used as means of communication for marketing of produce in India.

Magesa *et al.* (2014) Stated that access to market information allows farmer to sell produce at specific time. Further, the information allows farmer to select markets at which to send produce and even sell to the identified buyers. Thus well-informed farmers, equipped with marketing information make better decision when selling their produce to ensure they get better price. The overall goal is to ensure rural farmers are not exploited by other market participants but rather they get a good and fair share of their produce.

Miwanda *et al.* (2014) showed that about 54.4 per cent of respondents used agricultural marketing information accessed through Information and Communication Technology (ICTs) as a base for bargaining with buyers for their farm produce and as a result buyers' do not twist the market information in their favour in order to exploit farmers. Farmers got higher selling prices hence increased productivity. Stated most respondents preferred Radio followed by cell phones as their sources of Agricultural marketing information for their produce. Television and computer were the least preferred sources of market information by the respondents.

Mwombe *et al.* (2014) revealed that radio, television and the mobile phone were found to be the most accessible ICTs and were often used to access information on production or/ and marketing of bananas. The least accessible ICTs were computers, internet services and video cassettes. Use of ICTs was found to influence adoption of Tissue Culture (TC) bananas. Low levels of education and distance to internet services were found to be the most constraining to the use of ICT tools. Other constraints included: lack of money to buy internet services, digital cameras and computers. Farmers were of the opinion that radio and the mobile phone were the most useful ICT tools while television, print media, internet/email and video cassettes/DVDs were the least useful as a source of information on banana production.

Rajendran and Karthikesan (2014) a market information system is an important tool used by modern management to aid in problem solving and decision making.

Ramaulu and Lalitha (2014) reported that farmers receive information about prices prevailing in regulated market from local traders, they personally visited markets and also made phone calls to the market and to the friends. It is interesting to note that small farmers depend upon local traders and made personal visits to gather information on market prices while large farmers depend upon local traders and phone calls. Large farmers do not take the trouble of personally visiting the market. Surprisingly, media is not one of the important sources of market price information to the farmers. It implies that government should make all-out efforts to enhance the role of media in transmitting price information to the farmers.

Shankar (2014) revealed that marketing facilitation institutions established by Government of India for minor forest produce trade had severe limitations. In this regard, an alternative to supplement or compliment government's work was necessary to improve tribal livelihoods. Non-Government Organizations (NGOs) which gained importance since seventh five-year plan were taking efforts for linking Tribals to markets. Dhruva is one

such NGO established in Gujarat state. Through orchard programme, it created alternative asset base for tribal producers and established production, processing and marketing facilities. It also created community-based organizations to sustain activities in the long run.

Zanello *et al.* (2014) stated that radios and mobile phones were the main ICTs in the region (used respectively in 59% and 56% of the households). In 33 per cent of the transactions, sellers used mobile phones to gather market information, compared to 16 per cent that received market information from the radios and 38 per cent that obtained market information on discussion with the informants ('word of mouth'). The government released air, a weekly price bulletin in local languages broadcasted via radio throughout the country. It covered market price information of outputs and (in the production season) inputs in the markets in the regional and districts capitals in which it is aired.

Kiveu and Ofafa (2013) explained that increased awareness creation by the government and other stakeholders to promote the use of various available ICT applications already in use to improve market access. This includes the use of popular social sites for marketing by Small and Medium Enterprises (SMEs) e.g. facebook. Several enterprises are already using these sites to advertise their products and services, to communicate with potential customers. Use of such sites will address the constraint of market spaces, high marketing costs, and use of intermediaries to reach more potential customers. Social sites had a very high traffic of potential customers.

Oyeyinka (2013) stated that major sources of Agricultural marketing information outlets to the respondents were fellow farmers (81.3%), radio (85.4%) and Global System for Mobile (GSM) (83%).The study found that (61.3%) of the respondents were in low level category of ICTs users Radio and GSM among other means of disseminating information were the easiest or the most commonly used in the study area.

Anitha and Navyashree (2012) stated that rural population in our country still had difficulties in accessing crucial information in the form they can understand in order to make timely decisions for better farming.

Mittal and Mehar (2012) stated that the availability to knowledge and information helped in improving awareness, education, better adoption of technology, better health and efficiency, reduced transaction costs, better market efficiencies, etc. The use of mobile phones has been found to encourage poor farmers towards greater market participation and diversification to high-value crops. This change has helped increase farm earnings through higher price realization and reduction in wastages.

Rehman *et al*. (2012) observed that better and easy market access and efficient information flow can bring much desired market orientation of the production system. Indian agriculture, moving from commoditization to commercialization drives it towards market orientation.

Yadav and Misra (2012) found that the extraction and exploitation of non-timber forest products had been one of the major causes of the degradation of forests in developing countries like India. The highly unorganized and secretive nature of intermediary operations led to market imperfections that are usually to the disadvantage of the collectors and cultivators. This often leads to destructive and unsustainable harvesting techniques. We provide a possible solution based on a Market Information System (MIS) that can help to remove market imperfections by providing information related to demand and supply to collectors and cultivators. This can be helpful in promoting sustainable harvesting and also to policy-makers and implementation agencies.

Ali and Kumar (2011) studied those users of e-Choupal show significantly better decision-making aptitudes as compared to non-users on various Agricultural practices across the Agricultural supply chain. Further, socio demographic backgrounds of the users such as education levels, the social category they belong to, income levels and land holding size also played a significant role in determining decision-making aptitudes.

Badu (2011) observed that in India, the agricultural market information was criticized for many shortcomings, the most important being the message not relevant to the needs of the farming community. The National Agricultural Innovation Project (NAIP) project on "Establishing and Networking of Agricultural Market Intelligence Centers in India" could not only help the farmers in reducing their price risk, but provided many developmental options.

Barakade *et al*. (2011) stated that Agriculture Marketing Information Network (AGMARKNET) is a portal for Agricultural marketing information that used reporting for daily prices and arrivals data of 300 plus commodities.

Staatz *et al.* (2011) concluded that improved market information can affect the welfare of market actors through improved market polices and increased competition even if those actors do not have direct access to that information.

Amrutha and Hugar (2010) studied that the information was disseminated through various media like radio; newspapers, blackboard display and community address system at market yards. The utility of market information was low among the farmers as compared to traders. The benefit derived in the form of obtaining higher price by traders was relatively higher as compared to the benefits derived by farmers.

Samarakoon and Shamil (2010) indicated that there was a very high demand for information among vegetable farmers though information they receive doesn’t meet their information needs. Therefore, it will be fair to assume that farmers, if given access, will over time take advantage of available information in making decisions that will improve their productivity and profit margins.

2.2 STUDIES RELATED TO DETERMINANTS FOR UTILIZATION OF MIS FOR TRANSACTING AGRICULTURAL PRODUCE

Kimbi *et al.* (2020) analysed factors underlining the adoption of improved technologies among sorghum farmers in Tanzania and evaluates profitability of grain production. Data were analyzed using descriptive statistics, probit regression model Probit estimates indicated that age, sex, number of years in school, group membership, farm size, availability of free seeds, seed accessibility, grain market accessibility and grain market price were the significant factors influencing adoption of these technologies.

Ferdinand (2019) stated that results of probit model estimates by maximum likelihood have shown that the age of the household head, his level of education, the prices and the level of supply of the products have significant effects on the probability of using MIS in the 7 Sahelian countries studied.

Negasi (2016) study attempted to analyze the different aspects of marketing system of vegetable and fruit in Raya Kobo and Harbu woredas, Amhara regional state using different indicators. Probit estimation for determinant of participation probability in vegetable and fruit production and OLS estimation technique were also applied for examining determinants of market supply and demand for vegetable and fruit products. Accordingly, the results showed that lack of genuine and timely market information, poor institutions and arrangements, poor marketing infrastructures (poor storage, cool chain facilities, packaging, weak pre and post-harvest handling practices, non-scientific grading and standard, *etc*), long market channel, high and unfair profit margin distribution among the value chain actors with little share to the farmers were observed in both vegetable and fruit market. These are an indicative of poor marketing efficiency and thereby suboptimal operation of the marketing system.

Anang (2015) study employed a probit model to analyse the determinants of fertilizer adoption by Ghanaian cocoa farmers. The study revealed that farmers' age, farm size and farm income were the critical

determinants of adoption. The implications of the findings are that younger farmers are more likely to embrace technological change in cocoa production and efforts to encourage them to increase production can improve Ghana's cocoa output level.

Mittal and Mehar (2015) in their study multivariate probit model is used and the results showed that socio-economic characteristics of farmers like age, level of education and farm size are significantly related to farmer's use of different sources of agricultural information.

Osmani and Hossain (2015) explained that the market participation decision of smallholder farmers in Bangladesh and tries to sort out the most important factors that influence smallholder farmers' decision to participate in the output market to sell their produce in Bangladesh. To examine the relationship between the smallholder farmers' decision to participate in the market and the factors that affect these farmers' decision, a Probit regression model is employed. For this purpose this study uses primary data collected from 100 smallholder farmers of Durgapur Upazila under Rajshahi District. Main findings of this study indicate that there is moderate level of market participation by the households who decide to participate in the market with 57% sales of their produced crops. It is found that farm size, household labour, income from livestock and farm income might be the main factors that affect the smallholder farmers' decision to participate in the output market.

Alabi *et al*. (2014) examined Probit model analysis of smallholder's farmers decision to use agrochemical inputs in Gwagwalada and Kuje Area Councils of Federal Capital Territory, Abuja, Nigeria. Data obtained were analyzed using descriptive statistics and Probit model. Eight estimators, age; farm-size; education–level; extension services; access to credit; off-farm income; experiences in farming; in the Probit model were found statistically significant. Results show that the probability of using agrochemical inputs increases with age; farm-size; family-size; education-level; extension services; experiences in farming.

Duniya and Adinah (2014) examined the determinants of credit accessibility among cotton farmers in the Northern Guinea Savanna zone of Nigeria. The probit regression model were used to analyze the data. The results revealed that formal education, off-farm income, household size, farm size and farming experience were factors that significantly influenced credit accessibility to cotton farmers. Farmers had more access to informal sources of credit than the formal sources and the rate of accessibility to credit is highest among those sourcing from relatives and friends.

Ali (2013) studied farmers' willingness to pay for the index based crop insurance by employing different econometric models like Gustafsson-Wright model, Probit, Tobit and Poisson estimates. It had been found that these rain-fed areas considered indexed based insurance to be an important risk management strategy. The empirical results indicated that farmers' economic status, household assets and membership of community organization were the important determinants of their willingness to pay a higher insurance premium. The propensity score matching results revealed that farmers were satisfied with index based insurance and were also willing to increase the area under food as well as cash crops. This study also suggested that in order to make agricultural insurance scheme more successful, the government should provide subsidy which will help in increasing the area under food and cash crops and shall ensure food security in the region.

Falola *et al.* (2013) examined willingness to take agricultural insurance by cocoa farmers in Nigeria. The data was analyzed with descriptive statistics and probit regression model, where the results showed that 77.50% of the farmers were aware of agricultural insurance but only 50.00% were willing to take it. The average Willingness-To-Pay (WTP) for Agricultural Insurance by the respondents was N 11,087.5/ha ($69.85/ha). The significant variables influencing willingness to take agricultural insurance by the farmers were age of household head, educational level, access to extension service and farm income. The study therefore recommended encouraging young well educated people to engage in cocoa farming, overhauling agricultural extension services as well as provision of insurance services to farmers at affordable rate.

Wang and Huo (2013) in their study analysed some fundamental factors that influence member willingness to invest in an agricultural cooperative. The relationship between the selected factors and willingness to invest (a binary variable) is investigated by probit regression using data from a survey of 122 members in 9 apple-marketing cooperatives in Shaanxi Province in north-central China. The investment regression identifies five factors that have a statistically significant positive effect on members' willingness to invest in the cooperative. These factors are members' perception of self-importance in the cooperative, the subjective evaluation of difficulties faced in farming operations and sales, the evaluation of the cooperative's economic performance, the evaluation of the cooperative's ability to deliver services, and the availability of government support to the cooperative.

Cepar and Bojnec (2012) estimated the determinants of higher education participation using probit analysis, which was done using STATA 9.2. Gender, age and number of household incomes were found to have negative influence on participation, while internet access, higher household income and higher education of others influenced the participation positively. The score of 1 was given for participation and 0 for non-participation in higher education.

Uzunoz and Akcay (2012) employed probit model analysis to factors affecting consumption of packed and unpacked milk in Turkey. Most of the variables in the study, both dependent and independent, were dichotomous. The study showed that male gender, income levels, availability of packaged milk in supermarkets and belief of packaged milk being more hygienic contributed positively to the consumption of packaged milk.

Kumar *et al.* (2011) conducted survey on 600 farmers to assess their perception about various facets of crop insurance schemes. The Probit and Tobit models had been employed to analyse the factors affecting awareness among the farmers. Crop diversification index had also been used to examine the farmers' adjustment mechanism against risks. The survey revealed that most farmers (65%) were aware of risk mitigation measures of the government.

But, only half of the farmers had been found aware about the crop insurance schemes/products. This implied that there was a need to disseminate information about insurance schemes across the target groups. Further, it had been shown that factors such as gross cropped area, income from other than agricultural sources, presence of risk in farming, number of workers in the farm family, satisfaction with the premium rate and affordability of the insurance premium amount the adoption of insurance and premium paid by the farmers with positive significant values. The study had clearly brought out the urgency of developing more innovative products, having minimum human interventions.

Oladejo *et al.* (2011) in their study probit analysis was employed to investigate the determinants of women participation in agricultural production. The empirical results revealed that household size, marital status and local taboos had significant impact on the women participation in agricultural production; all at 5% probability level with a log likelihood of -96.160222, pseudo R^2 of 0.0875 and LR statistic of 18.44 which shows that the model has a good fit. Most of the respondents were illiterate with non-formal educational status which directly informed their participation in agricultural production.

Takele (2010) employed Heckman model as a part of his analysis of rice profitability and marketing chain in Fogera Woreda in south Gondar zone of Amhara National Regional State, Ethiopia. The model estimated by using a two-step procedure. In the first step the Probit regression was estimated to identify factors affecting decision to participate. In the second step the Ordinary Least Square (OLS) adjusted for selectivity bias model was estimated to identify the significant factors of level of participation or volume sold. The Probit model estimation indicates that 4 variables were found to be the significant factors affecting the household market participation decision. These variables are quantity of paddy produced, market information access, extension contact frequency and Total Livestock Value (TLU) respectively. Four of the variables had coefficients significantly different from zero and increased the chance of household selling of rice to the market positively. More over all the significant variables had the expected signs.

Sebopetji and Belete (2009) used the probit modelling approach to analyse the influence household characteristics have on farmers' decision to use credit. The model predicted 84.93 per cent of the sample correctly. The results revealed that farming experience, gender and marital status have positive significant effect on farmers' decision to use credit. In contrast, farmers' age, education level and membership to farmers' association had negative significant effect.

Seth *et al.* (2009) conducted a survey for determining farmers' willingness to pay for weather derivatives (or weather insurance) of groundnut growers in Rajasthan. They identified nine independent variables affecting the probability of farmer saying "Yes" to price quoted to him for weather derivatives. Using the results of probit and logit models, the farmers' willingness to pay was determined to be around 8.8 per cent of maximum possible payout of weather derivative contract.

Velandia *et al*. (2009) studied factors affecting the adoption of crop insurance, forward contracting, and spreading sales and were analyzed using multivariate and multinomial probit approaches that account for simultaneous adoption and correlation among the three risk management adoption decisions. Their empirical results suggested that the decision to adopt crop insurance, forward contracting, and spreading sales are correlated. Richer insights could be drawn from our multivariate and multinomial probit analysis than from separate, single-equation probit estimation that assumed independence of adoption decisions. Some factors significantly affecting the adoption of the risk management tools were proportion of owned acres, off-farm income, education, age, and level of business risks.

Damisa *et al.* (2007) used the probit analysis to investigate the determinants of women participation in agricultural production. Found that the level of the disposable income, perception, tenure rights and the level of the contribution of women to agriculture had significant impact on women participation in agriculture production.

2.3 STUDIES RELATED TO GROWTH TRENDS IN MARKET ARRIVALS AND PRICES OF AGRICULTURAL COMMODITIES

Chaudhary *et al.* (2019) examined the trends, relationship, as well as seasonal fluctuations in arrivals and prices of selected vegetables in Baijnath, regulated market of district Kangra in Himachal Pradesh for the year 2010-11 to 2015-16. The analysis showed that the rate of increase in the monthly arrivals was highest for cauliflower whereas for monthly prices it was highest for ladyfinger. The prices of vegetables moved contrary to arrivals i.e. prices increased with decreasing arrivals in the market hence negatively correlated.

Navasare *et al.* (2018) in Ahmednagar Agricultural Produce Market Committee (APMC) the highest arrival of sorghum, Tur, soybean, chickpea and bajra is found in the post-harvest period, while it was lowest in the before harvesting over 12 years period of time. It shows inverse proportion between arrival and prices of sorghum, Tur, soybean, chickpea and bajra. The more variability was observed in the arrivals of Sorghum, Tur, Soybean, Chickpea and Bajra due to fluctuations in the production.

Verma *et al.* (2018) a clear seasonal pattern in arrivals of soybean was observed. The highest arrivals were in peak season (October-January) and after that, there was subsequent decrease in arrivals. The reason for low market arrivals in mid and lean season was because of lack of proper storage facility with the farmers. The correlation coefficient between monthly arrivals and prices of soybean were negative in all the markets.

Bera (2017) in his study on market arrivals and prices of potato in five markets of West Bengal indicated that the trends in market arrivals were negative in four markets, but the values were non-significant except Dhupguri and the lone Champadanga market experiencing positive significant trend. The positive and significant trend values of current prices were recorded in all markets barring Dhupguri where the trend is non-significant.

Singh *et al.* (2017) did work on the variability in arrivals and prices of potato in Agra market from the year 2006 to 2015. The results revealed that the market arrival was highest in the year 2013 with a mean of 4.46 lakh quintals and lowest in the year 2006 (49.62 thousand quintals). The result also indicated that the market price was highest in the year 2013 with an average price of Rs.1345.58/ quintal and lowest in the year 2008 (Rs.311.75/ quintal).

Gholap *et al.* (2016) the results indicated that annual growth trend was maximum during 2011 -12 in area and production of loose flowers. Annual growth trend was maximum during 2009 -10 in production of cut flowers. The study indicated positive percentage change in prices of gerbera (+15.25%) and negative in prices of roses (-22.83). Maximum negative percentage change was observed in case of arrivals of gerbera. Trends in arrivals and prices of rose in gultekhadi market shows decreasing trends from year 2005 to 2014. In case of gerbera decreasing trend was observed in arrivals and increasing trend in prices. Co-efficient of variation of real price was found to be lowest in gerbera.

Bhat *et al.* (2014) studied the highest market arrivals in the Narwal mandi of Jammu commensurate with the harvesting date of the produce and it was found that orange 12339.40 quintal, kinnow 10116 quintal and lemon 7293 quintal arrivals were highest in February, December and June, respectively, which resulted a decreasing trend in prices. It was also noticed during the survey that the major portion of the farmers' produce was sold at the lower price in the post-harvest period thereby lowering their incomes.

Mahalle *et al.* (2014) noticed an increasing trend in arrivals of pigeon pea in Washim, Yeotmal, Nandura and Shegaon markets. The highest annual increase in market arrival (2786.5 quintal) was found in Nandura market followed by Washim (2577 quintal) and Yeotmal (1555.20 quintal) markets. However, highest annual increase in price was found in Latur market (Rs.172.64/quintal) followed by Washim (Rs.173.39/quintal) and Akola markets (Rs.172.64/quintal). All seven markets showed increasing positive trend in wholesale price of pigeon pea during study period, whereas, decreasing

trend in arrivals observed in Akola, Latur and Nanded markets. The price behaviour in off- season was on higher side and reverse was the case in on season.

Naidu and Kumari (2013) analysed the behaviour of arrivals and prices of castor in Kurnool and Adoni markets of Andhra Pradesh during 2004-12 (Kurnool) and 2007-12 (Adoni). The results of the study indicated that the markets exhibited increasing trend in arrivals and prices. The highest arrivals were observed in the months of October to December in Kurnool market, whereas from September and October in Adoni market. The highest seasonal variations in arrivals and prices were observed during the months of November and October in Kurnool market, whereas September and October in Adoni markets.

Kolur *et al.* (2012) there was an increasing trend in the prices of wheat in all the selected markets and were found to be highly significant. The annual increase in prices of wheat was found to be highest in Belgaum market Rs.649.75/quintal whereas lowest in Bagalkot *i.e.* Rs.423.89/quintal and were found to be statistically significant at 1 per cent.

Mishra and Kumar (2012) studied the price behaviour of major vegetables in hill region of Nepal. The seasonality in wholesale prices was analysed and found that during the post-harvest period, the wholesale prices ruled very low while during the lean period, the prices were quite high which was due to seasonal and perishable nature of the vegetables. The entire vegetables registered the positive and increasing trend and periodicities of 2 to 3 years in the wholesale prices of vegetables.

Pandit *et al.* (2012) analysed the price behaviour of rice in Eastern Indian markets over the years (1975 to 2008) and it was found that market of Chattisgarh had negative trend in prices. The seasonal fluctuations in arrivals were more pronounced than those of prices, the lowest index was 52 and highest 168. There were no definite cycles in the price series.

Andhalkar *et al.* (2011) maximum mean arrival of pigeonpea was 32920.67 quintals in 2005-2006. It was noticed that the trend of arrival was lowest in the year 1994-95. Then moved upto 732.88 per cent in 2008-09. Per quintal price of pigeonpea in Amravati market steadily increased from Rs. 1394 per quintal in 1994-95 upto Rs. 3875 per quintal in 2008-09. Mean arrival of pigeonpea was 11422.33 quintals in 2000-2001. It was observed that the trend of arrival was lowest in the year 1994-95 and then gradually increased from 1997-98, then moved upto 1776.42 per cent in 2008-09. Per quintal price of pigeonpea in Achalpur APMC market steadily increased from Rs. 1358.92 per quintal in 1994-95 upto Rs. 3554.92 per quintal in 2008-09.

Sharma (2011) in his study examined the behaviour of market arrivals and prices of tomato and their nature of relationship in selected markets over the years (1991-2003). It had been found that both market arrivals as well as prices of tomato showed an increasing trend in all the markets during the study period. The seasonality in prices was higher than the seasonality in market arrivals in all the selected markets emphasizing the improvement in the production and protection technologies and imperfection in markets and marketing system of tomato.

Benke *et al.* (2010) studied the percentage change which was the ratio of difference between average of last 3 years *i.e.* 2004 to 2006 over initial 3 years *i.e.* 1987 to 1989, had been worked out and the results revealed that the highest increase in arrival of soybean in Akola (1797.04 %). In case of price trend it showed highest price increase in Akola (63.11 %).

Gote *et al.* (2010) examined secondary data from the record of the Agricultural Produce Market Committee (APMC) of Palanpur market for the period from 1995-96 to 2005-06 and pointed out that market arrivals and prices of groundnut had shown no specific trend and also noticed that the market arrivals in 2000-01 were lower and higher in 2004-05.The prices were highest in July and lowest in the month of September for Palanpur market.

Kerur *et al*. (2010) studied that among the market functionaries, the traders accounted for 16.26 per cent followed by hamals (15.41 %) in the State which indicated large quantity of market arrivals. Growth of market arrivals of all selected commodities in the state registered a negative growth rate due to low productivity and low prices. Performance of financial indicators for the state as a whole revealed that income Rs.10971 lakh was higher than expenditure Rs.6961 lakh.

Chahal *et al*. (2004) revealed that the seasonal indices of prices were lowest during the peak harvest season. The market arrivals almost remained constant in Hoshiarpur market while these had increased overtime in Ludhiana market.

Balappa and Hugar (2002) analysed the trends in prices of six principal vegetable markets of Northern Karnataka for onion and potato. In case of onion, there was marginal increase in prices over the period with mild fluctuations in all markets except Belgaum, Hubli and Dharwad where upward trend was noticed in 1997-98. In case of potato the trend was increasing over the period with mild fluctuations in all the markets during 1997-98.

2.4 STUDIES RELATED TO DETERMINANTS OF STRENGTHENING MIS, MARKET ARRIVALS AND PRICES OF AGRICULTURAL COMMODITIES

Ega *et al*. (2021) in their study used the multiple linear regression modeling based on OLS. The results showed that there was a relationship and influence between agricultural diversification and the income of rural communities in East Taniwel District.

Chaudhary *et al.* (2019a) shows that the rate of increase in the monthly arrivals is highest for cauliflower whereas for monthly prices it is highest for ladyfinger. The prices of vegetables move contrary to arrivals i.e. prices increased with decreasing arrivals in the market hence negatively correlated.

Sachan *et al.* (2019a) reported a system which provide pricing information to farmers through Media lab Asia activities at Indian Institute of Technology (IIT), Mumbai named as Bhav Puchiye, an interface to provide

price information. Indian Tobacco Company (ITC) e-choupal portal which was launched during June 2000 transmits the mandi prices transversely the state, which is fed in daily by each of the mandi commission agents who have joined the ITC system.

Pavithra *et al.* (2018) studied that the governments provide financial support for creating essential infrastructure (computers, software, uninterrupted power supply and internet) for implementation of the concept of one-nation one market. This alone, however, is not sufficient. Effective implementation of e-NAM also requires infrastructure in the form of storage, warehousing, banks, grading and assaying facilities, etc. within the market yard, the absence of which may discourage traders from far off places to participate in e-tendering.

Pavithra *et al.* (2018) revealed that, higher indices of market arrivals and prices were observed in the peak period (September to December month) and positive correlation between prices and arrivals of cotton in all the four selected markets. Farmers have been forced to sell their produce immediately after the harvest due to greater financial pressure.

Subash *et al.* (2018) stated that e-NAM creating a unified market through online trading platform, both, at State and National level and promotes uniformity, streamlining of procedures across the integrated markets, removes information asymmetry between buyers and sellers and promotes real time price discovery, based on actual demand and supply, promotes transparency in auction process, and access to a nationwide market for the farmer, with prices commensurate with quality of his produce.

Bera (2017a) irregular movement observed in Bishnupur and Jhargram markets were may be due to the differences in availability of marketing facilities particularly storage, transport, nearby large terminal markets. Excepting Champadanga market, current price is negatively related with market arrivals and positive with lagged prices which are very common in highly perishable vegetable crops like potato.

Olojede *et al.* (2017) in their study showed the regression analysis of the socio-economic factors that influence ICT use. The coefficients of level of education, primary assignment, years of working experience and training on ICT were significant and positively related to ICT use, while age, marital status and household size were significant, but negatively related to ICT use. On the other hand, level of income was not significant with ICT use.

Singh *et al.* (2017a) results confirmed that in potato, there were both negative and positive relationships across months between market arrivals and prices in terms of correlation coefficients. There was a significant relationship between market arrivals and prices during the months of January, February and March. In order to get more benefit from potato, farmers need to check potato price across the market and then sell their produce. Moreover, they can also store potato in cold storage during harvesting season when prices are very low and sell later on when prices begin to increase.

Jairath and Shalendra (2016) studied the importance of E-national Agricultural market. It provided facilities of competiveness, efficiency, reducing transaction cost, price stabilization, quick realization and integrated value chains help farmers at national level. E-national Agricultural market of Central Government scheme encouraged all State Governments to participate in this channel with covering of wide range commodities. This type of system provided integrating services and better market information to farmers that give better marketing prices.

Sellam and Poovammal (2016) used Multivariate Regression Analysis to analyze the environmental factors and their infliction upon crop yield, which was the dependent variable. Various factors like Area Under Cultivation (AUC), Annual Rainfall (AR) and Food Price Index (FPI) that contributed to the crop yield have been considered. The Influenced value (R^2) of 0.7 clearly shows that yield is mainly dependent on AR.

Mahalakshmi *et al.* (2015a) stated that step-wise regression analysis revealed that 82.5% of the variation in the utilization of ICT can be accounted by the combined effect of five independent variables such as knowledge gained

through ICT, education, participation in ICT activities, extension media contact and training exposure.

Sulaiman *et al.* (2015) stated that fluctuation in prices recorded above could be partially removed by the reduction of information asymmetry in the region, however, a functional AMIS would be necessary to improve the position of farmers in the markets and help them in decision making and smoothing income volatilities.

Bhat *et al.* (2014a) revealed that the seasonal nature of citrus creates glut in the market which leads to sharp fall in prices during the post- harvest season and affects the orchardists adversely. The highest market arrivals in the Narwal mandi of Jammu commensurate with the harvesting date of the produce and it was found that orange, kinnow and lemon arrivals were highest in February, December and June, respectively, which resulted a decreasing trend in prices.

Bissa and Vyas (2014a) studied that, poor linkages in the marketing channels and poor marketing infrastructure are leading to high and fluctuating consumer prices, and to only a small proportion of the consumer rupee reaching the farmers. There is also substantial wastage, deterioration in quality, and frequent mismatch between demand and supply spatially and over time. The proper development of infrastructure system will not only decrease the cost of distribution but also facilitate to various section of the population like farmers, traders, consumers, scientists, sociologists, administrators etc.

Magesa *et al.* (2014a) reported that infrastructure may comprise improvements in roads, providing electricity in rural areas and developing policies that ensure smallholder farmers are not exploited in the markets. The infrastructure can also ensure that the provision of Agricultural market information is possible which may involve set-up of ICT based systems.

Mwombe *et al.* (2014a) reported that most common FM radio stations that broadcasted Agricultural programmes in the local language include Inooro (Mugambo wa murimi, ‘voice of the farmer’), Kameme (Kenyu na Kenyu,

'piece by piece') and Coro (featuring programmes by Agro-chemical companies and the Ministry of Agriculture).

Olumba and Rahji (2014) analyzed the determinants of the adoption of improved plantain technologies in Anambra State, Nigeria. Adoption Index and its prospective determinants (Explanatory variables) were subjected to linear regression, to find that the farmers' age, farm size, household size, educational status, farmers' income and extension visit showed a significant relationship with the farmers' level of adoption of the technologies. The results of multiple regression analysis showed that there is a high level of awareness among farmers on the technologies though the adoption of these technologies was relatively low considering their potentials. The study revealed that the farmers' awareness level was significantly related to the adoption of improved plantain technologies in the study area.

Kiveu and Ofafa (2013a) explained that increased awareness creation by the government and other stakeholders to promote the use of various available ICT applications already in use to improve market access. This includes the use of popular social sites for marketing by Small and Medium Enterprises (SMEs) e.g. face book.

Olaniyi *et al.* (2013) revealed that, Radio, television, video recorder, audio cassette, Global System for Mobile (GSM), computer and camera were categorized into high level of awareness and access. These ICT tools were also rated as highly relevant to cassava production activities in the areas of cassava stem selection, land selection, land preparation, time of planting of cassava stem and marketing of cassava produce. The independent sampled t-test revealed significant differences in the mean scores of awareness and access to radio, television, computer, video and camera. These ICT tools were highly relevant to cassava production in the study area.

Kolur *et al.* (2012a) stated long-term movements of arrivals showed that it was significant in Belgaum and Bijapur markets, while non-significant in

Dharwad, Bagalkot and Gadag. In selected markets, prices were established which were significant. Analysis of seasonal fluctuation revealed that during January there were lowest arrivals in the market and prices were highest in February.

Manjunath and Kannan (2012) study has attempted to examine the relationship between market facilities and arrival in the APMC markets of Karnataka by using regression analysis at market level. The analysis of the distribution of market infrastructure reveals that the main markets are fairly distributed equally between Northern and Southern Karnataka. However, markets in Northern Karnataka are better equipped with market facilities than the markets in Southern region. Regression analysis has showed that the coefficient of market facilities was positive but its statistical significance varied across crops. Market facilities differed in their effectiveness in inducing market arrivals of different crops. The differentials in the influence could be due to absence of produce-specific market facilities, geographic location of the markets, and the cropping pattern of areas served by different markets. Nevertheless, it is important to note that higher production need not lead to higher market arrivals in a district. Despite relatively lower production in a given year, market arrivals could still remain high due to delayed sale of crops made possible by better storage facilities.

Mishra and Kumar (2012a) found that during the post-harvest period, the wholesale price ruled very low while during the lean period, the prices were quite high which is due to seasonal and perishable nature of the vegetables. The entire vegetables registered the positive and increasing trend and periodicities of 2 to 3 years in the wholesale price of vegetables. The effect of lagged price on current wholesale price was positively significant and high in magnitude and significant negative response was observed for the relationship between wholesale price and market arrival for all the vegetables in the market of hill region. Therefore, improved market information system is a need of efficient vegetable markets in Nepal in order to enable farmers to make proper production and marketing decisions.

Mittal and Mehar (2012a) studied that the full potential of information dissemination was enabled by mobile telephony along with supporting infrastructure and capacity building amongst farmers and it is essential to ensure the quality of information, its timeliness and trustworthiness.

Nyamba and Mlozi (2012) in their study a regression analysis was run to determine the influence of some selected variables on the use of mobile phones to communicate agricultural information, such variables included respondents' age, sex, marital status, income, and types of agricultural information to be communicated. Showed that with the exception of sex, all other factors were found statistically significant at ($\rho \leq 0.01$), suggesting that, they influenced respondents' mobile phones use to communicate agricultural information.

Andhalkar *et al.* (2011a) studied the data on arrivals and prices of selected major pulses in APMC Amaravati and Achalpur for the period of 15 years *i.e.* from 1994-95 up to 2008-09 and revealed that both positive as well as negative relationship between arrivals and prices was observed during the study period.

Aker (2010) revealed that information provision is necessary, but not sufficient, for welfare improvements, especially in the presence of other market failures. Nevertheless, mobile phones appear to be a particularly effective and low-cost means of providing such information, and were well-suited to social and commercial norms in sub-Saharan Africa. These issues were central to the current debate concerning the role of information technology in promoting economic development. Mobile phone infrastructure could have positive spill-over effects on markets, thereby serving as an effective poverty reduction tool for poor rural households. However, it cannot replace investments in other infrastructure necessary for sustainable development, such as power, roads and electricity.

Benke *et al.* (2010a) found that the monthly seasonal indices for sorghum arrivals were higher immediately after harvest in Akola market. The price indices of sorghum were lower during peak arrival months and vice versa. Cyclical fluctuations were found to be more pronounced than seasonal fluctuations in prices. This showed that when maximum production is there, prices decreased and increased during the pre- harvest month.

Bhatta *et al*. (2009) observed the potential of organic agriculture in Nepal. The study conducted in Lalitpur and Bhaktapur Districts consisted of collection and analysis of data from 130 respondents. Regression Analysis was employed to observe those factors that influence the Additional Willingness To Pay (AWTP) for different types of vegetables. Independent variables such as education (Coefficient = 0.322) and the involvement of the consumers in job or their enterprises (Coefficient = 3.892) were found to be highly significant while family income (Coefficient = 0.116) was merely significant. Therefore, purchase decision of organic vegetables and willingness to pay has been governed by the personal and family income and level of education of the consumers.

Pawar and Jadhav (2007) showed that the black gram highest mean arrival were in the month of October i.e. 18,887.60 quintal. followed by September *i.e.*7827.20 quintal. These months had overall highest arrivals in the month due to the harvest of black gram is the month of September and the average mean prices per quintal were highest in the month October *i.e.* Rs.2087.60 followed by November *i.e.* Rs.2060. The highest indices of market arrivals were in the month of October, *i.e.*. 398.96 per cent followed by September *i.e.* 372.91 per cent and the highest seasonal indices of market prices were observed in the month February *i.e.* 116.22 per cent followed by January *i.e.* 115.55 per cent. It was observed that seasonal indices of arrival and prices exhibited inverse relationship indicating that there by when arrival indices were less price indices more and vice-versa.

Tiamiyu *et al.* (2007) assessed technology adoption and productivity difference among growers of New Rice for Africa (NERICA) in Savanna Zone of Nigeria. Data were collected from 227 growers of NERICA varieties based on production activities for 2006 cropping season using structured questionnaires and analyzed using Tobit regression model and Cobb-Douglas production function. The result of Tobit regression analysis had shown that all the variables in the model except farm income have the expected signs and six are significant in explaining use of improved rice technologies. The positively related and significant variables include: farmers' level of education, extension visits, rice farming experience, land ownership, credit use and level of rice commercialization as expected. This meant that improvement in these major factors would lead to higher level of technology use.

Kumar *et al.* (2005) in their study shown that the extent of variability in the arrivals of cabbage was lower in Bangalore and higher in Mumbai. The prices were relatively stable in Mumbai but were more volatile in Bangalore. There was broadly a similar pattern in the price variability across different months in Kolkata and Delhi markets. The results of the study had confirmed the negative relationship between market arrivals and prices in terms of correlation coefficients over the years and across months in all the four metropolitan markets, though there were several instances of positive relationship.

Jairath (2004) examined that on the storage front, there was a need for construction of more scientific storage structures and cold stores especially in the rural areas for protection of produce with participation of private sector. On the processing front, the existing processing facilities need to be modernized to meet the growing demand for quality products. There was a need for expansion of network of State AGMARK laboratories in important markets of the country to ensure availability of State Grading laboratories to consumers of all areas. E-Trading should be popularized by educating various stake holders so as to promote direct marketing of produce. MIS should be extended to cover all important Agricultural markets and commodities.

Singh *et al.* (2004) observed that physical infrastructural facilities as well as market information were not adequate in selected markets of Puri and Cuttack in Orissa. The farmers were deprived of reasonable/ remunerative price for their produce in the absence of or weak dissemination of marketing information among producers. Hence, there was a need to improve the efficiency of food markets through improvement of transport facilities, telecommunication and market information in the state to make the Agriculture markets more efficient.

Kaur and Kaur (2003) examined that over the years not only the regulated markets had increased but the infrastructural facilities required for systematic marketing of Agricultural produce had also grown at a good pace. The income of market committees had also increased significantly which is being invested back for expansion of infrastructure facilities including rural roads for the benefit of primary producers and ultimate consumers.

Pendnekar (2003) viewed that there had been significant increase in the market arrivals both in physical and value terms of all selected commodities. Major increase was observed in coconut arrivals. Also, keen interest had been taken in improving the market conditions by cementing the entire market yard, construction of weighing shed-cum godowns, provision for drying plots etc.

2.5 STUDIES RELATED TO IMPACT EVALUATION OF MODERN AGRICULTURAL TECHNOLOGY

Adeyemi *et al.* (2020) analysed the impact of improved rice varieties' adoption on sustainable rice productivity among farmers in Southwestern Nigeria through applying PSM technique. Results of the PSM showed a significant positive impact of (267.34 kg/ha) on rice productivity while instrumental variable regression showed an impact of 338.29 kg/ha. This clearly implies that the adoption of these varieties significantly improved rice productivity in the study area.

Bannor *et al.* (2020) studied the impact of modern rice varieties on poverty in Eastern India through employing PSM technique. The findings of the study revealed that adopters have a higher per capita monthly household expenditure between Rs.3222.00 and Rs. 3853.17 across different algorithms of nearest neighbor matching, stratification matching, radius matching and kernel matching.

Bello *et al.* (2020) examined the productivity impact of Improved Rice Varieties (IRV) among smallholder farmers in South West, Nigeria. Their study revealed that education, experience in rice farming, extension contacts, access to financial services and access to IRV seeds had a positive and statistically significant influence on the adoption of IRV. The findings of PSM concluded that treated farmers gain 452 kg more rice yield compared to untreated. So, the study concluded that strengthening e-commerce extension services is the need of the hour to address large group of farmers.

Wang *et al*. (2020) studied the impact of Improved Rice Varieties (IRV) in the Uplands of Yunnan, China through employing PSM. This study employed the nearest neighbor matching method to estimate the average impact and the radius and kernel matching methods as alternative specifications for assessing the sensitivity of results with respect to matching methods. The findings revealed that the estimate of the difference in the average rice income per household between the adopter and non-adopter of improved rice variety was found to be in the range of $45–51, accounting for 42–48 per cent of non-adopters' cash income from grain sales. The rice income difference accounts for 50–62 per cent of the total income effect. The balance of the income difference arises from non-rice sources. The results of Rosenbaum bounds indicated the robustness of estimates and the absence of systematic biases.

Guo *et al.* (2018) estimated the impacts of distance education on agricultural performance and household income in peri-urban districts of Beijing. Logistic regression was used to compute the propensity scores. Although psweighted regression was used to estimate the ATT of distance

education programme, Radius and caliper, nearest neighbor and kernel matching methods were used to estimate the bias-corrected effects of the treatment, and found that the programme had a significant positive impact on agricultural labor productivity, farm productivity and farm input use efficiency.

Ahmed *et al.* (2017) used PSM to check the robustness of the estimated treatment effects, which in this case, the improved maize varieties, on farm productivity and well-being of farming communities in the east Hararghe zone of Ethiopia. The study produced a remarkable p-score graph detailing the propensity scores of treated and untreated farmers with both on-support and off-support. Average Treatment on Treated (ATT) were estimated by using nearest neighbour, kernel and radius matching methods, and concluded that cultivation of improved maize varieties resulted a spike in the holdings of small farmers, who comprised the majority of farmers in the area.

Kebebe (2017) employed Propensity Score Matching (PSM) and inverse probability weighting estimator with regression adjustment to examine the difference in the household nutrition and income between adopters and non-adopters of improved dairy technologies in rural Ethiopia. The impact estimates using the inverse probability weighting estimator with regression adjustment were found to be consistent and comparable with the impact estimates by PSM. The results obtained showed that adopting cross bred dairy cows has a substantially higher effect on household income for adopters, which is particularly strong for farmers with better resource endowment. Kebebe also pointed out that differences in welfare outcome potentials between adopters and non-adopters of dairy technologies might be the reason for non-adoption of dairy technologies by Ethiopian smallholders, along with bottlenecks in supply chain, which drives the underinvestment in dairy technologies in rural Ethiopia.

Gebrehiwot and Veen (2015) estimated the impact of a Food Security Program (FSP) in Tigray region of Northern Ethiopia. PSM was employed, in which different household characteristics were included as regressors. The size of the land holding, livestock ownership and proximity to markets were

observed to be the characteristics that have a significantly positive impact on the household participation in FSP. The estimated mean propensity score using the main specification for the whole sample was 0.472 (with a standard deviation of 0.453), implying that the average probability of participating in the FSP program for all individual households was 47 per cent.

Josephat and Likangaga (2015) in their studies in rural Tanzania used Propensity Score Matching (PSM) to analyze the effects of District Agricultural Sector Investment Project (DASIP) using agricultural data from the study area. Apart from their expression of PSM as a data-hungry method, they implied that the adoption of PSM in the study controls to some extent the selection bias and makes the difference between the study groups to be due to treatment and not to other factors. The t-test was adopted to compare the means of the two groups (control and treatment), and found that the farmers participating in DASIP are not significantly different from those who do not participate in the programme, thus concluding that DASIP has not contributed much to the welfare of the farmers.

Jalan and Ravallion (2014) applied recent advances in PSM to the problem of estimating the distribution of net income gains from an Argentinian workfare program. PSM has a number of attractive features in this context, including the need to allow for heterogeneous impacts, while optimally weighting observed characteristics when forming a comparison group. The logit regression was used to estimate the propensity scores on the basis of which the matching is subsequently done. After estimating the propensity scores for the treated and the comparison group, they were plotted to check the common support condition, to find that there were regions of no overlapping support, non-participants of which were excluded. Trabajar (workfare program) sample's mean propensity score was 0.405, which was significantly higher than that of the national sample (0.075), which indicated a significant impact of the program on the participants who were mostly poor, due to the fact that a majority of the non-poor haven't felt the need to participate in the program.

Shehu and Sidique (2014) deduced that marital status, health, education and household size among the personal variables, market from the community characteristics and the location factor of the farmers' presence in the northern region had positive influence on the well-being of the farmers of Nigeria, understood by the greater propensity scores of the said variables. Also, the primary matching method employed was the radius matching method, whose sensitivity analysis was performed using Nearest Neighbor and Kernel Gaussian matching techniques to find that additional non-farm enterprise activities contributed to an added benefit of $524 per annum.

Vigneri and Lombardini (2014) employed PSM in their evaluation of impact of the climate change community-based adaptation model for food security project in Thailand. The PSM estimates were bootstrapped with 1000 repetitions to produce an unbiased effect of the treatment when the information between organic and inorganic farmers was subjected to analyses on several fronts.

Djido and Sanders (2013) addressed self-selection bias using PSM while assessing the performance of farmers adopting an improved sorghum technology package (cultivar Sepon 82 along with inorganic fertilizers, fungicides and training) in the Maradi region of Niger. In their three-step estimation method to evaluate the technology's impact, a probability model for the adoption of sorghum technological package was developed to generate the propensity of being an adopter. The nearest neighbor matching method was then employed to estimate the Average Treatment on the Treated (ATT), which was observed at 718 kg/ha.

Laporte (2013) in his estimation of impact of extension services promoted by National Agriculture and Livestock Extension Programme (NALEP) among farming households in Western Kenya, used PSM to conclude that households with extension support from the program were less likely to store their surplus maize and release it into the markets for sale. Also, it was found that the productivity per acre remained unaffected by the extension treatment, despite the treated farmers increasing their fertilizer dosage by 23.8 per cent.

Kirchweger and Kantelhardt (2012) used PSM to obtain treatment effects from the agricultural investment support programme in Austria on the farm income, and also tested the robustness of the results to hidden bias with sensitivity analysis. Here, the sample was split in more homogeneous subsamples to increase the robustness of the results. Binary logit model was applied to get the propensity scores, and Greedy algorithm was applied to obtain the best results regarding the matching balance. The results show a statistically significant and positive Average Treatment on Treated (ATT) (227 farms) in farm income per year by roughly 7,000 Euros.

Lane *et al.* (2012) estimated propensity scores of several variables using Logistic regression on data centrally based on Florida Comprehensive Assessment Test (FCAT) scores and Grade Point Average (GPA) of high school students in Florida. The impact of Content Area Reading Strategy programme (CARS) among the students was estimated to find that students receiving CARS instruction seemed to have higher levels of GPA by 0.21 than those who didn't.

Liebenehm *et al.* (2011) applied Propensity Score Matching (PSM) to measure the impact of ILRI (International Livestock Research Institute) led research activities to control African Animal Trypanosomosis (AAT) in West Africa. They observed that the strongest effect of outreach activities is related to the farmers' knowledge of how to treat AAT, accounting for approximately 4 per cent according to different matching algorithms. They also identified the significant knowledge advancements on preventive control strategies of around 3 percent. They concluded that providing cattle farmers with access to appropriate disease control information has resulted in increase in farmers' knowledge of Trypanosomosis and in improving their treatment and prevention practices.

Nicoletti (2011) used PSM to estimate the impact of rural prosperity initiative on the farmers of Zambia. The initiative was in the form of a comprehensive micro-irrigation program, which effected farmers' income and

crop production. The estimation of propensity scores and their subsequent estimation of Average Treatment on Treated (ATT) through nearest neighbor matching and kernel matching methods revealed the total crop revenue benefit of $168 and $227 respectively from the adoption of irrigation technologies introduced to the Zambian farmers in 2010 by the non-profit organization, International Development Enterprises (IDE).

Wu *et al*. (2010) employed PSM to assess the impact of improved upland rice technology on farmers' well-being in rural China using data from the years 2000, 2002 and 2004. PSM was used to address the problem of 'self-selection,' because technology adoption was not randomly assigned. The work details the usage of three popular matching algorithms once the propensity scores have been calculated, namely, Nearest Neighbor Matching (NNM) method, Caliper method and Kernel matching method. They stated that in general, NNM causes the least sample loss, but its matching quality is the worst. The caliper approach has the best matching quality despite a high sample loss during matching. The kernel approach has a lower sample loss and a better matching quality. Using 50 times bootstrapping to test the statistical significance, the results show that the improved upland rice technology has a robust and positive effect on farmers' income.

Pufahl and Weiss (2008) applied a non-parametric propensity score matching approach to evaluate the effects of two farm programs, namely, Agri-Environment (AE) program and Less Favored Area (LFA) program on input use and farm output of individual farms in Germany. The study generated an ATT of 3.5 per cent growth rate in farm sales from the AE program. The comparison of kernel smoothed regressions of both the programs indicated that the treatment effect of AE increased with the probability of participation. In other words, farmers who generated the largest benefit from the AE program had the greatest chance of participating in it.

Mendola (2007) used PSM to shed some light on the potential impact of agricultural technology adoption on poverty alleviation strategies. He stated that the main feature of the matching procedure is the creation of the conditions

of a randomized experiment, in order to evaluate a causal effect or an average technological effect as in a controlled experiment. The technological effect on household income had been given by both the Nearest Neighbor Matching (NNM) and Kernel-Based Matching (KBM) methods, indices of which indicated the positive impact of technology adoption on resource-poor farmers, in terms of rise of income and poverty reduction. On the other hand, technology adoption seems to increase income of poorer near-landless but it hardly helps them to overcome the poverty line, unless other equity-enhancing policy measures are undertaken.

Caliendo and Kopeinig (2005) provided practical guidance for the implementation of PSM in estimation of causal treatment effects. They clearly outlined the procedure of estimating treatment effects, beginning from estimation of propensity score, followed by the selection of a suitable matching algorithm to choose and determine the region of common support. Also, a detailed description of matching algorithms like Nearest Neighbor, Caliper and Radius, Stratification and Linear, Kernel and Local Linear, and Weighting algorithms, with their usage conditions, pros and cons, was given.

Bryson *et al.* (2002) gave a detailed account of the role of PSM in evaluation of active labor market policies. He explained that PSM is a data hungry approach that requires a greater sample size, and an asymmetrical one with a greater number of non-participants than the participants. This point was proven by using PSM to evaluate three programs, namely, one, New Deal for Young People (NDYP) and New Deal for Lone Patients (NDLP), which have varied sample sizes in ascending order, i.e., as low as 517 for ONE and as high as 65000 for NDLP. The PSM evaluation of NDLP yielded more significant results than those of one and NDYP, indicating the need for a larger sample for analysis with PSM.

2.6 STUDIES RELATED TO CONSTRAINTS TO IMPLEMENTATION OF MIS

Chandra and Sharma (2019a) revealed that the primary producers are facing a huge information gap in terms of resources sustainability and business competitiveness.

Kumari *et al.* (2017) studied that, main constraints faced by farmers in marketing of various commodities mainly through lack of scientific storage at farm level, distress sale, insufficient information about market prices and marketing charges, and exploitative practices by the traders in market.

Amrutha and Reddy (2015) the study was carried out in selected districts of north eastern Karnataka and stated that major constraints to adopt these technologies were illiteracy, no access to electronic devices of farmers. Present marketing system was mostly depending on computers with internet connection, adopting modern information technologies and playing main role in smoothing of marketing system. Positive effect pointed out that selling operation time was reduced due to utilization of e- tendering and e- balance process methods. It was also pointed out that delay of payment to farmers between 1-15 days was observed in all the markets.

Chete and Fasoyiro (2014) results showed that the scheme is hampered by poor literacy, poor understanding on use of ICT for Agricultural transactions and lack of mobile phones by some farmers.

Rajendran and Karthikesan (2014a) studied that all computerized systems do not necessarily mean MIS or does MIS necessarily imply computerized processing of data to create information, reported that the growers received low prices in Bangladesh because of lack of market information which resulted in wide inter-market price variation.

Olajide and Uwaya (2013) investigated the constraints to the use of ICTs for Agricultural information dissemination in Edo state, Nigeria. Results indicated that most extension workers were male (67.2 %) with Diploma

qualification (74.1 %), with vast professional experience ranging from 11-20 years (65.4 %) and being ICT literate (51.7 %). Available ICT tools for information dissemination were radio (83.6 %), mobile telephony (86.2 %) and short message services (81.0 %). While network fluctuation (42.2 %) and lack of expertise on the part of the extension workers (51.7 %) were figured out as technical constraints, organizational constraints identified as impeding ICT use included insufficient computer training for extension personnel (41.4 %) and poor funding for ICTs in extension organizations (33.6 %). Inadequate regulatory environment (48.3 %) and strategic vision in developing ICT for rural areas (63.8 %) were identified as regulatory constraints for ICTs use for Agricultural information dissemination.

Amrutha *and* Hugar (2010a) reported that lack of information was an entry barrier to both production and trade. Conventionally, the markets maintained information in the form of registers. The daily prices were compiled manually and written on the blackboards for the use of farmers visiting the markets.

Okwusi (2010) examined the problems associated with the utilization of Information and Communication Technologies (ICTs) in Southeast agro ecological zone of Nigeria. The identified problems associated with the utilization of ICTs include ignorance, lack of ICT resources, high cost of access not capable in manipulating some ICT facilities, lack of electricity supply, and lack of network coverage and cyber problem.

Samarakoon and Shamil (2010a) found that most of the information is collected to make informed decisions at higher level. In certain instance these organizations tend to interdependent on each other on type of information they collect. Lack of a collective purpose to collect information, lack of an integrated system or mechanism to collect information, lack of a formal mechanism to provide information for farmers has resulted in the weaknesses identified by farmers in receiving information.

Ovwigho *et al*. (2009) identified that the constraints faced by extension agents in the use of information communication technologies; and examined the relationship in the frequency of use of interpersonal communication, print media, and information communication technologies. The extension agents did not often make use of information communication technologies in disseminating information to the farmers. The constraints faced by the extension agents in the use of information communication technologies were electricity (x = 3.42), inadequacy of ICTs (x = 3.75), lack of fund from government (x = 2.98), high cost of computer and other ICTS (x = 2.94), problem in connectivity (x = 2.65), lack of supportive government policies and legislation on ICTs (x = 3.63), lack of on job training for ICTs (x = 3.92), low level of education of farmers (x = 3.37) and transportation difficulties (x = 3.86). There existed a significant relationship ($P<0.05$) in the responses of the extension agents to the use of ICTs.

Kshirsagar (2006) observed that the Horticulture sector in India was terribly affected by inadequate marketing infrastructure facilities. Major constraints faced by farmers were shortage of pre-cooling and cold-storage facilities, lack of skilled labour and high wages of grading and packing, shortage of packing material and its high prices, shortage of vehicles, high transportation costs, inadequate or no access to vital market information, absence of transparency, rarely receiving fair price, need for training and shortage of processing facilities.

Meera *et al*. (2004) suggested ICT projects require qualified and well-motivated staff to serve as an interface with computer systems. Staff for Agricultural extension projects should have adequate training in Agriculture. Efforts should be made to ensure that farmers have faith in the ICT project personnel and that they are committed to the goals of the project.

Shreshtha (2003) identified duplication of efforts, lack of standardization, inadequate network for information flow, lack of coordination and integration with various agencies as some of the limitations of Market Information System in Nepal.

The literature reviewed above enabled the researcher to understand in-depth about the importance of MFP to the Indian economy in general and to Andhra Pradesh in particular, importance of MIS in transacting agricultural produce (including MFP), different sources of MIS for both farmer and traders, dissemination and utilization of MIS, market arrivals and prices of agricultural commodities, impact assessment of modern agricultural technologies and prioritization of constraints of MIS. These relevant studies form the backdrop for the conduction of present in-depth investigation focusing on the application of MIS in transacting MFP in HAT zone of Andhra Pradesh. The critical review of past studies also enable the researcher to execute relevant statistical tools and techniques, draw realistic conclusions from the analytical findings and thus, guided the researcher to suggest useful policy implications for strengthening MIS in HAT zone of Andhra Pradesh towards making the tribal farmers provide revelation about application of modern marketing techniques and information and consequently for improving their livelihood.

Chapter – III

Material and Methods

Chapter III

MATERIAL AND METHODS

The present study entitled "**Marketing Information System and its Application for Minor Forest Produce in High Altitude and Tribal Area Zone of Andhra Pradesh**" was undertaken with a view to study dissemination and utilization of marketing information on MFP in HAT zone of Andhra Pradesh. This chapter provided a brief explanation of different tools and techniques employed to analyze the formulated objectives of this study. This chapter was divided into following heads.

3.1 Sample design

3.2 Collection of data

3.3 Tools of analysis

3.4 Concepts and terms used in the study

3.1 SAMPLE DESIGN

Present study was carried out with help of multi-stage sampling design *i.e.* Division level, GPCMS level and shandy level to select the representative sample.

3.1.1 Selection of the Zone

HAT zone of Andhra Pradesh (Figure 3.1) was selected in view of the major availability of MFP. This zone covers hilly areas of four districts *viz.*, East Godavari, Visakhapatnam, Vizianagaram and Srikakulam of Andhra Pradesh.

3.1.2 Selection of Division

In HAT zone, there were five divisions under GCC *viz.*, Chintapalli (Visakhapatnam), Paderu (Visakhapatnam), Parvathipuram (Vizianagaram), Rampachodavaram (East Godavari) and Seethampeta (Srikakulam) all these divisions were included in the study (Figure 3.2).

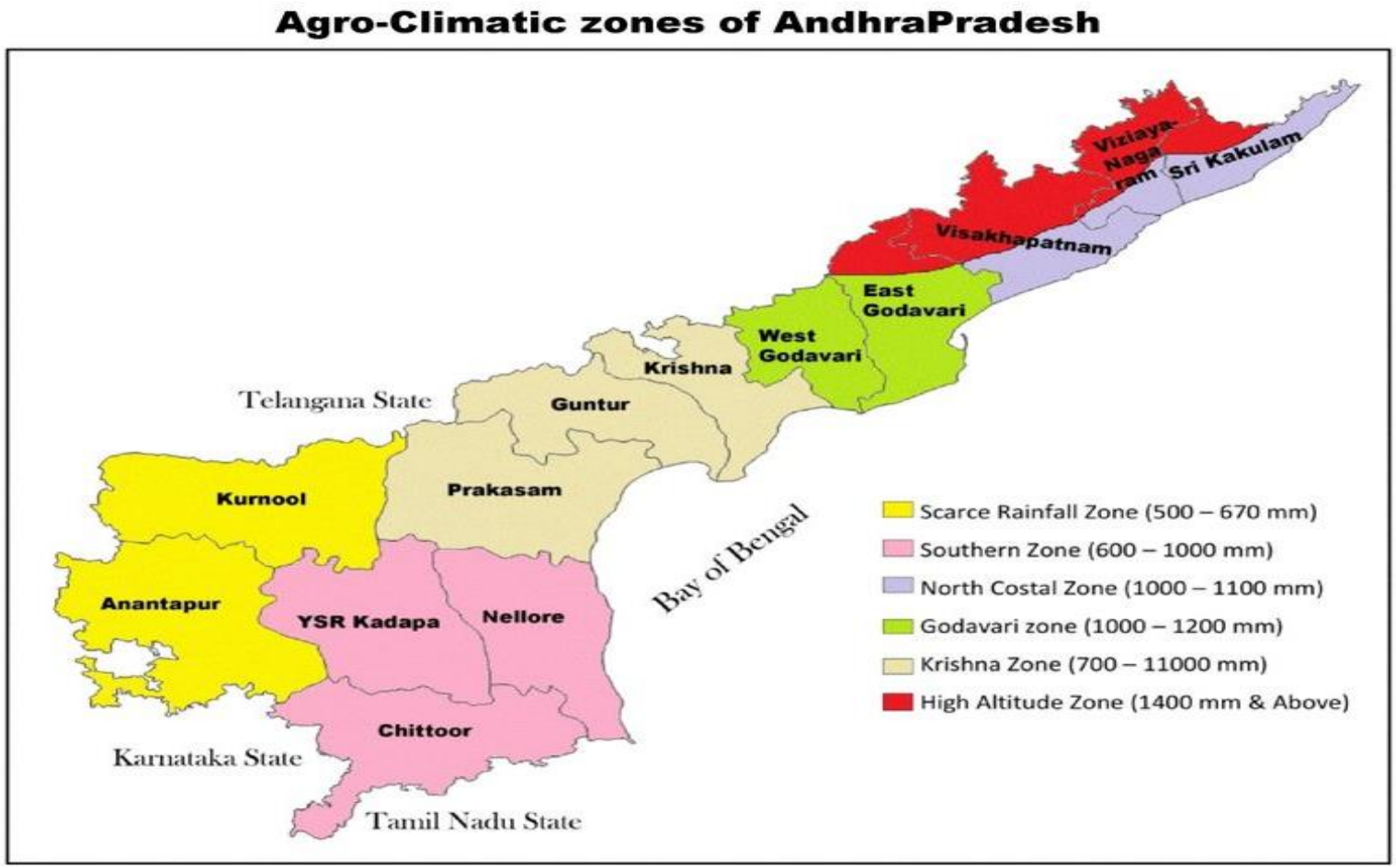

Fig. 3.1. Map of Andhra Pradesh state showing the selected districts and zones

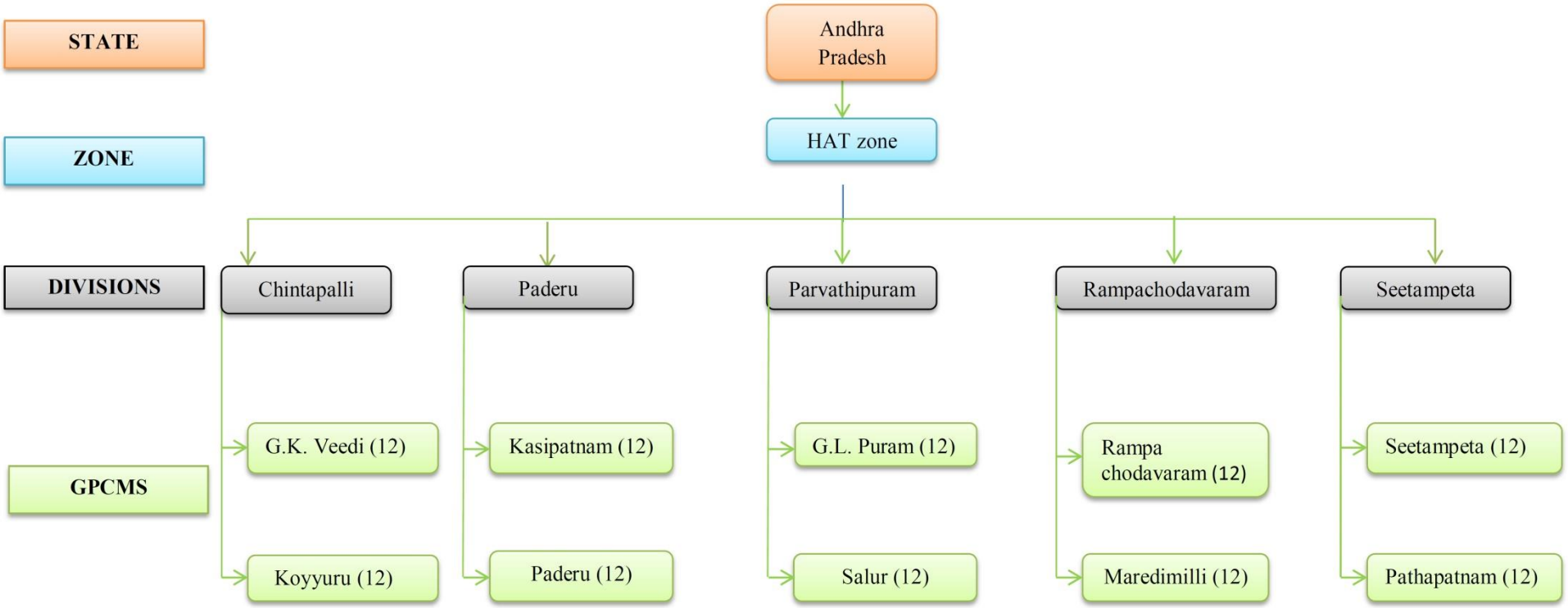

Fig. 3.2. Sampling design regarding selection of GPCMS and sample farmers

3.1.3 Selection of MFP

As shown through Table 3.1, MFP like hill broom, honey, markingnut, myrobalan, naramamidi bark and seeded tamarind were purposively selected for this study, as they together accounted for 84.80 per cent share of total value of MFP procured by GPCMS in the HAT zone of Andhra Pradesh (Average of 2011-2018). (Girijan Co-operative Corporation. https://www.apgirijan.com)

Table 3.1. Selection of MFP from HAT zone (Value in Rs. Lakh)

S. No.	MFP	2011	2012	2013	2014	2015	2016	2017	2018	Total	Average
1	Bees wax	0.05	0.05	0.14	0.04	0.02	0	0	0.03	0.33	0.04
2	Cleaningnut	0.08	0.05	0.34	0.06	0.37	0.14	0.01	0.13	1.18	0.15
3	Dry amla	2.15	0.99	39.48	33.58	17.99	8.36	0.49	103.48	206.53	25.82
4	**Honey**	**47.16**	**52.03**	**33.44**	**336.73**	**51.58**	**67.57**	**98.88**	**228.44**	**915.84**	**114.48**
5	**Hill broom**	**93.91**	**38.93**	**64.11**	**34.03**	**46.40**	**188.29**	**133.21**	**62.68**	**661.57**	**82.70**
6	Maredugaddalu	0.00	0.00	0.00	1.58	0.000	0.00	0.00	20.88	22.46	2.81
7	**Markingnut**	**17.73**	**7.73**	**27.12**	**17.56**	**46.75**	**105.79**	**19.78**	**26.83**	**269.29**	**33.66**
8	Mohwa flower	0.00	0.00	0.00	0.00	0.00	0.08	1.32	0.01	1.41	0.18
9	Mohwa seed	0.13	0.00	0.65	0.32	3.45	4.68	4.71	0.42	14.35	1.79
10	**Myrobalan**	**40.74**	**34.95**	**38.64**	**27**	**33.73**	**28.25**	**4.28**	**65.11**	**272.70**	**34.09**
11	**Naramamidi bark**	**64.25**	**27.11**	**38.69**	**38.60**	**57.86**	**65.85**	**67.83**	**142.55**	**502.74**	**62.84**
12	Nuxvomica	3.30	0.82	17.17	3.95	16.05	1.76	8.83	45.51	97.38	12.17
13	Pungam seed	3.35	1.34	0.51	2.18	0.17	0.25	1.10	1.13	10.03	1.25
14	**Seeded tamarind**	**393.13**	**342.17**	**473.64**	**233.12**	**214.40**	**7.89**	**21.03**	**185.49**	**1870.86**	**233.86**
15	Deseeded tamarind	32.06	47.57	27.2	11.21	28.38	42.44	11.39	54.88	255.14	31.89
16	Flower tamarind	0.00	0.00	0.00	19.14	0.00	0.07	0.00	59.62	78.83	9.85
17	Sheekakai	2.14	2.95	2.63	1.4	3.56	5.52	5.46	14.30	37.95	4.74
18	Soapnuts	0.39	0.07	1.80	2.5	2.02	1.26	6.13	30.74	44.93	5.62
19	Tamarind seed	0.07	0.00	2.58	0.00	0.19	0.00	0.00	1.49	4.33	0.54
20	Addaleaf	7.18	0.00	1.08	0.00	0	0.00	0.00	0.00	8.26	1.03
21	Rellabark	2.69	1.22	3.44	8.69	4.05	1.85	0.02	0.01	21.97	2.75

Source: Girijan Co-operative Corporation (GCC)

3.1.4 Selection of GPCMS

Two GPCMSs with highest arrivals of selected MFP from each division under GCC were purposively chosen for the study (Table 3.2). Thus, 10 GPCMSs are selected for this study. These GPCMSs are procuring the selected MFP from the tribal farmers through PPCs or Depots.

Table 3.2. GPCMS wise arrivals (Quintals) in HAT zone (Average from 2015-2019)

S. No.	Division	GPCMS	Hill broom	Honey	Marking nut	Myrobalan	Naramamidi bark	Seeded tamarind
1	Chintapalli	G.K.veedi	0.08	161.05	151.39	39.40	55.89	209.35
		Koyyur	4.92	88.62	74.25	11.88	52.87	55.07
2	Paderu	Kasipatnam	0.01	22.39	607.60	726.89	77.22	62.86
		Paderu	0.01	1.42	236.33	57.12	65.39	962.81
3	Parvathi puram	G.L.puram	159.74	10.83	198.92	875.81	326.93	1092.37
		Salur	237.76	71.38	356.50	201.55	142.16	1147.96
4	Rampa chodavaram	Rampa chodavaram	1102.07	111.59	102.68	322.32	119.26	0.32
		Maredu milli	208.28	14.44	16.96	22.33	153.12	33.95
5	Seetampeta	Seetampeta	74.79	0.01	158.64	9.15	972.05	54.50
		Pathapatnam	24.94	0.01	35.00	23.19	186.75	24.37

Source: Girijan Co-operative Corporation (GCC)

3.1.5 Selection of Shandies

In HAT zone of Andhra Pradesh, there were 79 shandies in five selected divisions under GPCMSs. In total, random samples of 20 shandies were selected based on proportion to number in each GPCMS (Figure 3.3).

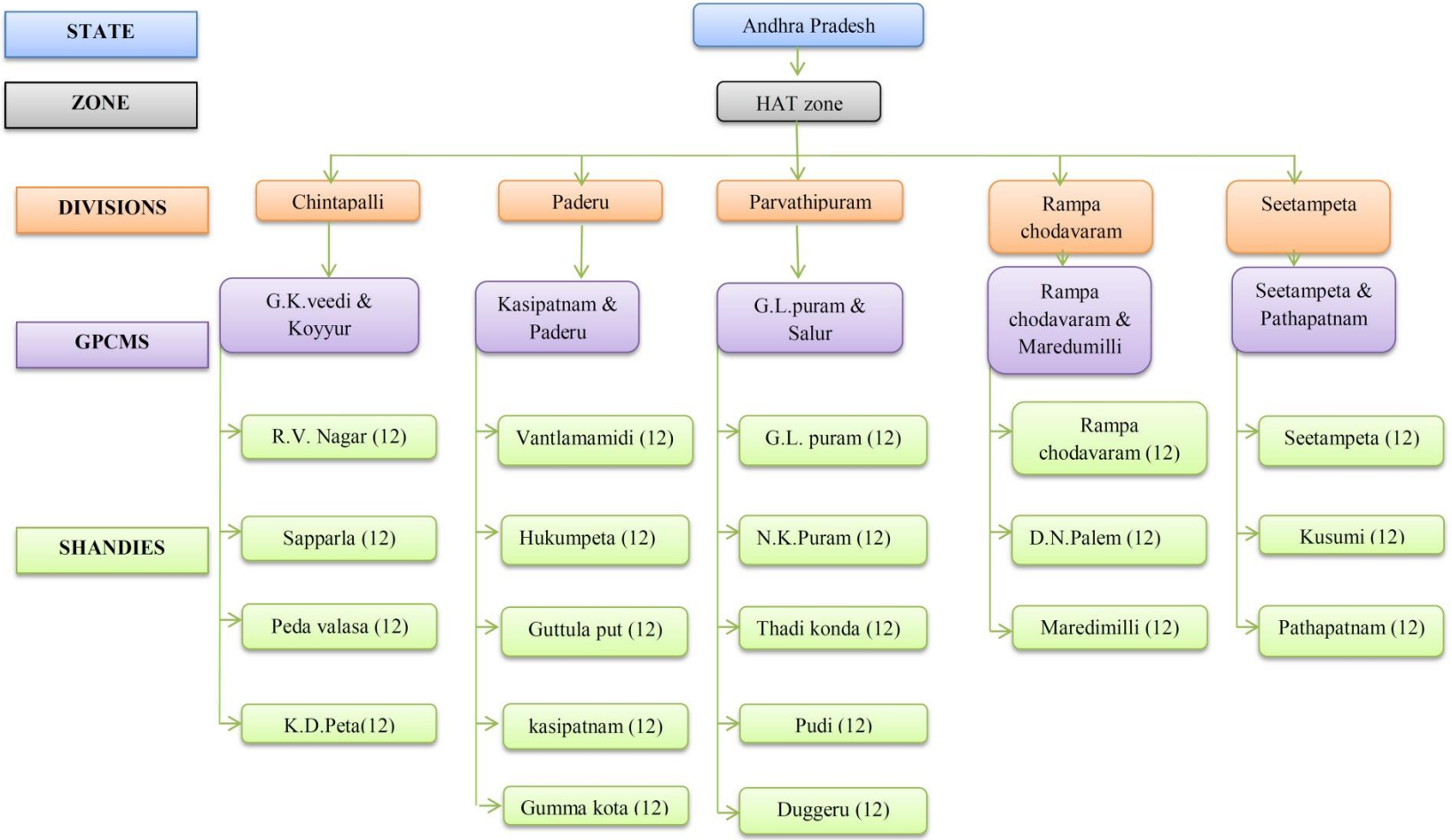

Fig. 3.3. Sampling design regarding selection of shandies and sample farmers

3.1.6 Selection of Tribal Farmers

The tribal farmers generally transact their MFP in shandies, where they transact the produce to either GPCMS/PPCs or private traders or both depending upon the relative prices offered by these two market players. So, accordingly, two samples were drawn for each MFP transacted by the tribal farmer. Twelve sample farmers/shandy who transact MFP with private traders per each division under GCC were selected randomly and again Twenty four sample farmers per each division under GCC who transact selected MFP with GPCMS/PPCs (Table 3.3). 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.

Table 3.3. Sample farmers transacting selected MFP across PPCs under GPCMS and shandies

S. No.	Division	GPCMS	Shandies	Number of the forest produce (6) * Sample farmers (2)		Shandies + GCC	Division
				Shandies (6*2)	GCC		
1	Chintapalli	G.K. Veedi	1.R.V.Nagar 2.Sapparla 3.Pedavalasa	12 12 12	12+12	48+24	72
		Koyyur	1. K. D. Peta	12			
2	Paderu	Paderu	1.Vantlamamidi 2.Hukum peta 3.Guttula put	12 12 12	12+12	60 +24	84
		Kasipatnam	1.Kasipatnam 2.Gumma kota	12 12			
3	Parvathipuram	Salur	1.Pudi 2.Duggeru	12 12	12+12	60+24	84
		G.L.puram	1.G.L.Puram 2.N.K. Puram 3.Tadikonda	12 12 12			
4	Rampachodavaram	Rampachodavaram	1.Rampachodavaram 2.D.N.Palem	12 12	12+12	36+24	60
		Maredumilli	1.Maredumilli	12			
5	Seethampeta	Seetampeta	1.Seetampeta 2.Kusimi	12 12	12+12	36+24	60
		Pathapatnam	1.Pathapatnam	12			
	5	10	20	240	120		360

3.1.7 Selection of Traders

Traders purchasing the MFP in the market are selected randomly, n = 120 (@ 20 traders per each commodity) on random basis to elicit the requisite data about the sources, awareness and utilization of market information in HAT zone.

3.1.8 Selection of Managers

All the Managers working in 10 GPCMSs and five divisional Managers of GCC were selected for this study to elicit relevant information pertaining to the MIS infrastructure and utilization by the tribal farmers at various PPCs, GPCMS and divisional levels in the HAT zone of Andhra Pradesh.

3.2 COLLECTION OF DATA

3.2.1 Primary Data

Primary data are collected from sample farmers, traders and GCC officials. From sample farmers transacting MFP through PPCs under GPCMS and shandies, data are collected pertaining to different sources of market information at village level and market level, awareness on market information, collection and documentation of market information, mode and frequency of dissemination, pattern of utilization and benefits of market information, determinants of utilization of market information, market arrivals and prices of MFP in HAT zone, constraints in dissemination of market information, suggestions to promote effective MIS in HAT zone and other relevant information. Similar information or data are obtained from sampled traders. Informal discussions are held with PPCs, GPCMS and GCC officials to elicit the information pertaining to MIS. The surveys are conducted by interview and recall memory method with the help of pretested and well-structured schedule.

3.2.2 Secondary Data

General information about study area and data pertaining to annual arrivals and prices of selected MFP *i.e.* hill broom, honey, markingnut, myrobalan, naramamidi bark and seeded tamarind are collected from GPCMSs, divisional level offices and GCC head office, Visakhapatnam. Relevant information obtained from agricultural department and AP forest department.

3.3 TOOLS OF ANALYSIS

Following tools and techniques was used to analyze the research data

3.3.1 Descriptive Statistics

3.3.2 Compound Growth Rates (CGRs)

3.3.3 Probit Model

3.3.4. Multiple Linear Regression Model (MLRM)

3.3.5. Propensity Score Matching (PSM)

3.3.6 Garrett's Ranking Technique

3.3.1 Descriptive Statistics

Descriptive statistics such as frequency, percentage and mean were used to draw meaningful relevant information from the collected data.

3.3.2 Compound Growth Rates (CGRs)

Annual CGRs of market arrivals and prices of selected MFP were calculated by using log linear function (Dandekar, 1980: Singh *et al.* 2001).

$$Y_t = A(1+r)^t$$

where, Y = the value for which growth rate is to be calculated; t= time in years; r= growth rate.

Taking log on both sides of above equation,

$$\text{Log } Y_t = \log A + t \log (1+r)$$

Putting Log Y_t = Y, log A = a and log (1+r) = b

$$Y = a + bt$$

$$1 + r = \exp^b$$

Finally, the CGRs is estimated by the following equation:

$$r = (\exp^b - 1)*100$$

3.3.3 Probit Model

Probit model was used to analyze the factors affecting the use of MIS in the HAT zone and to highlight their significant effects on the probability of using MIS by the tribal farmers. According (Egbetokun and Omonona, 2012), the Probit model can be computed from the standard normal cumulative distribution function. This model is a statistical probability model with two categories in the dependent variable. That is, the binary dependent variable, Utilization of MIS ie., MIS_U takes on the values of zero and one. The Probit analysis provides statistically significant findings of which demographics increase or decrease the probability of MIS_U. In this binary Probit model, the preference of the farmer to utilize MIS was taken as '1', and '0' otherwise. It is assumed that the i^{th} farmer obtains maximum utility, if he/she transact MFP through utilizing market information offered by the GPCMS/PPCs rather than non-utilizing the same information.

The probability P_i of choosing any alternative over not choosing it can be expressed as in (1), where φ represents the cumulative distribution of a standard normal random variable:

$P_i = \text{prob}[Y_i=1|X] = \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp(-\frac{t^2}{2}) d = \Phi(x_i'\beta)$ ——————————— (1)

Considering the variables selected (Table 3.4), the Probit model formulated in this study is as given below:

$P(0, 1) = MIS_U = \beta_0 + \beta_1 SEX + \beta_2 EDU + \beta_3 EXP + \beta_4 TR + \beta_5 PI + \beta_6 RADIO + \beta_7 TV + \beta_8 SMS + \beta_9 WEB + \varepsilon_i$

where, MIS_U = Decision regarding utilization of MIS by the tribal farmer in transacting MFP, which can take the value of '1' if the farmer utilized or '0' if he/she do not.

The relationship between a specific variable and the outcome of the probability is interpreted by means of the marginal e*ff*ect, which accounts for the partial change in the probability. The marginal e*ff*ect associated with continuous explanatory variables X_k on the probability P (Yi = 1 | X), holding the other variables constant, can be derived as follows:

$\frac{\partial P_i}{\partial x_{ik}} = \Phi(x_i'\beta)\, \beta_k$ ——————————— (2)

Where, φ represents the probability density function of a standard normal variable.

The marginal e*ff*ect on dummy variables should be estimated di*ff*erently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal e*ff*ect when evaluating the influence of a dummy variable. Such an e*ff*ect can be derived from the following:

$\Delta = \Phi(\bar{x}\beta, d = 1) - \Phi(\bar{x}\beta, d = 0)$ ——————————— (3)

The marginal e*ff*ects provide insights into how the explanatory variables shift the probability of MIS_U for transacting MFP. The marginal e*ff*ects were calculated for each variable, while holding other variables constant at their sample mean values.

Table 3.4. Description of the variables in the Probit model for MIS_U

Variable	Variable Name	Variable type	Variable measurement
Dependent Variables			
MIS_U	Utilization of MIS	Dummy	1 if farmer utilized market information received from PPCs in transacting MFP, 0 otherwise
Independent 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
EXP	Experience	Continuous	Number of years engaged in collection of MFP
TR	Trainings received on importance of MIS	Dummy	1 if farmer received trainings on importance of MIS, '0' otherwise
PI	Timely dissemination of price information about MFP	Dummy	1 if dissemination of PI is timely, '0' otherwise
RADIO	Information received from Radio	Dummy	1 if farmer has access to radio, '0' otherwise
TV	Information received from television	Dummy	1 if farmer has access to television, '0' otherwise
SMS	Messages received in mobile	Dummy	1 if farmer has access to SMS messages on market prices, '0' otherwise
WEB	Price information provided in website of GCC	Dummy	1 if farmer has access to web information on market prices, '0' otherwise

Probit model was again employed to analyze the determinants (Table 3.5) of prices realized by the farmers (relative to prices prevailing in shandies) in transacting the produce through GPCMS/PPCs.

Table 3.5. Determinants of prices for selected MFP in GPCMS/PPCs

Variables	Variable type	Prices
Dependent Variable	Dummy variable	Probability of getting remunerative prices for MFP in GPCMS/PPCs (relative to prices prevailing in shandies) (1 if realized remunerative prices, '0' otherwise)
Independent Variables		
X_1	Dummy variable	Access to information about market prices in time (1 if enjoy access to MIS, '0' otherwise)
X_2	Dummy variable	Availability of storage facilities in GPCMS/PPCs (1 if available, '0' otherwise)
X_3	Dummy variable	Availability of grading facilities in GPCMS/PPCs (1 if available, '0' otherwise)
X_4	Dummy variable	Availability of transportation facilities to GPCMS/PPCs in right time (1 if available, '0' otherwise)
X_5	Continuous	Investment on MIS in GPCMS/PPCs (Rs)

Considering the variables selected (Table 3.5), the Probit model is formulated as below:

$$P(0, 1) = MP = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \text{ ———————— (4)}$$

where, MP = Probability of getting remunerative prices for MFP in GPCMS/PPCs (relative to prices prevailing in shandies, which can take the value of '1' if the farmer realized remunerative price or '0' if he do not.

3.3.4 Multiple Linear Regression Model (MLRM)

MLRM was carried out to analyze the factors determining strengthening of infrastructure (MIS) in GPCMS/PPCs and market arrivals of selected MFP in GPCMS/PPCs. Each model included one dependent variable and five explanatory variables. The following linear model was employed for the analyses:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu_i \text{ ——————(5)}$$

In the above models, β_0 is the intercept term, giving average effect of Y when all the included variables were absent. The stochastic terms μ_i and ε_i reflect intrinsic randomness in the data of respective models. β_1 to β_5 are partial regression coefficients. The partial regression coefficient, (β_1 to β_5) measures change in the mean value of Y per unit change in X_i holding other variables constant.

Table 3.6. Determinants for strengthening infrastructure (MIS) and Market arrivals in selected GPCMS/PPCs

Variables	Strengthening MIS	Variable type	Market Arrivals	Variable type
Dependent Variable (Y)	Investments made on strengthening MIS (Rs)	Continuous	Quantity of market arrivals of MFP in GPCMS/PPCs (Quintals)	Continuous
Independent Variables				
X_1	Quantity of market arrivals of MFP (Quintals)	Continuous	Rainfall (mm)	Continuous
X_2	Number of farmers participated in selling MFP in GPCMS/PPCs	Continuous	Remunerative prices realized for MFP in GPCMS/PPCs (relative to prices prevailing in shandies) (1 if realized remunerative prices, '0' otherwise)	Dummy variable
X_3	Number of buyers participated in transactions at GPCMS/PPCs	Continuous	Timely market information from GPCMS/PPCs (1 if there is information, '0' otherwise)	Dummy variable
X_4	Funds received from GCC (Rs)	Continuous	Availability of good road facility to GPCMS/PPCs (1 if available, '0' otherwise)	Dummy variable
X_5	Availability of physical amenities like pucca building, internet connectivity etc. (1 if available, '0' otherwise)	Dummy variable	Prompt payment of sales proceeds (1 if there is prompt payment, '0' otherwise)	Dummy variable

3.3.5 Propensity Score Matching (PSM)

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 stratified into treated and untreated based on the access to market information from GPCMS/PPCs officials. Thus, a representative sample of 360 farmers (comprising of 120 treated and 240 untreated) are selected from HAT zone. Across the selected MFP, the selected treated and untreated categories of farmers are given in Table 3.7.

Table 3.7. Number of treated and untreated categories of farmers across selected MFP

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 analyze the impact of MIS on prices realized for selected MFP transacted by tribal farmers. In this technique, each farmer of treated category is matched with the farmer of untreated category based on the observable covariates (Table 3.8). This will facilitate to assign the treatment randomly across the two categories to analyze the average differences in prices. The PSM can be expressed as:

$$p(X) = Pr\,[D = 1|X] = E[D|X];\ p(X) = F\{h(X_i)\}, \quad \text{——————————} \quad (6)$$

Where, p(X) is a propensity score and Pr is the probability of receiving market information (treated farmer will receive the value of '1', and '0' otherwise) conditional on the vector of covariates mentioned earlier. Probit model (Equation 7) was employed to estimate the predicted probabilities (propensity scores) of receiving market information (Greene, 2003; Verbeek, 2008; Willy *et al.*, 2014):

$$\Pr(D = 1|X) = G(z) = \int_{-\infty}^{X'\beta} \emptyset(z)dZ = \phi(X'\beta) \quad \text{(7)}$$

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 3.8. 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 analyze the sensitivity of the estimated ATT to unobserved confounders (Rosenbaum, 2002 and Rosenbaum and Rubin, 1983).

3.3.6 Garrett's Ranking Technique

Garrett's ranking test was employed to identify the constraints faced by the farmers regarding implementation of MIS by the GPCMS/PPCs in HAT zone. The major prevailing constraints highlighted during preliminary survey were arranged in ascending order and were converted into ranks by using Garrett's formula. Accordingly, these ranks were converted to scores by referring to Garrett's table. Garrett's formula for converting ranks into percent is given by:

$$\text{Percent position} = \frac{100^* (R_{ij} - 0.50)}{N_j}$$

where, R_{ij} = Rank given for i^{th} item by j^{th} farmer; N_j = Number of items ranked by j^{th} farmer; 0.5 subtracted from R_{ij} as rank is an interval on a scale and its mid-point best represents an interval.

The per cent position of each rank was converted into scores referring to the table given by (Garrett and Woodworth, 1969). For each constraint, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores was added. These mean scores for all the constraints were arranged in descending order; the constraints were accordingly ranked.

3.4 CONCEPTS AND TERMS USED IN THE STUDY

Minor Forest Produce: The forest produce other than timber and wood are called "minor forest produce".

GCC: It is a statutory body established in 1956 for offering fair prices to the MFP collected by the tribal farmers.

PPC: To procure MFP and Agricultural produce from tribals by establishing PPCs and paying them remunerative prices curbing exploitation by preventing distress sale and forces sale of their produce.

GPCMS: They procure and sell the minor forest produce and agricultural produce, disbursing and recovering seasonal agricultural loans and consumption credit from the Girijans.

Shandy: These are the places where the rural consumers congregate periodically, held on a particular day of every week.

HAT Zone: High Altitude and Tribal Zone consist of tribal areas spread in Srikakulam, Vizianagaram, Visakhapatnam and East Godavari under special agro climatic zone.

Tribe: A tribe is a group of bands occupying a contiguous territory or territories and having a feeling of unity deriving numerous similarities in culture, frequent contacts and a certain community of interest.

Market: According to Gupta market means a social institution which performs activities and provides facilities for exchanging commodities between buyers and sellers.

MIS: It is a process of gathering, processing, storing and using information to make better marketing decisions and to improve marketing exchange.

Agricultural marketing: According to Richard, L. Khols and Joseph W. Uhl, agricultural marketing is the performance of all business activities involved in the flow of goods and services from point of initial agricultural production until they are in the hands of the ultimate consumer.

Prices: Value of produce expressed in terms of money

Propensity Score Matching (**PSM**): It is a statistical matching technique that attempts to estimate the effect of a treatment, policy, or other intervention by accounting for the covariates that predict receiving the treatment. PSM

attempts to reduce the bias due to confounding variables that could be found in an estimate of the treatment effect obtained from simply comparing outcomes among units that received the treatment versus those that did not.

Nearest Neighbor Matching (**NNM):** It is also known as greedy matching. It involves running through the list of treated units and selecting the closest eligible control unit to be paired with each treated unit.

Kernel – Based Matching (KBM): It is the closer the treated and untreated observations are based on the propensity score, the larger weight is given to the untreated observation. Thus, the more "similar" the untreated observations are to the treated observations, the more weight they are given.

Radius Matching (RM): In this matching each treated unit is matched only with the control unit whose propensity score falls in a predefined neighborhood of the propensity score of the treated unit.

Probit model: A probit model (also called probit regression), is a way to perform regression for binary outcome variables. Binary outcome variables are dependent variables with two possibilities like yes/no, positive test result/negative test result or single/not single. The word “probit” is a combination of the words probability and unit; the probit model estimates the probability a value will fall into one of the two possible binary (*i.e*. unit) outcomes.

Chapter – IV

Results and Discussion

Chapter IV

RESULTS AND DISCUSSION

This chapter presents the analytical findings and discussion pertaining to the objectives and methodology outlined in the previous chapters.

4.1 Descriptive statistics of respondents

4.2 Sources of market information to farmers and traders at village level and market level

4.2.1 Awareness on market information

4.2.2 Collection and documentation of market information

4.3 Mode and frequency of dissemination

4.3.1 Pattern of utilization and benefits of market information to farmers and traders

4.3.2 Factors determining the use of MIS in the HAT zone

4.4 CGRs for arrivals and prices of selected MFP

4.5 Determinants of infrastructure (MIS), arrivals and prices of MFP in GPCMS/PPCs

4.5.1 Determinants of infrastructure (MIS)

4.5.2 Determinants of market arrivals of selected MFP

4.5.3 Determinants of market prices of selected MFP

4.5.4 Impact of MIS on prices realization for selected MFP

4.6 Constraints to implementation of MIS

4.1 DESCRIPTIVE STATISTICS OF RESPONDENTS

The descriptive statistics of sample tribal farmers presented through Table 4.1 indicated that the average age of the farmers was about 48 years with a family of 5 members. Around 57 per cent of selected tribal farmers are women involved in collection and transacting MFP in HAT zone and

remaining 43 per cent are men. It is disappointing that 50 per cent of the farmers were illiterates, 21 per cent of them had been to a primary school and only nine per cent had college education. It was observed that 62 per cent of sample farmers are engaged both in farming and collection and sale of MFP and the informal discussions held with the sample farmers revealed that they transact their produce through mutual negotiations with GPCMS/PPC officials and private traders working in shandies.

Table 4.1. Socio-economic characteristics of sample farmers (n = 360)

S. No.	Characteristics	Number	Percentage
1	Average age (Years)	48.24	-
2	Sex		
	a. Male	155	43.06
	b. Female	205	56.94
3	Education		
	a. Illiterate	181	50.27
	b. Primary	74	20.56
	c. Higher	72	20.00
	d. Collegiate	33	9.17
	Total	360	100.00
4	Average family size		
	a. Male	1.65	31.67
	b. Female	1.05	20.15
	c. Children	2.51	48.18
	Total	5.21	100.00
5	Occupation		
	a. Collection of MFP	74	20.56
	b. Farming + Collection of MFP	225	62.50
	c. Collection of MFP + Other business	61	16.94
	Total	360	100.00
6	Ownership of audio-visual communication systems		
	Radio	179	49.72
	Television	257	71.39
	News papers	121	33.61
	Magazines	52	14.44
	Mobile phone	288	80.00
	Internet	37	10.28

Note: The percentages do not add up to 100 due to multiple or no response

Eighty per cent of the farmers owned a mobile phone, 71 per cent of owned a television and around 50 per cent of the farmers owned radio as major communication systems for receiving the market information. Only 34, 14 and 10 per cents of sample farmers subscribed for newspapers, magazines and internet for accessing the market information. In HAT zone, the existing MIS was regulated by GCC with its Head Office located at Visakhapatnam. It had wide range of network for their operations and dissemination of market information with help of divisional office, GPCMS and PPCs.

4.2 SOURCES OF MARKET INFORMATION TO FARMERS AND TRADERS AT VILLAGE LEVEL AND MARKET LEVEL

Table 4.2 explains the sources of market information at village level indicated that mobile phone (77%), co-farmers (70%), television (49%) and relatives (42%) were the general sources for sample farmers. With the advent of mobile network since past one decade, this source has gained momentum over television in HAT zone. The farmers continue to depend on co-farmers to receive the market information on mutual trust basis. The farmers depend lesser extent on the institutional agency at village level *viz.*, Gram panchayat office (13%) in accessing market information displayed on the notice boards.

Table 4.2. Sources of market information to tribal farmers at village level in HAT zone (n = 360)

S. No.	Sources	Number	Percentage
1	Gram panchayat office	47	13.06
2	Co-farmers	252	70.00
3	Relatives	151	41.94
4	Radio	43	11.94
5	Television	175	48.61
6	Mobile Phone (SMS)	277	76.94
7	News Papers	66	18.33
8	Magazines		
	a. Annadata	23	6.39
	b. Rythu Nestham	13	3.61

Note: The percentages do not add up to 100 due to multiple or no response

However, at market level (Table 4.3) display boards in GPCMS/PPCs are the most sought among different market information sources (91%) followed by announcements at GPCMS/PPCs (46%) and traders (44%) for the sample farmers. The farmers even enjoyed a fair relationship with traders to elicit market information to compare relative prices offered by GPCMS/ PPC and at local shandies.

Table 4.3. Sources of market information to tribal farmers at market level in HAT zone (n = 360)

S. No.	Sources	Number	Percentage
1	Display boards in GPCMS/PPCs	328	91.11
2	Announcements at GPCMS/PPCs	167	46.39
3	Traders	160	44.44
4	Website of GCC	11	3.06
5	Bulletins of GPCMS	96	26.67
6	Market intelligence cell in GPCMS	41	11.39

Note: The percentages do not add up to 100 due to multiple or no response

Regarding traders (Table 4.4), at village level mobile phones (92%), good number (88%) access the market information through Gram panchayat office (unlike farmers) and television (67.5%) sources.

Table 4.4. Sources of market information to traders at village level in HAT zone (n = 120)

S. No.	Sources	Number	Percentage
1	Gram panchayat office	106	88.33
2	Radio	53	44.17
3	Television	81	67.50
4	Mobile Phone (SMS)	110	91.67
5	News Papers	61	50.83
6	Magazines		
	a. Annadata	18	15.00
	b. Rythu Nestham	11	9.17

Note: The percentages do not add up to 100 due to multiple or no response

At market level (Table 4.5), traders also access the market information mainly through display boards in GPCMS/PPCs (96%). They also enjoy access through announcements in GPCMS/PPCs (89%), fellow traders (76%) and bulletins frequently published by GPCMS (51%), unlike the farmers. Thus, besides Government sources (GPCMS/PPCs/website/bulletins), contacts with fellow traders also found as major sources of market information on arrivals and prices among traders. It is interesting that, besides informal sources, traders are accessing marketing information through Government publications, market intelligence cell *etc.*

Table 4.5. Sources of market information to traders at market level in HAT zone (n = 120)

S. No.	Sources	Number	Percentage
1	Display boards in GPCMS/PPCs	115	95.83
2	Announcements in GPCMS/PPCs	107	89.17
3	Website of GCC	49	40.83
4	Bulletins of GPCMS	61	50.83
5	Market intelligence cell in GPCMS	54	45.00
6	Fellow traders	91	75.83

Note: The percentages do not add up to 100 due to multiple or no response

4.2.1 Awareness on Market Information

Table 4.6 indicated the awareness of the sample farmers on different components of market information. It is disappointing that, the awareness of farmers on quality and grades of MFP collected (26%) was found to be poor. However, the farmers are highly aware about prices of MFP in local GPCMS/PPCs (89%) and in local shandies (84%) compared to other GPCMS/PPCs (41%) and other shandies (35%). Same is the case with reference to market arrivals *ie.*, farmers enjoy more awareness with reference to local GPCMS/PPCs (52%) and local shandies (76%) compared

to other GPCMS/PPCs (22%) and other shandies (24%). This analysis further highlighted that the farmers are highly price conscious and are relatively more curious about prices in local GPCMS/PPC and local shandy for easy disposable of the collected MFP.

Table 4.6. Farmers awareness on market information (n = 360)

S. No.	Type of market information	Number	Percentage
1	Arrivals in local GPCMS/PPC	186	51.67
2	Arrivals in other GPCMS/PPCs	78	21.67
3	Arrivals in local shandy	275	76.39
4	Arrivals in other shandies	87	24.17
5	Prices in local GPCMS/PPC	320	88.89
6	Prices in other GPCMS/PPCs	146	40.56
7	Prices in local shandy	303	84.17
8	Prices in other shandies	126	35.00
9	Quality and grade of MFP collected	93	25.83

Note: The percentages do not add up to 100 due to multiple or no response

Table 4.7. Traders' awareness on market information (n = 120)

S. No.	Type of market information	Number	Percentage
1	Arrivals in local GPCMS/PPCs	88	73.33
2	Arrivals in other GPCMS/PPCs	69	57.50
3	Arrivals in local shandy	106	88.33
4	Arrivals in other shandies	91	75.83
5	Prices in local GPCMS/PPCs	109	90.83
6	Prices in other GPCMS/PPCs	101	84.17
7	Prices in local shandy	111	92.50
8	Prices in other shandies	106	88.33
9	Quality and grade of MFP in market	71	59.17

Note: The percentages do not add up to 100 due to multiple or no response

Regarding traders (Table 4.7), they gather market information about arrivals and prices of MFP in GPCMS/PPCs and shandies both in local and non-local areas. This facilitates them to procure and transact the MFP in different markets and reap the profits. They are comparatively more aware about different grades and standards of MFP and hence, enjoy higher marketing margins compared to farmers.

4.2.2 Collection and Documentation of Market Information

Table 4.8. Market information documentation in GPCMS/PPCs and Shandies

S. No.	Market Information	GPCMS/PPCs	Shandies
1	Arrivals	✓	✓
2	Prices		
	a. Maximum	✓	✓
	b. Minimum	✓	✓
	c. Modal	✓	✓
3	Quality/grades/ standards	x	x
4	Post-harvest handling	x	x
5	Pattern of packing	x	x
6	Storage facilities available	x	x

Note: '✓' indicates positive response (Yes); 'x' indicates negative response (No)

It is observed from Table 4.8, that market arrivals and prices (maximum, minimum and modal) were the only two major types of market information documented and made available to the farmers on daily basis in GPCMS/PPCs and weekly conducted shandies in the HAT zone. However, no attempt was made in documentation of information like quality / grade standards, post-harvest handling, pattern of packing the produce and availability of storage facilities (in GPCMS/PPCs).

Table 4.9. Mode and level of documentation of market information

S. No.	Mode	GPCMS/PPCs	Shandies
1	Mode of documentation		
	a. Written form	✓	✓
	b. Electronic form	✓	✓
2	Level of documentation		
	a. GPCMS	✓	x
	b. PPC	✓	x

Note: '✓' indicates positive response (Yes); 'x' indicates negative response (No)

The arrivals and prices information were documented both in written form and electronic form (Table 4.9) both at GPCMS and PPCs and also for shandies conducted by the local authorities. The documented information on daily basis in PPCs are compiled and reported on weekly basis to GPCMS and monthly basis to the end user (GCC).

Table 4.10. Nature of personnel involved in documentation of market information

S. No.	Particulars	GPCMS/PPCs	Shandies
1	Number of Personnel	1	1
2	Regularity of employment	1	0
3	Casual / contract worker	1	1
4	Qualification		
	a) Matriculation	0	1
	b) Graduation	1	0
5	Formal Training	1	1
6	Un-trained	0	0
7	No. of MFP covered / person	25	25

Note: '1' indicates presence; '0' indicates absence

A regular and trained employee (data operator) is being involved in documentation of market information in all (Table 4.10), GPCMS/PPCs and GCC. Regarding the qualification, the data operator is a degree holder in GPCMS/PPC, while in shandy, the data operator is a matriculate.

Traditional methods like personal visit to the sale points by the personnel working in PPCs /random checks by GPCMS, personal interactions with farmers and traders were the major methods of collection of market information (Table 4.11) while transacting produce through GPCMS/PPCs. In shandies, the data are maintained only through random checks at sale points. Thus, the data documented at GPCMS/PPCs level is more authentic compared to shandy level. It is disappointing that the advanced Information and Communication Technologies (ICTs) like fax and internet are rarely used as a means for collecting market information.

Table 4.11. Method of collection of market information

S. No.	Method of collection	GPCMS/PPCs	Shandies
1	Personal visit to sale points	✓	✓
2	Telephone/fax	x	x
3	Personal interactions with farmers	✓	x
4	Personal interactions with traders	✓	x

Note: '✓' indicates positive response (Yes); 'x' indicates negative response (No)

4.3 MODE AND FREQUENCY OF DISSEMINATION

There are different modes of dissemination of the market information in HAT zone. The market information was mainly transmitted through notice boards in GPCMS/PPCs, mobile, newspapers and television (Table 4.12). The market information was disseminated daily by GPCMS/PPCs, mobile, newspaper and radio. From GPCMS, the information reaches to GCC official website on daily, weekly, monthly and annual basis. Similarly, the market information was also sent to Andhra Pradesh Forest Department, gram panchayat, local horticulture research stations, Integrated Tribal Development Agency (ITDA) and District Statistical Officer (DSO) once in a year in the form of annual reports.

Table 4.12. Frequency of dissemination of market information

S. No.	Agency / mode	Daily	Weekly	Monthly	Annually
1	GPCMS/PPCs Notice Boards	✓	x	x	x
2	Mobile	✓	x	x	x
3	Newspapers	✓	x	x	x
4	Television (local channels)	x	✓	x	x
5	Radio	x	✓	x	x
6	GCC website	✓	✓	✓	✓
7	A.P. Forest Department	x	x	x	✓
8	Gram Panchayat	x	x	x	✓
9	Horticulture Research Stations	x	x	x	✓
10	ITDA	x	x	x	✓
11	District Statistical Officer	x	x	x	✓

Note: '✓' indicates positive response (Yes); 'x' indicates negative response (No)

4.3.1 Pattern of Utilization and Benefits of Market Information to Farmers and Traders

Table 4.13. Market information utilization by tribal farmers (n = 360)

S. No.	Nature/Type of decision	Number	Percentage
1	MFP to be collected	310.00	86.11
2	Where to sell the MFP (GPCMS/PPCs or Shandy)	248.00	68.88
3	When to sell	35.00	9.72
4	Whom to sell	32.00	8.89
5	Quantity to sell	34.00	9.44
6	Drying	20.00	5.56
7	Grading	11.00	3.06
8	Bagging	12.00	3.33
9	Transportation	11.00	3.06
10	Processing	12.00	3.33
11	Storage	10.00	2.78

Note: The percentages do not add up to 100 due to multiple or no response

A perusal of Table 4.13 indicated that the market information accessed by the farmers enable them in taking timely marketing decisions of MFP. It can be clearly seen that majority of the farmers utilized the market information for deciding the nature of MFP to be collected (86%) followed by place of its sale *ie.,* either at GPCMS/PPCs or in shandy depending upon the relative prices (69%). However, it is disappointing that majority of the farmers were not making use of market information for performing marketing functions (storage, transportation, processing, grading *etc.*) and marketing decisions like when, where and whom to sell the MFP.

Table 4.14. Benefits derived from market information by tribal farmers

(n = 360)

S. No.	Benefits	Number	Percentage
1	By change of place of sale	98.00	27.22
2	By change of time of sale	32.00	8.89
3	Grading of MFP	29.00	8.06
4	Storing of MFP at times of low prices	19.00	5.28
5	Better mode of packaging	18.00	5.00
6	Realizing higher prices	164.00	45.56

Note: The percentages do not add up to 100 due to multiple or no response

The benefits that the farmers derived as per their opinion by utilizing market information are presented in Table 4.14. It was again observed that only few farmers used the market information in performing marketing functions like grading, storage and packaging decision-making. However, the farmers are interested in using the market information for realizing higher prices (46%) followed by changing the place of sale based on the relative prices across GPCMS/PPCs or shandies or across different GPCMS/PPCs or across different shandies (27%).

Table 4.15. Market information utilization by traders (n = 120)

S. No.	Nature/Type of decision	Number	Percentage
1	MFP bought	112	93.33
2	Where to purchase the MFP (GPCMS/PPCs or Shandy)	98	81.67
3	When to buy	104	86.67
4	From whom to buy	99	82.50
5	Quantity to buy	94	78.33
6	Grading	89	74.17
7	Transportation	87	72.50
8	Processing	31	25.83
9	Storage	106	88.33

Note: The percentages do not add up to 100 due to multiple or no response

A perusal of Table 4.15 indicated the extent of market information utilized by traders in decision making. It can be clearly seen that traders mainly utilize the market information to purchase the MFP from farmers preferably at low prices (93%). That is, they also use the market information to plan their purchasing decision *ie.*, 'when to buy' (87%). They even take the decision to stock the produce when the prices are low in the market (88%). Other decisions like 'where to buy' (82%) and 'from whom to buy' (82%) are also taken by the traders based on the collected market information.

4.3.2 Factors Determining the Use of MIS in the HAT Zone

To analyze the factors influencing MIS_U, binary Probit model was employed. This model has been estimated by the maximum likelihood method (Table 4.16). The estimated coefficients and Standard Errors (SEs) revealed the major factors that influence farmers' MIS_U. A statistically significant coefficient suggests that the likelihood of farmer's utilization of market information will increase/decrease as the response of the explanatory variable increases/decreases. The likelihood ratio statistic as indicated by χ^2 is significant ($P < 0.0317$), suggesting that all the model parameters were jointly significant in explaining the dependent variable. The McFadden's Pseudo R^2

was 0.29 suggesting that the model was well-specified. This is in line with (Hensher *et al*., 2005) criterion for best fit model *ie.*, if the value of Pseudo R^2 lies between 0.2 and 0.4, it is considered to be extremely good fit.

Table 4.16. Factors influencing the farmers' MIS_U in HAT zone (n = 360)

Variables	Coefficient	SE	Marginal effect (dy/dx)	Z Cal	P > |z|
SEX	-0.169	0.126	-0.062	-1.344	0.179
EDU	0.002	0.001	0.016**	2.831	0.003
EXP	0.205	0.099	0.075*	2.074	0.038
TR	0.233	0.104	0.084*	2.247	0.024
PI	0.242	0.048	0.088**	5.099	0.000
RADIO	0.019	0.009	0.032*	2.111	0.037
TV	0.171	0.080	0.064*	2.123	0.034
SMS	0.013	0.006	0.011*	2.167	0.027
WEB	-0.132	0.164	-0.049	-0.807	0.419
Constant	0.488	0.320		1.526	0.127
LR χ^2 (9) = 17.96*					
Prob > χ^2 = 0.0317					
Log likelihood = -38.163					
Pseudo R^2 = 0.29					

Note: **-Significant at 1% level; *-Significant at 5% level

Raw Data Source: Field Survey

The results pertaining to the influences of selected explanatory variables revealed that, education status (EDU) and timely dissemination of price information (PI) of MFP are the most important factors that have positively and significantly (at 1% level) influenced the probability of farmers' MIS_U. Similarly, other factors like trainings (TR) received on importance of MIS, experience (EXP) in collecting and transacting MFP, receipt of market information through radio (RADIO), television (TV) and SMS also exerted positive and significant influence on farmers' MIS_U. However, SEX of the individual and WEB had no significant effect on the decisions of farmers to MIS_U.

The marginal effects were also computed to interpret the change in probability of farmers' MIS_U. The Probit results showed that 'education (EDU)' had shown positive and significant (at 1% level) influence on the farmers' decision to utilize MIS in transacting MFP. The marginal effect indicated that the increase in one year of education would increase the probability of farmers' MIS_U by 1.6 per cent. This may be due to the fact that with increase in education among the farmers, they are willing to accept the modern marketing technology (ie., MIS) to earn remunerative prices for their produce. These findings are in consistent with the earlier studies (Feder *et al.*,1985; Awe, 1999) that literacy level positively influenced the adoption of a technology in south western Nigeria and Berkeley, USA, respectively. Timely dissemination of price information (PI) also exerted positive and significant (at 1% level) influence on farmers' MIS_U. The marginal effect implies that timely dissemination of price information would increase the probability of the farmer to transact their MFP at right time by 8.8 per cent to realize remunerative prices. This finding is in line with the findings of (World Bank, 2007) that reported that dissemination of timely market information is one of the fundamental factors in commercializing the smallholder agriculture.

Similarly, 'trainings (TR)' imparted to the farmers on the benefits of MIS also exerted positive and significant influence (at 5% level) on the farmers' MIS_U. The sign and coefficient of the estimate (+0.233*) implies that, if a farmer receives 'training (TR)', the probability of farmers' utilizing market information increases. The marginal effect (0.084) revealed that imparting trainings to the farmers on the benefits of MIS would increase the probability of MIS_U by 8.4 per cent. Thus, the exposure of sample farmers to modern MIS through trainings had positively and significantly influenced their MIS_U in transacting MFP in the study area. This is because, the trainings offered by the extension personnel will act as a trigger mechanism for intensive adoption of MIS technology. Similar findings are noticed in the studies conducted by (Polson and Spencer, 1991; Lawal and Oluyole, 2008; Nkonya *et al.*, 1997 and Onu, 2006) in case of adoption of production technologies by the farmers.

Regarding other factors, the three major information sources viz., radio, television (TV) and SMS have exerted positive and significant (at 5% level) on the farmers' MIS_U. That is, with increased dissemination of market information through above three sources, the farmers' MIS_U will increase by 3.2, 6.4 and 1.1 per cents respectively. This finding is encouraging as the modern technology of market information dissemination *ie.,* SMS has contributed positive influence and this mode of dissemination is relatively more advantageous compared to other two sources (RADIO & TV) in the sense that it is cost-effective, can be accessed at any location, can be analyzed from time to time *etc.* This technology could be a game changer in the future in transacting MFP, as it create opportunities to access information and services through mobile applications, online videos and social media. Sites like Facebook, Twitter and Youtube present a cost-effective means of communication with, and among, tribal farmers and other key stakeholders such as extension officers, wholesale traders, retailers, agricultural researchers and policy makers. This finding is in consistent with the study of (Trendov *et al*., 2019). Further, 'experience (EXP)' of tribal farmers in collection and transaction of MFP also showed positive and significant influence on effect on their MIS_U. The marginal effect imply that every one year increase in experience will increases the probability of the farmers to MIS_U by 7.5 per cent. This means that the long farming (and marketing) experience decreases the probability of being a subsistence farmer because, it insinuates the fact of having good access to modern market information networks and linkages with market players towards transacting the collected MFP. This finding is in line with the findings of (World Bank, 2007) that reported that experience and skills are the fundamental factors in commercializing the smallholder agriculture. However, the present research finding is found contradictory with the earlier findings of (Alene *et al*., 2008; Heltberg and Tarp, 2002) who found that besides being risk averse, older farmers (with more farming experience) are slow in adopting technology which may reduce their production and marketable surplus in Kenya and Mozambique respectively.

However, the Probit results revealed that 'WEB' was found to have negative influence on the probability of farmers' MIS_U and is non-significant. This because, the tribal farmers are largely illiterate and that too with poor internet connectivity (due to high altitude location and weather related issues), they are less interested in viewing the market information disseminated through website of GCC. So, the WEB showed unpredicted negative sign in influencing farmers' MIS_U.

4.4 CGRs FOR ARRIVALS AND PRICES OF SELECTED MFP

CGRs were worked out to analyze the growth in market arrivals and prices of MFP across GPCMS/PPCs of selected divisions in HAT zone during the reference period, 2005-2019 (Table 4.17). It is heartening that CGRs for prices of all selected MFP showed significant (at 1% level) increasing trend except for naramamidi bark in Parvathipuram, Rampachodavaram and Seetampeta divisions. The informal discussions held with the Officials in GPCMS/PPCs revealed that quality standards of produce, large quantum of previous years stocks stocked in godowns and lack of adequate demand from processors are responsible for declining prices of this commodity. In the recent period *ie.*, after 2014, with the strengthening of marketing infrastructure *viz.*, assaying facilities, MIS, link roads from remote villages *etc.*, in the selected divisions, there is increased competition among the buyers that led to price escalation of selected MFP. Further, the relative prices of selected MFP are higher compared to local shandies in view of prompt dissemination of market information and improved assaying facilities. However, it is disappointing that market arrivals of all selected MFP showed significant declining trends across the selected divisions, except for honey in Chintapalli (3.49**) and Pravathipuram (5.46**) divisions; hill broom (1.41**) and myrobalan (10.18**) in Seetampeta division. The informal discussions held with the Officials of at GPCMS/PPCs revealed that fluctuating production due to seasonality, incessant rainfall across the selected divisions, unsustainable harvesting and migration of educated youth away from tribal areas in search

for employment to other districts like Visakhapatnam, Vizianagaram, Srikakulam and East Godavari are mainly responsible for declining market arrivals. The educated youth in tribal areas are showing less interest on the activities of collection and transaction of MFP and hence, only the elderly farmers are still continuing these activities, as they are unable to switch to other occupations in HAT zone. This also adversely affected the market arrivals of selected MFP across the divisions in HAT zone.

Table 4.17. Division-wise CGRs (%) of arrivals and prices of selected MFP in HAT zone (2005-2019)

Division	Hill broom		Honey		Markingnut		Myrobalan		Naramamidi bark		Seeded tamarind	
	Arrivals	**Prices**	**Arrivals**	**Prices**	**Arrivals**	**Prices**	**Arrivals**	**Prices**	**Arrivals**	**Prices**	**Arrivals**	**Prices**
Chintapalli	-6.58**	8.92**	3.49**	5.93**	-8.9**	3.94**	-0.72**	12.69**	-3.74**	2.12**	-19.91**	8.82**
Paderu	-27.47**	12.16**	-3.11**	6.12**	-12.51**	3.4**	-13.09**	11.63**	-7.37**	1.39**	-16.75**	8.82**
Parvathipuram	-19.99**	10.91**	5.46**	5.86**	-17.51**	5.57**	-8.89**	11.28**	-5.18**	-0.13^{NS}	-10.96**	9.84**
Rampachodavaram	-5.18**	8.84**	0.31^{NS}	5.36**	-2.77**	3.62**	-5.86**	11.89**	-2.78**	-0.24^{NS}	-9.76**	9.98**
Seetampeta	1.41**	6.25**	-11.77**	5.91**	-9.22**	4.01**	10.18**	8.72**	-2.49**	-0.93^{NS}	-9.73**	9.39**

Note: ** - Significant at 1% level; NS – Non-Significant

Source: Girijan Co-operative Corporation (GCC)

Though these farmers are trained enough about the marketing infrastructure such as assaying and MIS in GPCMS/PPCs, the declining proportion of workforce engaged in MFP transactions adversely affected the market arrivals of MFP. So, assured market that ensure remunerative prices for MFP, proper supervision from GPCMS/PPC officials, timely dissemination of market information and prompt payment of sales proceeds may contribute for sustaining tribal farmers in this business in the future.

It is interesting to note that figures 4.1 to 4.60 arrivals of selected MFP show decreasing trend mostly, whereas prices showed increasing trend in the HAT zone. A keen observation of the areas surveyed revealed that the arrival status of all the six commodities studied in Paderu division declined over the years, despite having increasing price trends. This could be attributed to conversion of forest cover by the farmers of the locality into Coffee and Black pepper plantations. The high percentage of educated population in this area in comparison to the rest makes easier to speculate the prices and prefers to maximize his profits in the short run. Very few may be privy to the fact that long run sustainability results from the protection of forest cover and biodiversity. This continued scenario keeps them at risk in the long run. Whereas, farmers of Chintapalli prefer to keep their forest cover intact and cultivate Coffee and Black pepper, harmonizing it with their existing vegetation cover. This explains why their arrivals of honey, marking nuts, myrobalan and naramamidi bark are relatively stable. However, the arrivals of hill broom and seed tamarind to the GCC of the division decreased owing to the poor road connectivity in the area. The divisions of Parvathipuram, Rampachodavaram and Seetampeta were characterized by high trader competition, proximity to the plain areas and better road connectivity than the divisions stated earlier. The arrivals of hill brooms, honey and naramamidi bark in Parvathipuram division rose slightly over the years, while the rest three declined. Despite its ups and downs, Rampachodavaram division achieved a relative stability in the arrivals of markingnuts and naramamidi bark. Seetampeta, whose environment is favorable for the grown of naramamidi bark, showed a great increase in the trend of arrivals of the product.

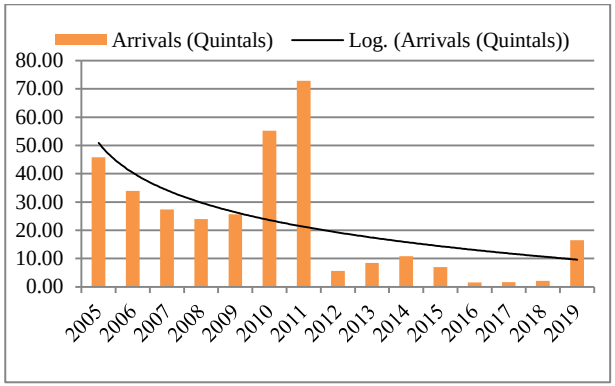

Fig. 4.1. Trends in Hill broom arrivals in Chintapalli division (2005-2019)

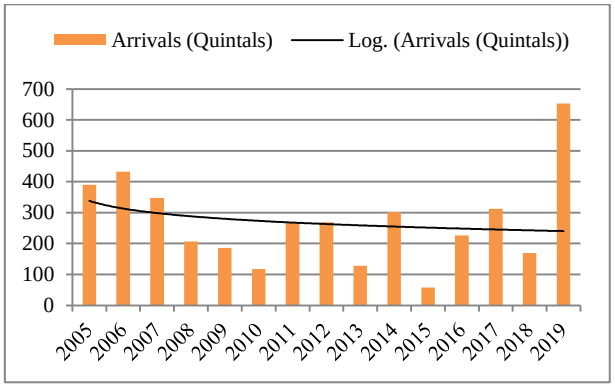

Fig. 4.3. Trends in Honey arrivals in Chintapalli division (2005-2019)

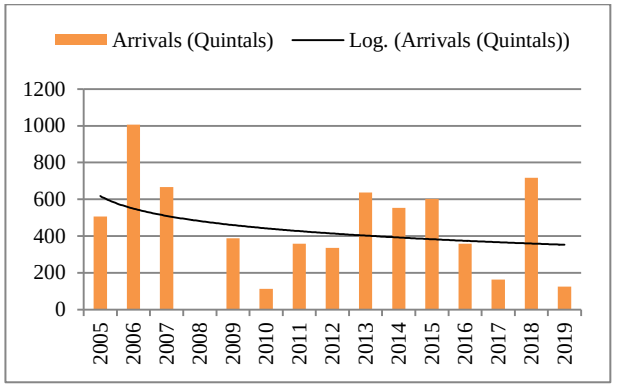

Fig. 4.5. Trends in Markingnut arrivals in Chintapalli division (2005-2019)

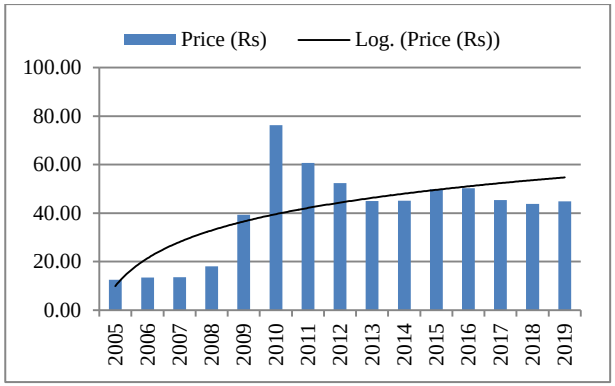

Fig. 4.2. Hill broom trends (Rs/unit) in Chintapalli division (2005-2019)

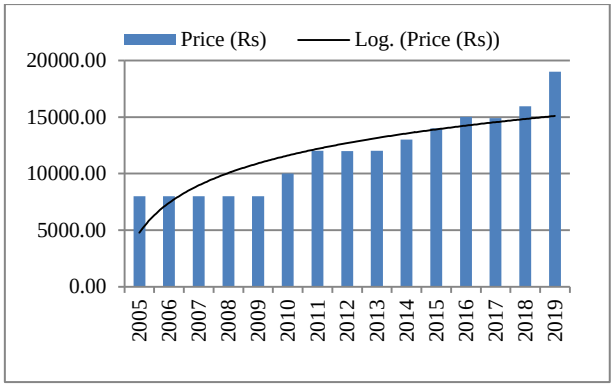

Fig. 4.4. Honey trends (Rs/quintal) in Chintapalli division (2005-2019)

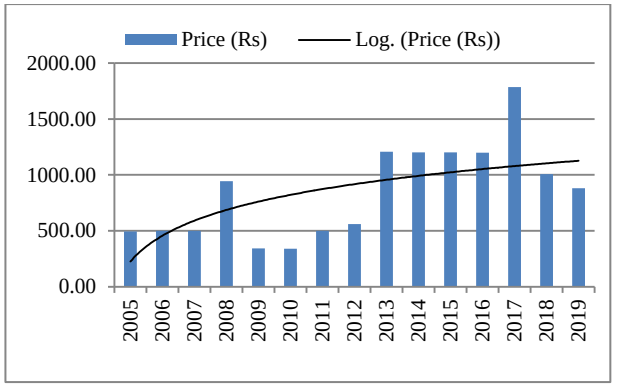

Fig. 4.6. Markingnut trends (Rs/quintal) in Chintapalli division (2005-2019)

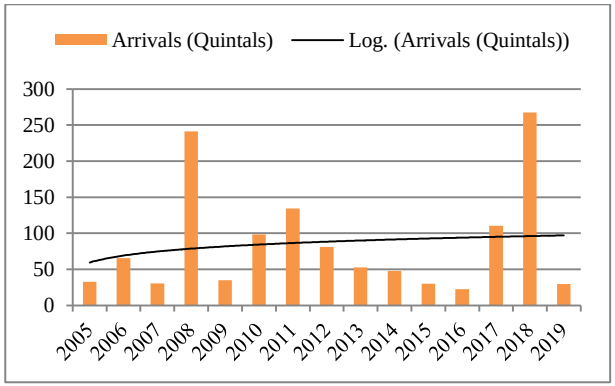

Fig. 4.7. Trends in Myrobalan arrivals in Chintapalli division (2005-2019)

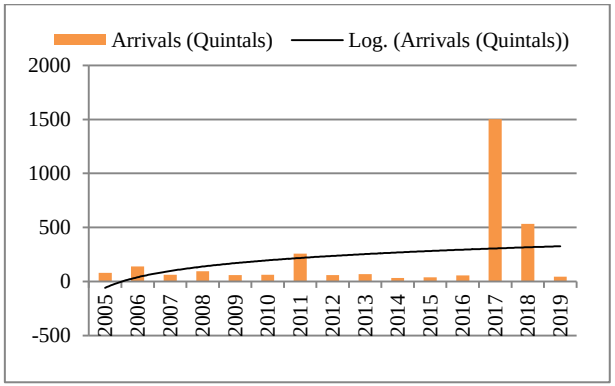

Fig. 4.9. Trends in Naramamidi bark arrivals in Chintapalli division (2005-2019)

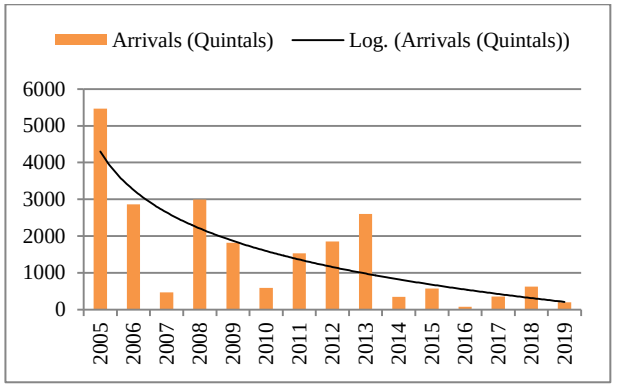

Fig. 4.11. Trends in Seeded tamarind arrivals in Chintapalli division (2005-2019)

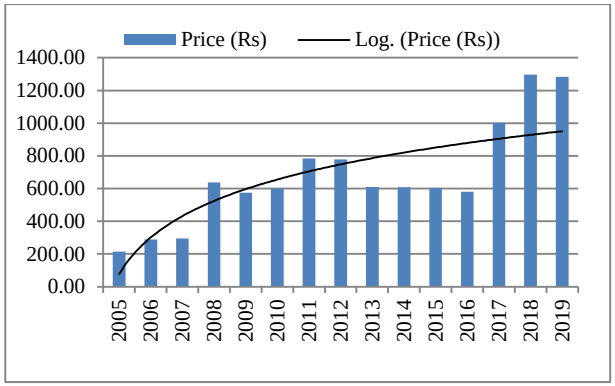

Fig. 4.8. Myrobalan trends (Rs/quintal) in Chintapalli division (2005-2019)

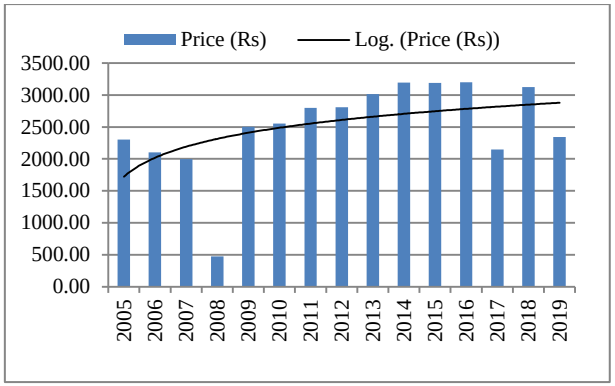

Fig. 4.10. Naramamidi bark trends (Rs/quintal) in Chintapalli division (2005-2019)

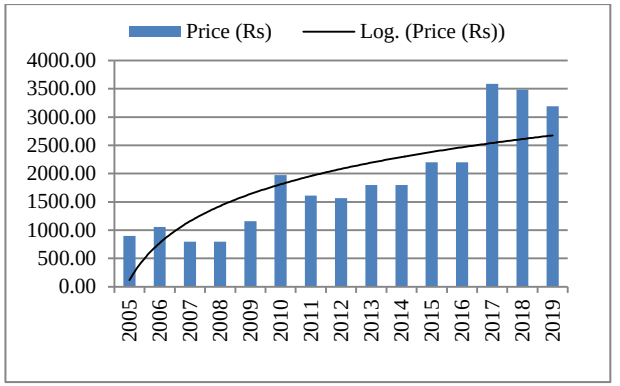

Fig. 4.12. Seeded tamarind trends (Rs/quintal) in Chintapalli division (2005-2019)

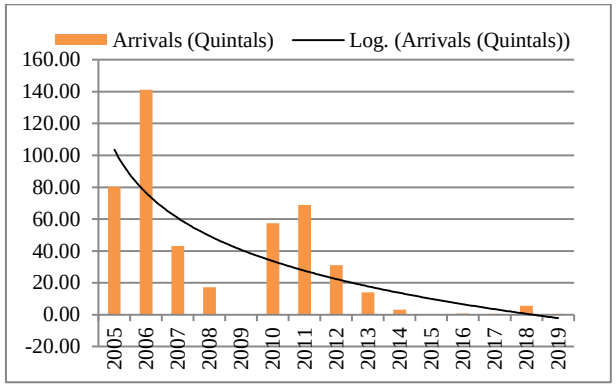

Fig.4.13. Trends in Hill broom arrivals in Paderu division (2005-2019)

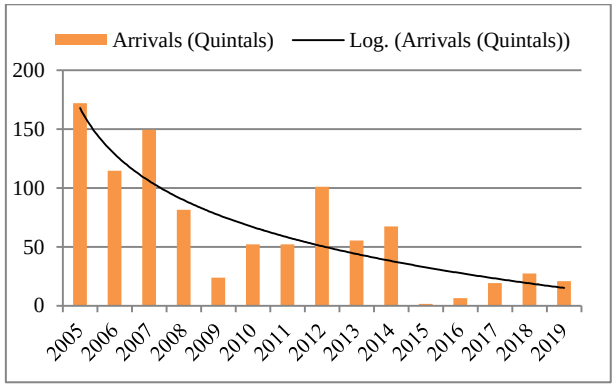

Fig.4.15. Trends in Honey arrivals in Paderu division (2005-2019)

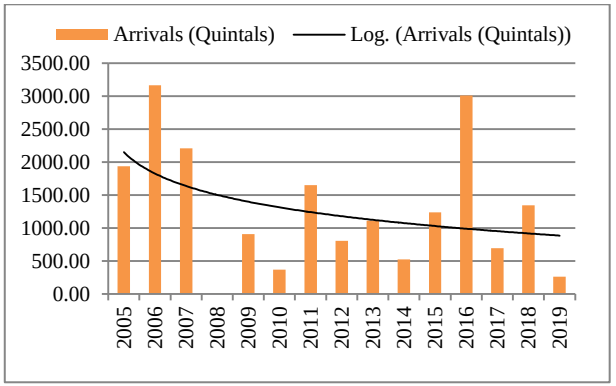

Fig.4.17. Trends in Markingnut arrivals in Paderu division (2005-2019)

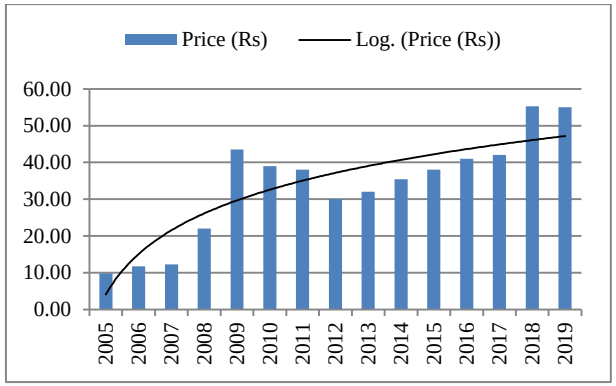

Fig. 4.14. Hill broom trends (Rs/unit) in Paderu division (2005-2019)

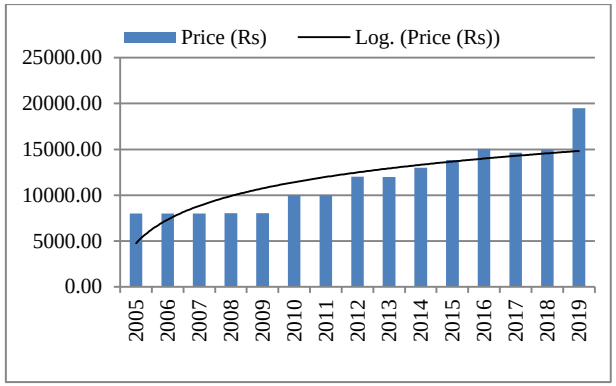

Fig. 4.16. Honey trends (Rs/quintal) in Paderu division (2005-2019)

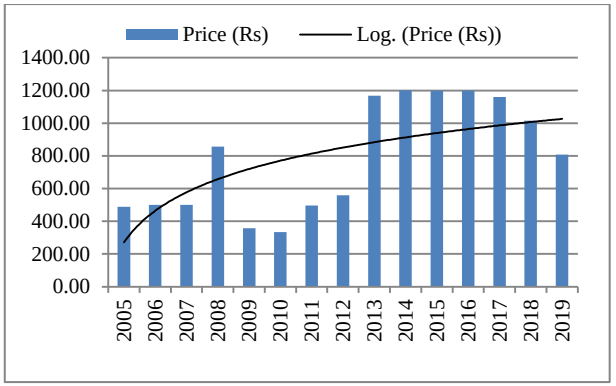

Fig. 4.18. Markingnut trends (Rs/quintal) in Paderu division (2005-2019)

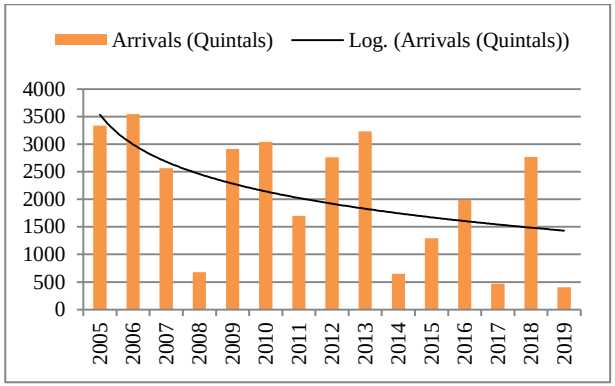

Fig. 4.19. Trends in Myrobalan arrivals in Paderu division (2005-2019)

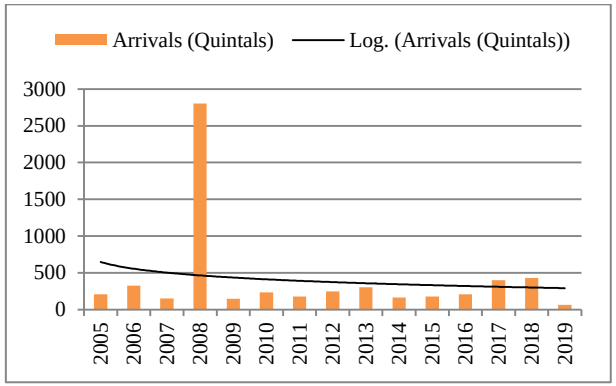

Fig. 4.21. Trends in Naramamidi bark arrivals in Paderu division (2005-2019)

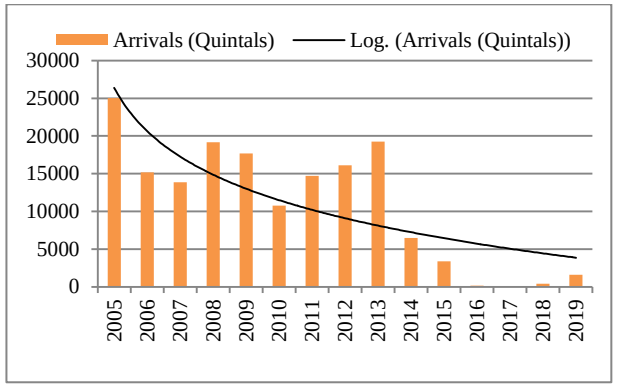

Fig. 4.23. Trends in Seeded tamarind arrivals in Paderu division (2005-2019)

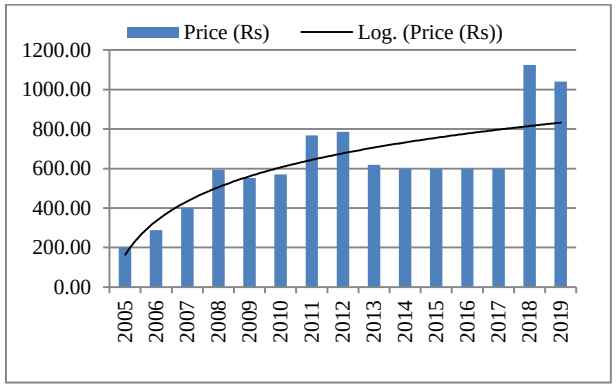

Fig. 4.20. Myrobalan trends (Rs/quintal) in Paderu division (2005-2019)

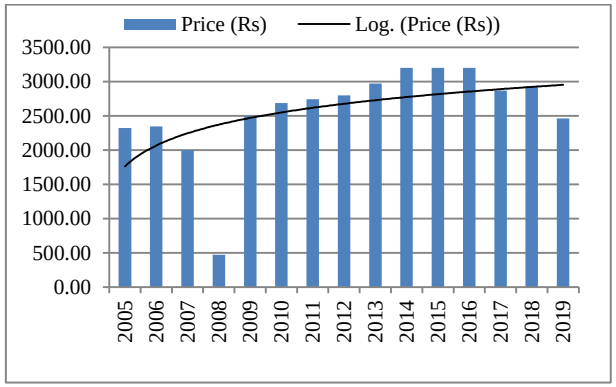

Fig. 4.22. Naramamidi bark trends (Rs/quintal) in Paderu division (2005-2019)

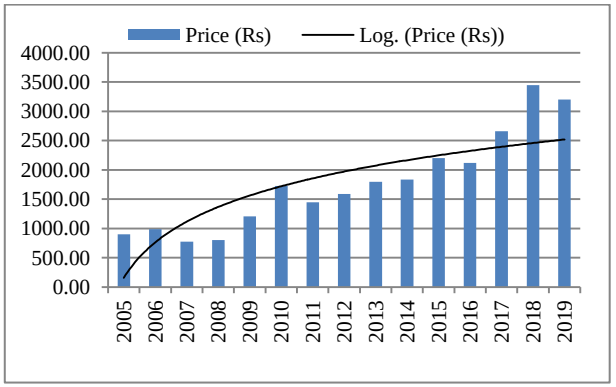

Fig. 4.24. Seeded tamarind trends (Rs/quintal) in Paderu division (2005-2019)

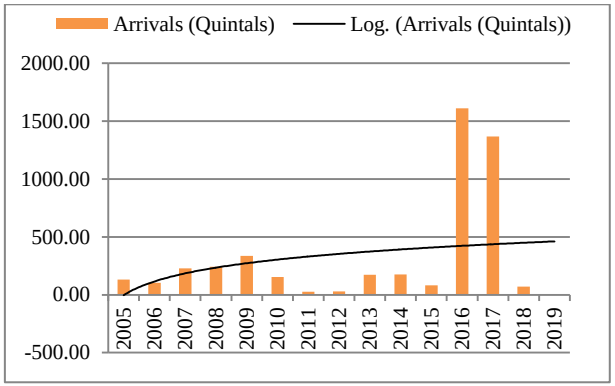

Fig. 4.25. Trends in Hill broom arrivals in Parvathipuram division (2005-2019)

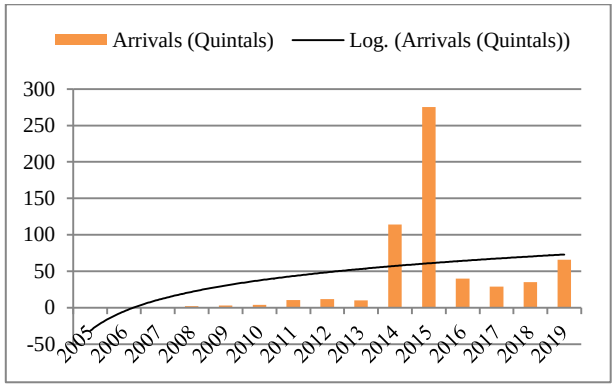

Fig. 4.27. Trends in Honey arrivals in Parvathipuram division (2005-2019)

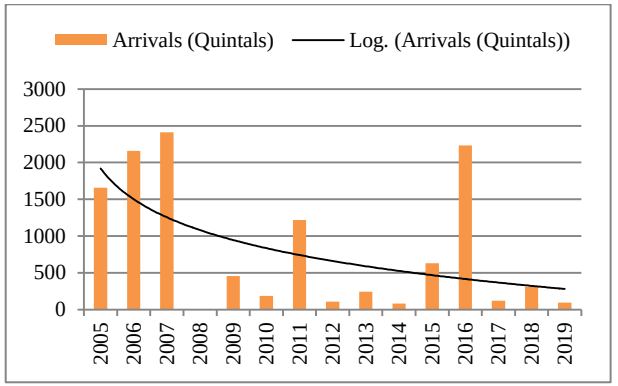

Fig. 4.29. Trends in Markingnut arrivals in Parvathipuram division (2005-2019)

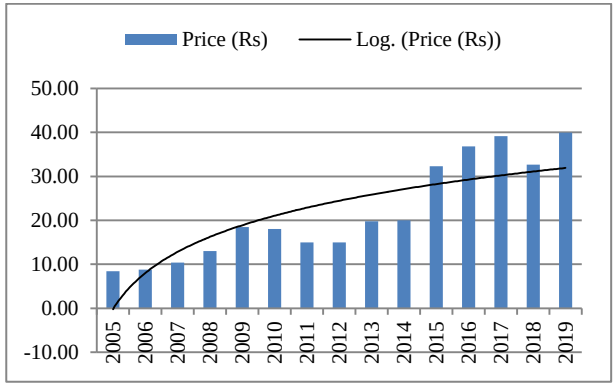

Fig. 4.26. Hill broom trends (Rs/unit) in Parvathipuram division (2005-2019)

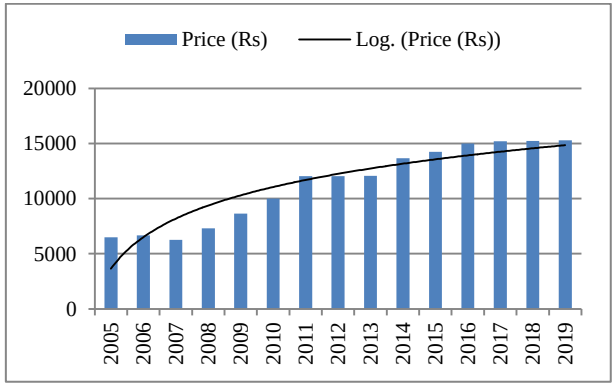

Fig. 4.28. Honey trends (Rs/quintal) in Parvathipuram division (2005-2019)

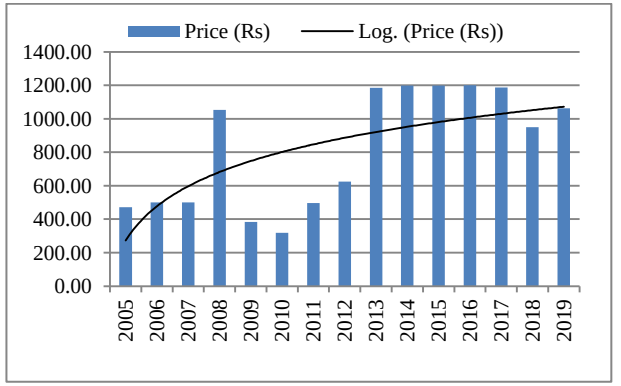

Fig. 4.30. Markingnut trends (Rs/quintal) in Parvathipuram division (2005-2019)

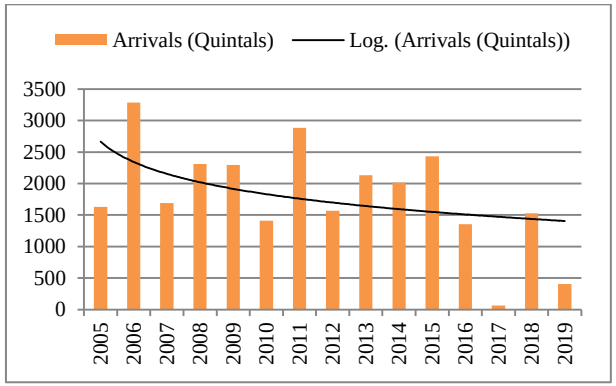

Fig. 4.31. Trends in Myrobalan arrivals in Parvathipuram division (2005-2019)

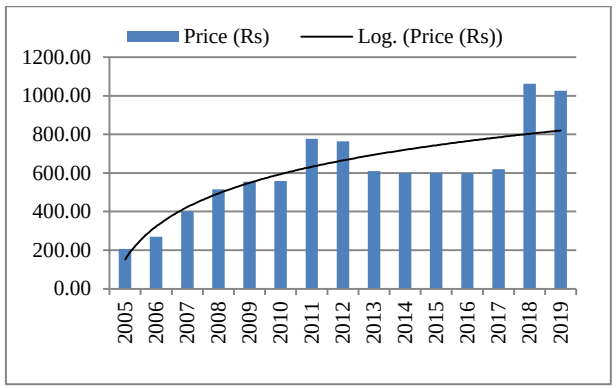

Fig. 4.32. Myrobalan trends (Rs/quintal) in Parvathipuram division (2005-2019)

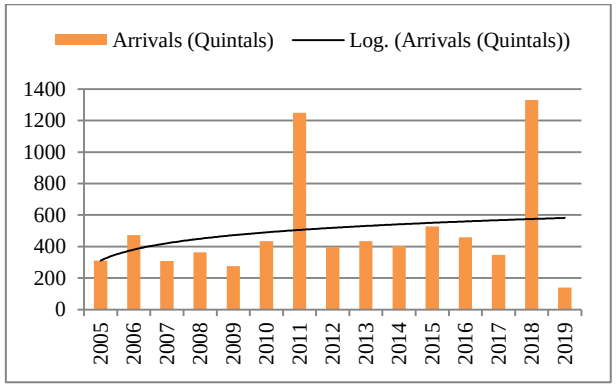

Fig. 4.33. Trends in Naramamidi bark arrivals in Parvathipuram division (2005-2019)

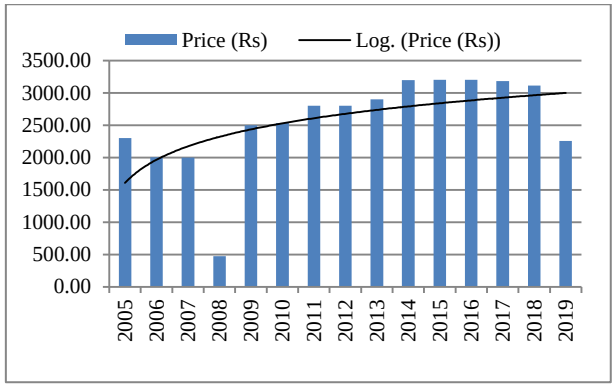

Fig. 4.34. Naramamidi bark trends (Rs/quintal) in Parvathipuram division (2005-2019)

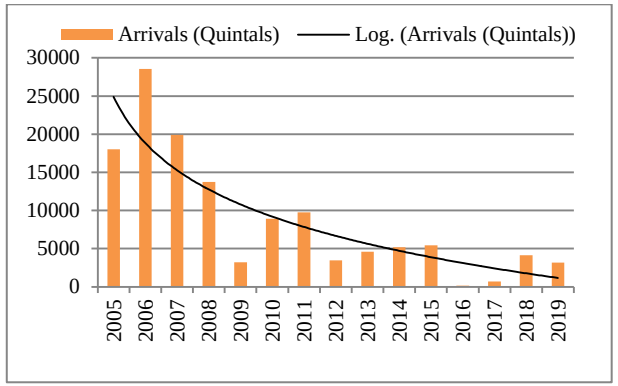

Fig. 4.35. Trends in Seeded tamarind arrivals in Parvathipuram division (2005-2019)

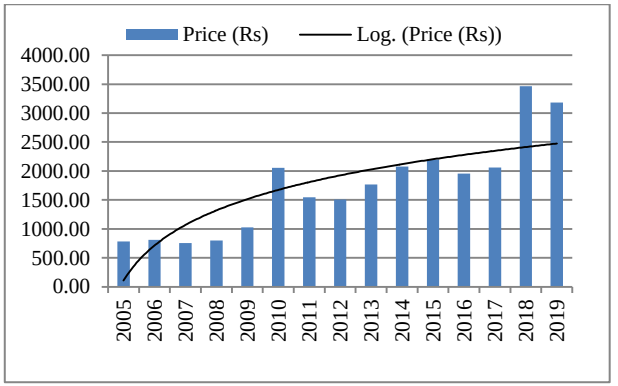

Fig. 4.36. Seeded tamarind trends (Rs/quintal) in Parvathipuram division (2005-2019)

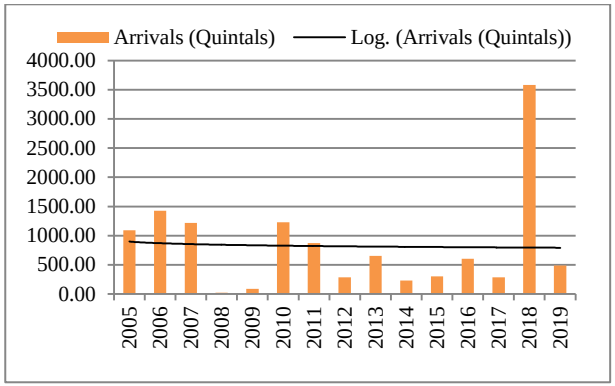

Fig. 4.37. Trends in Hill broom arrivals in Rampachodavaram division (2005-2019)

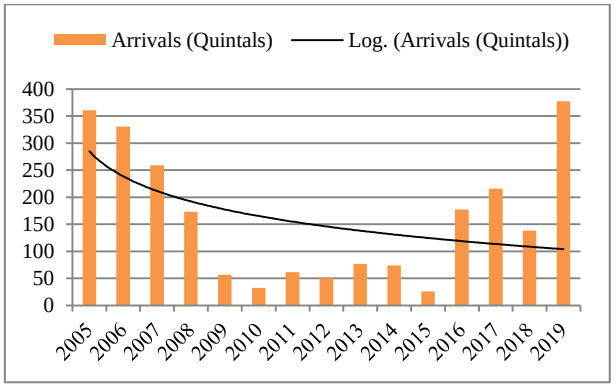

Fig. 4.39. Trends in Honey arrivals in Rampachodavaram division (2005-2019)

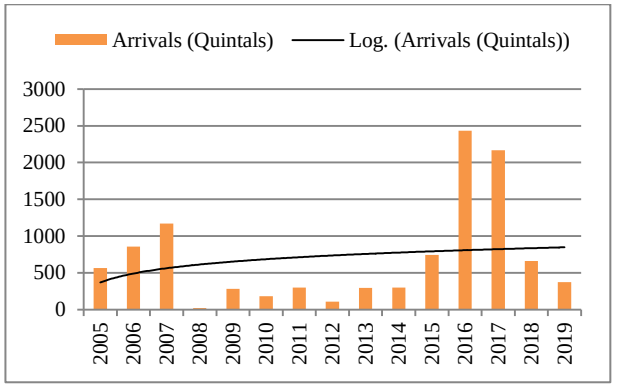

Fig. 4.41. Trends in Markingnut arrivals in Rampachodavaram division (2005-2019)

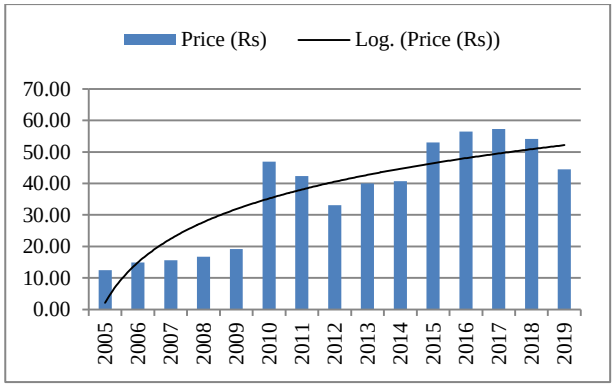

Fig. 4.38. Hill broom trends (Rs/unit) in Rampachodavaram division (2005-2019)

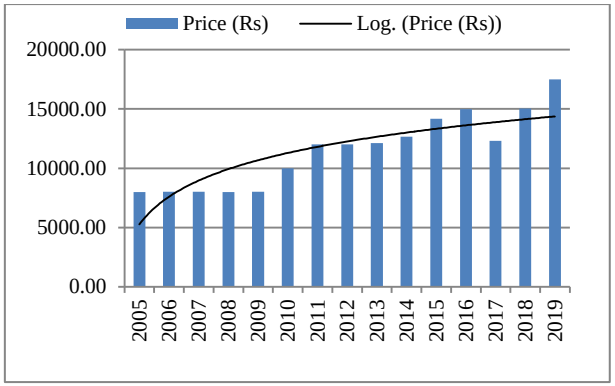

Fig. 4.40. Honey trends (Rs/quintal) in Rampachodavaram division (2005-2019)

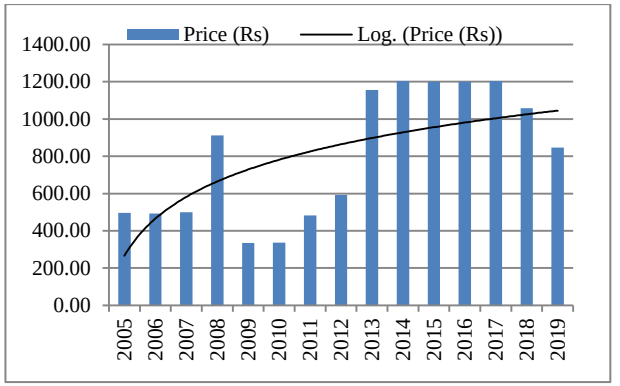

Fig. 4.42. Markingnut trends (Rs/quintal) in Rampachodavaram division (2005-2019)

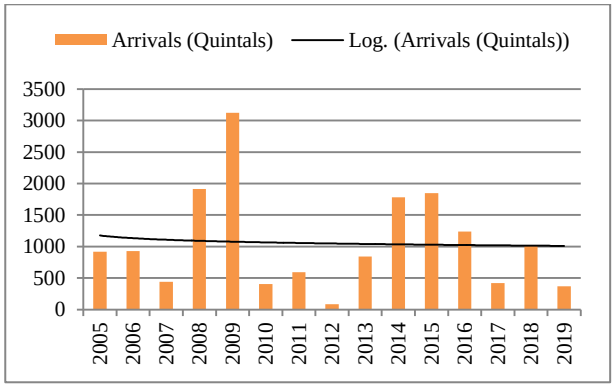

Fig. 4.43. Trends in Myrobalan arrivals in Rampachodavaram division (2005-2019)

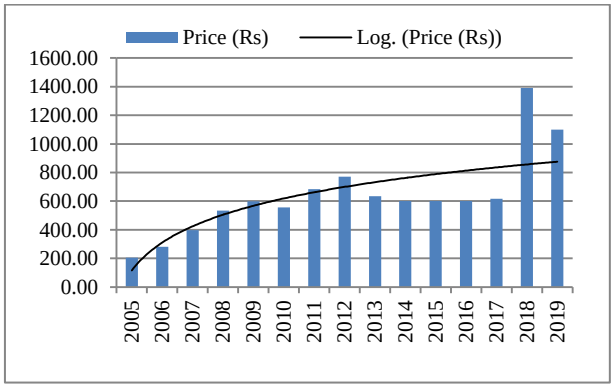

Fig. 4.44. Myrobalan trends (Rs/quintal) in Rampachodavaram division (2005-2019)

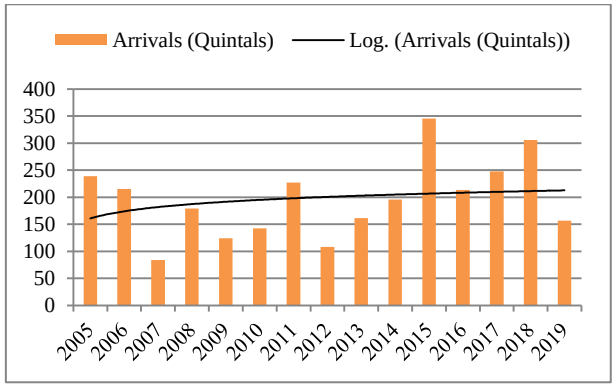

Fig. 4.45. Trends in Naramamidi bark arrivals in Rampachodavaram division (2005-2019)

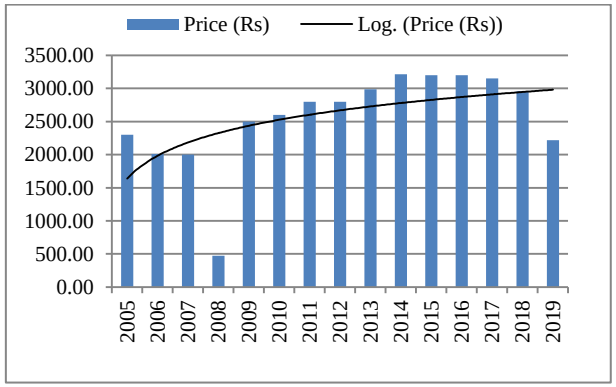

Fig. 4.46. Naramamidi bark trends (Rs/quintal) in Rampachodavaram division (2005-2019)

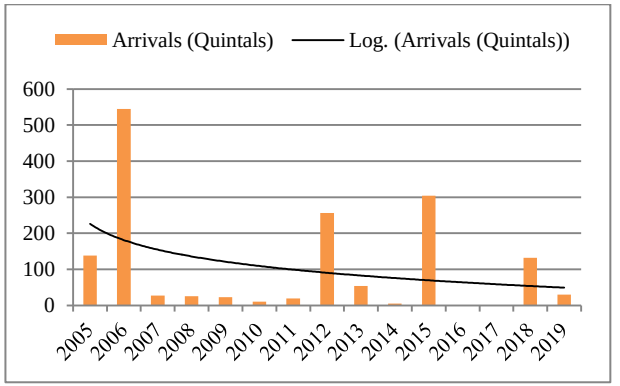

Fig. 4.47. Trends in Seeded tamarind arrivals in Rampachodavaram division (2005-2019)

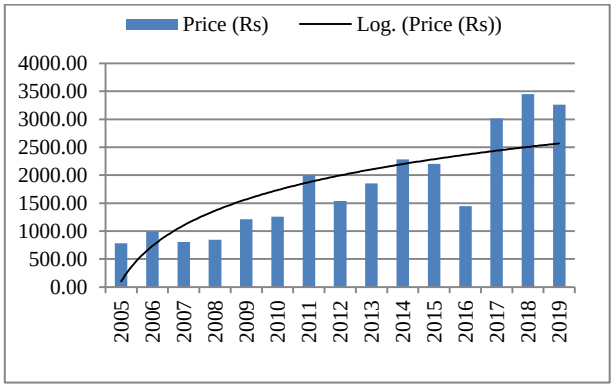

Fig. 4.48. Seeded tamarind trends (Rs/quintal) in Rampachodavaram division (2005-2019)

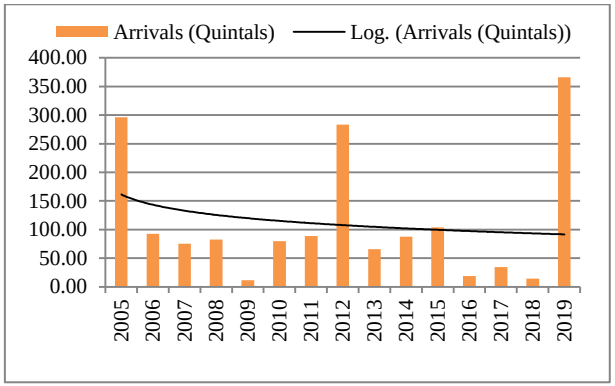

Fig. 4.49. Trends in Hill broom arrivals in Seetampeta division (2005-2019)

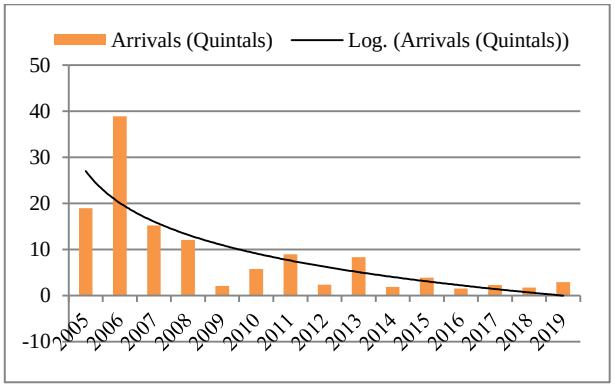

Fig. 4.51. Trends in Honey arrivals in Seetampeta division (2005-2019)

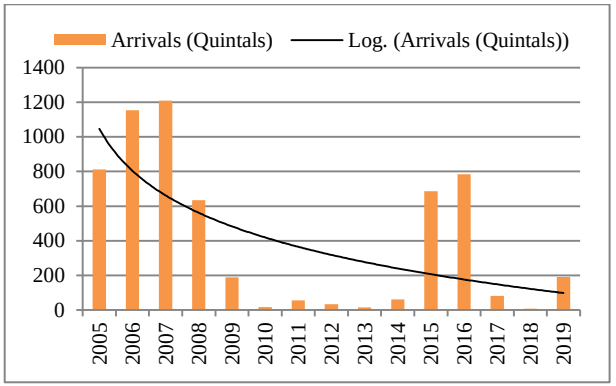

Fig. 4.53. Trends in Markingnut arrivals in Seetampeta division (2005-2019)

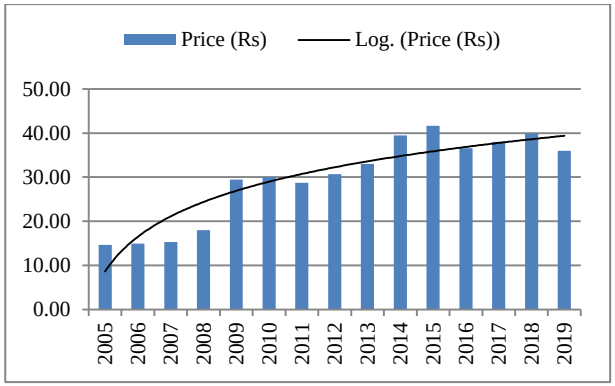

Fig. 4.50. Hill broom trends (Rs/unit) in Seetampeta division (2005-2019)

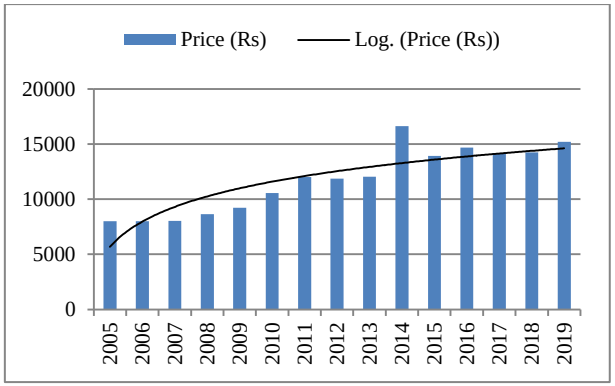

Fig. 4.52. Honey trends (Rs/quintal) in Seetampeta division (2005-2019)

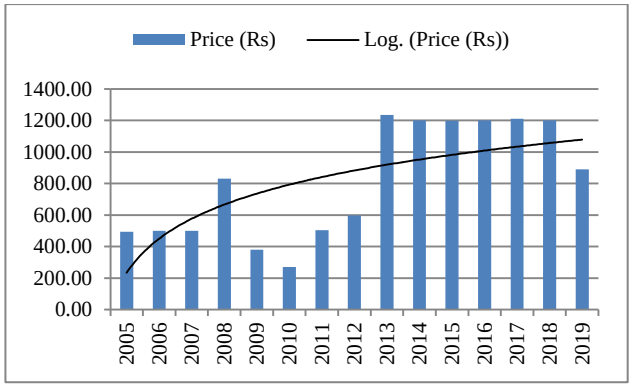

Fig. 4.54. Markingnut trends (Rs/quintal) in Seetampeta division (2005-2019)

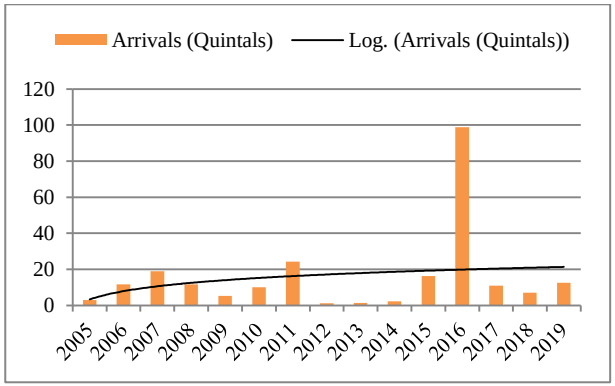

Fig. 4.55. Trends in Myrobalan arrivals in Seetampeta division (2005-2019)

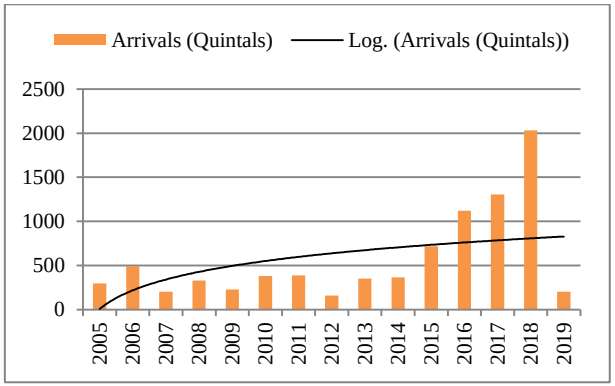

Fig. 4.57. Trends in Naramamidi bark arrivals in Seetampeta division (2005-2019)

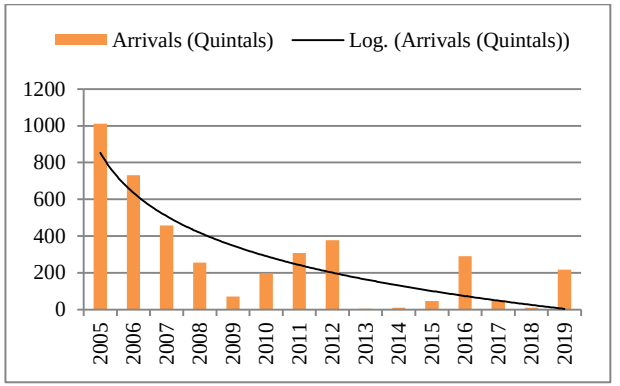

Fig. 5.59. Trends in Seeded tamarind arrivals in Seetampeta division (2005-2019)

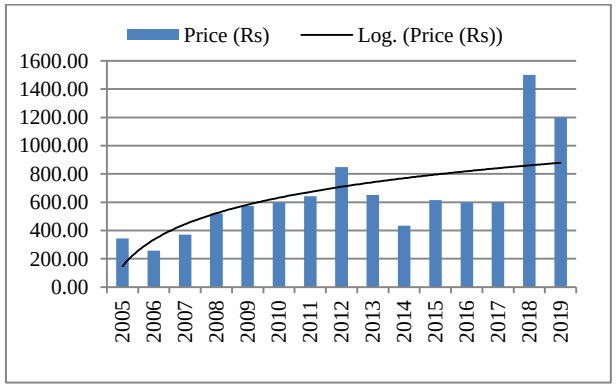

Fig. 4.56. Myrobalan trends (Rs/quintal) in Seetampeta division (2005-2019)

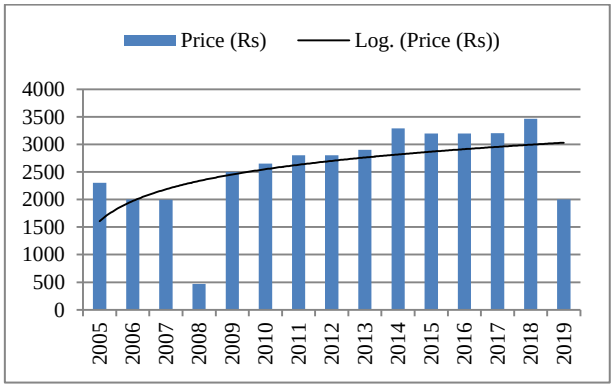

Fig. 4.58. Naramamidi bark trends (Rs/quintal) in Seetampeta division (2005-2019)

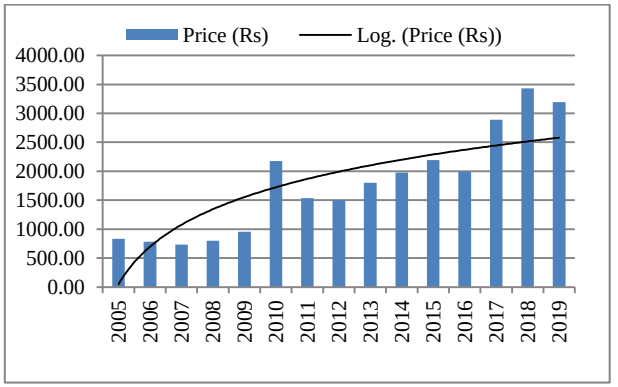

Fig. 4.60. Seeded tamarind trends (Rs/quintal) in Seetampeta division (2005-2019)

As we look from the standpoint of each product, declining trends of hill broom arrivals in most divisions were observed, especially in Chintapalli and Paderu. The same could be said for those of seeded tamarind. The severity of decline is more pronounced in Chintapalli and Paderu due to poor road connectivity and heavy competition from the plain-grown product. For example, traders were willing to pay about Rs.50/- per kg of seeded tamarind, which is Rs.10 more than that paid by the GCC. Honey arrivals to GCC from Paderu, Rampachodavaram and Seetampeta noted a declining trend because of pollinating agent disturbances resulting from environmentally adverse human activities. Naramamidi bark price has recorded an increasing trend in most divisions. Its arrivals' trend is relatively stable in Rampachodavaram where GCC offers a fixed price of Rs.30/- per kg. Overall, arrivals of directly consumable produce fell over the years, and those that needed processing have showed increasing trends with the passage of time.

4.5 DETERMINANTS OF INFRASTRUCTURE (MIS), ARRIVALS AND PRICES OF MFP IN GPCMS/PPCS

4.5.1 Determinants of Infrastructure (MIS)

MLRM employed to analyze the determinants of strengthening of infrastructure (MIS) in GPCMS/PPCs revealed that market arrivals of MFP in GPCMS/PPCs and funds received from GCC are the major influential factors that are significant at one per cent level (Table 4.18) though the growth in market arrivals of selected MFP showed declining trends in GPCMS/PPCs (Table 4.17), it is still the major contributory factor for generating revenue by the GCC and this in turn facilitate infrastructure investment on MIS in GPCMS/PPCs. This is because, GPCMS and PPCs at the grass root level are aimed to protect the tribal farmers from exploitation by middlemen and petty traders. It also aimed at establishing a mutually beneficial relationship between the tribals and the procurement agencies. The other important activities of GPCMS/PPCs like procuring MFP from tribals at reasonable and fair prices, prompt payment of sales proceeds, supplying essential commodities and other daily requirements at a fair price through a network of fair price shops

(otherwise called as Daily Requirement depots), meeting their credit requirements in an easy, convenient and effective manner, imparting training to tribals in collecting the MFP without endangering the trees and environment, providing market information from time to time, guarding against deterioration and degradation of MFP, researching to find better information dissemination and storage techniques etc., have certainly contributed for gaining confidence among the tribal farmers. So, the strengthening of GPCMS/PPCs with requisite infrastructure facilities at grass root level will definitely contribute towards safeguarding the tribal farmers' interests. The increased revenue of GCC through the retail sales of MFP and consequent allocation of funds to GPCMS/PPCs have exerted positive and significant influence (at 1% level) on strengthening MIS in the HAT zone. This is because, market information pertaining to facilities available at GPCMS/PPCs and timely dissemination of market prices data of MFP to farmers and traders enable them to derive maximum benefit of their sales and purchases. Further, it will increase the efficiency in marketing. It is also found interesting that the competitive environment between farmers and traders (through their active participation) also contributed significantly (at 5% level) to strengthen MIS at GPCMS/PPCs. This signifies that, allocation of funds from GCC and increased arrivals of produce to GPCMS/PPCs and active participation of farmers and traders are the major influential factors that contribute to strengthening of MIS in selected GPCMS/PPCs.

Table 4.18. Determinants for strengthening infrastructure (MIS) in GPCMS/PPCs

Variables	Coefficients	SE	't' cal
Constant	14537.623	7028.886	3.491
Quantity of market arrivals of MFP (Quintal)	4.061**	1.135	3.577
Number of farmers participated in selling MFP in GPCMS/PPCs	5.543*	2.590	2.140
Number of buyers participated in transactions at GPCMS/PPC	1.580*	0.763	2.070
Funds received from GCC (Rs)	0.662**	0.151	4.388
Availability of physical amenities	1.845^{NS}	1.764	1.046
Adj R^2	0.762**		

Note: **-Significant at 1% level; *-Significant at 5% level, NS – Non-Significant
Raw Data Source: Field Survey

4.5.2 Determinants of Market Arrivals of Selected MFP

MLRM was again employed to analyze the determinants of market arrivals of MFP in GPCMS/PPCs. The findings (Table 4.19) revealed that all the considered explanatory variables (except rainfall) have exerted positive and significant influence on market arrivals of MFP in GPCMS/PPCs. It is interesting that the market prices prevailing for MFP (relative to prices prevailing in shandies) have exerted positive and significant influence (at 1% level) on market arrivals in GPCMS/PPCs. This is mainly because of competitive environment and prompt dissemination of market prices information from time to time (significant at 1% level) to farmers through display boards, SMS, and daily announcements through radio, local television channel *etc.* Further, prompt procurement and payment of sales proceeds have also contributed for significant (1% level) increase in market arrivals. So, the GPCMS/PPCs should focus on above three influential factors to promote market arrivals of MFP, as the growth performance of market arrivals (Table 4.17) revealed a disappointing picture across majority of GPCMS/PPCs. Further, strengthening link roads to GPCMS/PPCs also contributed significant influence on market arrivals of MFP to GPCMS/PPCs.

Table 4.19. Determinants of market arrivals of MFP in GPCMS/PPCs

Variables	Coefficients	SE	't' cal
Constant	275.327	94.058	2.927
Rainfall	0.228^{NS}	0.165	1.388
Remunerative prices realized for MFP in GPCMS/PPCs (relative to prices prevailing in shandies)	61.244**	21.020	2.914
Timely market information from GPCMS/PPCs	3.976**	1.250	3.182
Availability of good road facility to GPCMS/PPCs	6.096*	2.890	2.109
Prompt payment of sales proceeds	8.409**	2.119	3.968
Adj R^2	0.831**		

Note: **-Significant at 1% level; *-Significant at 5% level, NS – Non-Significant
Raw Data Source: Field Survey

4.5.3 Determinants of Market Prices of Selected MFP

In order to analyze the determinants for realization of remunerative prices of MFP in GPCMS/PPCs (relative to prices realized in shandies), Probit regression model was employed (Table 4.20). It can be noticed that the likelihood ratio statistics as indicated by chi-square are highly significant ($P < 0.000$), suggesting that all the model parameters were jointly significant in explaining the dependent variable. The McFadden's Pseudo R^2 was 0.31 suggesting that the model was well-specified in line with (Hensher *et al*., 2005) criterion for best fit model.

The results indicated that explanatory variables *viz.,* access to price information from GPCMS/PPCs in right time, availability of storage facilities in GPCMS/PPCs and investment on MIS in GPCMS/PPCs have positively and significantly influenced the probability of realizing higher prices for MFP in GPCMS/PPCs. However, grading facilities and access to transportation facilities in right time are not significantly influencing the realization of remunerative prices. These two marketing functions should deserve special attention in the ensuing future, so as to enable the farmers realize higher prices and to increase market arrivals to the GPCMS/PPCs.

The marginal effects were used to interpret the change in probability of realization of remunerative prices among the selected farmers. The marginal effect of 'access to information about market prices in time' revealed that the shift from lack of access to market information would increase the probability of realization of remunerative prices for MFP by 42.8 per cent. This is because the increased accessibility to market information allows the farmers to transact the MFP at right time and quantity, which in turn increase the price realization for the produce. Similarly, the shift from lack of storage facilities would increase the probability of realization of remunerative prices for MFP by 12 per cent. This is because the increased accessibility to storage facilities in GPCMS/PPCs will allow the farmers to retain the produce at times of glut and later de-storage the MFP at right time to realize higher prices. The marginal

effect of 'investment on MIS' showed that the increase in investment by one rupee increases the probability of a farmer to utilize the market information and consequently, realize higher prices by 8.1 per cent. This means that the investment made on MIS in GPCMS/PPCs decreases the probability of being a subsistence farmer or transacting the MFP in local shandies (Mbitsemunda and Karangwa, 2017).

Table 4.20. Determinants of market prices of MFP in GPCMS/PPCs (n=120)

Variables	Coefficient	SE	Marginal effect (dy/dx)	Z Cal	P > |Z|
Constant	1.999	1.941		1.030	0.416
Access to information about market prices in time	2.491	1.016	0.428**	2.452	0.004
Availability of storage facilities in GPCMS/PPCs	0.120	0.042	0.120**	2.855	0.003
Availability of grading facilities in GPCMS/PPCs	0.175	0.331	0.026^{NS}	0.528	0.381
Availability of transportation facilities to GPCMS/PPCs in right time	0.559	0.463	0.132^{NS}	1.207	0.337
Investment on MIS in GPCMS/PPCs (Rs)	2.029	0.992	0.081*	2.045	0.015
LR χ^2 (5) = 31.29**					
Prob > χ^2 = 0.000					
Log likelihood = -24.831					
Pseudo R^2 = 0.31					

Note: **-Significant at 1% level; *-Significant at 5% level, NS – Non-Significant
Raw Data Source: Field Survey

4.5.4 Impact of MIS on Prices Realization for Selected MFP – PSM Technique

PSM technique was employed to analyze the impact of MIS on price realization of selected MFP across treated and untreated categories of farmers. The matched pairs across the selected MFP as analyzed through STATA 13 are shown through Table 4.21.

Table 4.21. 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

Raw Data Source: Field Survey

The results from the Probit analysis and the variables used in the matching procedures are reported in Table 4.22. As expected, there is a positive and significant association between the selected variables *viz.,* experience (EXP), frequency of visit (FREQ) to GPCMS/PPCs, trainings (TRG) on the importance of MIS in accessing market information from GPCMS and PPCs in the study area. The 'experience (EXP)' of tribal farmers and their frequent visits (FREQ) to shandies/GPCMS/PPCs enabled them to gain good access to GPCMS/PPC officials for useful and timely market information for selling the produce 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 (TRG) received by the tribal farmers through GPCMS enabled them to gain knowledge about different sources of market information and its importance for transacting MFP timely in the market. The marginal effects of 'EXP', 'FREQ' and 'TRG' revealed that the shift from lack of these factors would increase 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 (AMP) are receiving market information from time to time with respect to minimum, maximum and modal prices, grading standards *etc.*, and hence, exerted positive and significant influences on the access to market information from GPCMS/PPCs regarding

prices of honey, naramamidi bark and seeded tamarind. Similarly, the education background (EDU) of farmers has contributed positively in accessing marketing information with respect to hill broom, honey, naramamidi bark and seeded tamarind. However, 'distance to market (DTM)' has exerted significant negative influence on the access to market information from GPCMS/PPCs in transacting markingnut and myrobalan due to higher transaction costs. Thus, the findings suggest the importance of all the explanatory variables in influencing the farmers to accessing market information from GPCMS and PPCs in the HAT zone.

Table 4.22. Probit model results (Marginal effects) for determinants of 'access to market information' from GPMCS or PPCs in HAT zone

Variables	Hill broom	Honey	Marking nut	Myrobalan	Naramaidi 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: ** & * indicate significance at 1 and 5 percent probability levels respectively
Raw Data Source: Field Survey

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 4.23 to 4.25 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 that the market information received from GPCMS/PPCs 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/PPCs. 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/PPCs (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) that adoption of improved Agricultural technology had a strong and significant impact on household income in eastern Ethiopia.

Table 4.23. 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: *** - P≤0.01
Raw Data Source: Field Survey,

Table 4.24. 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 matched pairs)	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	.	
	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: *** - P≤0.01
Raw Data Source: Field Survey,

Table 4.25. 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: *** - P≤0.01

Raw Data Source: Field Survey,

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 4.26. 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
Markingnut (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

4.6 CONSTRAINTS TO IMPLEMENTATION OF MIS

Garrett's ranking technique was employed to analyze and prioritize the constraints in the present MIS in HAT zone (Table 4.27). Seven key constraints concerning MIS in HAT zones were identified in the study area. Despite the similarities in the nature of the problems, the severity of each problem is unique to each division. The severities of the constraints were quantified with the aid of Garrett ranking technique. It is evident that 'mobile network issue' is the top most prioritized constraint expressed by the tribal farmers across all the selected divisions except Paderu. Owing to deep forest locations (especially in Chintapalli division) mobile phones do not function properly. As Chintapalli mandal is at an altitude of 1000 m above sea level, it is even difficult to install mobile network towers. However, keeping in view the digital transformation of the agriculture sector, the Government of Andhra Pradesh is making all efforts for setting up new mobile towers across all the divisions in HAT zone with the assistance of the ITDA through a private agency. As service providers were hesitant with inherent fears, most cell towers are within the premises of police stations. This access to digital technology can offer significant advantages to tribal farmers and other rural business by providing links to suppliers and information and allowing users to tap into workforce talent, build strategic partnership, access support services such as training, finance and legal services and, critically, reach markets and customers (Trendov *et al*., 2019). However, in Paderu division, 'market information' not timely' is the top most prioritized problem. Across all the divisions in HAT zone, 'absence of updating of market information' and 'frequent fluctuations in prices of MFP' are the other prioritized problems. It is interesting that though in Paderu division, there are no mobile network issues, unlike other divisions, but due to lack of adequate staff, there is no frequent updating of market information. This is a serious concern on the part of tribal farmers in collection of MFP in relevance to the price information/trends in the locality. So, the staff strength should be streamlined and the GPCMS should use a combination of the Internet and cell phones to help farmers in disseminating timely and updated information to farmers even in the remotest parts of the division.

The informal discussions held with the farmers and traders further revealed that lack of wireless telecommunication infrastructure, lack of proper road connectivity to GPCMS/PPCs and lack of proper coordination among Government departments like ITDA, GCC, Banks, Andhra Pradesh Forest also should deserve special attention in HAT zone. The informal discussions held with the sample farmers belonging to the divisions of Chintapalli and Seetampeta reported poor mobile connectivity, lack of updated market information and frequent price fluctuations of MFP as the top three constraints affecting their respective MIS.

Table 4.27. Prioritization of constraints with respect to MIS in HAT zone

S. No.	Constraints	Chintapalli (n=72)		Paderu (n=84)		Parvathipuram (n=84)		Rampa chodavaram (n=60)		Seetampeta (n=60)		HAT zone (N=360)	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
1	Mobile network problems	76.04	I	48.01	IV	74.21	I	79.18	I	80.75	I	68.19	I
2	No updating of market information	73.15	II	70.25	II	72.14	II	75.42	II	78.88	II	64.89	II
3	Frequent fluctuations in prices of MFP	59.24	III	55.28	III	47.64	IV	56.75	IV	60.15	III	55.24	III
4	Higher transportation cost	51.90	IV	23.68	VII	56.46	III	62.85	III	37.27	VI	21.73	VII
5	Less number of trainings on grading of MFP	46.68	V	44.38	V	42.60	V	40.80	VI	53.48	V	35.29	VI
6	Low literacy of tribal farmers in accessing towards published information and GCC website	38.21	VI	37.19	VI	36.77	VI	27.98	VII	33.75	VII	43.56	V
7	Market information not timely	25.35	VII	73.69	I	21.38	VII	51.63	V	58.13	IV	46.96	IV

This statement is supported by their respective Garrett scores. This scenario is similar to those farmers of Parvathipuram and Rampachodavaram, except for the higher transportation costs which exists as the third major constraint in these divisions with respective Garrett scores of 56.46 and 62.85 respectively. Paderu division showed a distinct severity from others, with the prime constraint being unavailability of timely market information, which recorded a Garrett score of 73.69. The Government has always prioritized education in the study area, which explains why tribal farmers were literate enough to assimilate the accessible information published or broadcasted by GCC, and illiteracy wasn't a major concern. However, low frequency of trainings on grading of MFP had always been the characteristic feature of HAT zones due to poor physical and virtual connectivity, but this continues to improve over the years due to constant institutional intervention. It would be more informative to give a deeper understanding about the constraints of each division in detail.

Chintapalli: This division has poor mobile communication infrastructure, and the severity of mobile telecommunications, specified by the Garrett score of 76.04, indicates the need for its improvement. Even if there exists a proper connectivity between the GCC staff and farmers, the former finds it hard to receive updated market information from the Divisional office due to poor connectivity, which affects the farmers indirectly. The Garrett score of 73.15 supports this. High transportation costs combined with the above-mentioned factors led to fluctuation in prices.

Paderu: Unavailability of timely market information from GCC affected the farmers of this division to the highest degree, which in turn led to provision of outdated information, evidenced by the Garrett score of 70.25 putting this at the second. Mobile connectivity here is relatively better than the rest of the divisions, it being a tourist area. Less severity of higher transportation costs on the farmers (Garret score of 23.68) could be attributed to either good road connectivity or affordability of transportation services.

Parvathipuram, Rampachodavaram and Seethampeta: These three divisions have two common traits: proximity to plain areas, and high trader competition. Despite the GCCs not having updated market information to disseminate, most farmers remain unaffected due to proper information provision by traders, who offer such services to survive the competition. Higher transportation costs in Seethampeta recorded a Garrett score of 37.27, making it the sixth severe constraint. This leads to the conclusion that the road connectivity of Seetampeta is better than Parvathipuram and Rampachodavaram.

HAT zone

On an aggregate level, in HAT zone, issues with mobile telecommunication was identified the major constraint, consequent to which are the second and third severe constraints, namely delayed updating of market information, followed by price fluctuations. Since this plagues even those personnel of GCC, farmers fail to access updated information at the right time, which was observed as the fourth constraint. Overall, except in few remotest corners of the study area, transportation facilities have relatively improved in comparison to over a decade ago, and are considered less severe amongst the identified constraints. However, literacy rate issues and lack of training on accessing GCC information sources, though relatively less severe, need to be addressed at the earliest possible before it evolves into a much bigger problem in the future.

Chapter – V

Summary and Conclusions

Chapter V

SUMMARY AND CONCLUSIONS

Market information is all the data that can help those who involved in production, trading, identify the client's needs and meet their interests. In order to compete at global level in transacting MFP, the tribal farmers should have latest information regarding new techniques of collection, quality promotion, marketing of the MFP, Government policies regarding MFP, export potential of the MFP deserve considerable attention. In the tribal areas of Andhra Pradesh, the GCC has been charged with the responsibility to disseminate market information among tribal farmers.

In Andhra Pradesh, the HAT zone produces a wide range of MFP and this attracted considerable global interest in the recent years, as its value to local and national economies, food security and maintenance of biological diversity has been recognized in the last decade. Collection and marketing of MFP is the backbone of tribal economy in Andhra Pradesh. Until the last decade and half, the transactions of MFP in tribal areas had been very poor due to the subsistence and traditional system. This is because, MFP sector had not been adequately supported with necessary infrastructure, technology, appropriate extension and market information. So, with this background, the present study is focused to analyse the present utilization and contributions of MIS towards better marketing of MFP in tribal areas of Andhra Pradesh. That is, keeping the above issues in view, the present study on **Marketing Information System and its application for Minor Forest Produce in High Altitude and Tribal Area Zone of Andhra Pradesh** is an attempt to analyse the following aspects in an integrated manner:

5.1 OBJECTIVES

1. To study the existing MIS for MFP in HAT zone
2. To study the pattern and extent of the dissemination and utilization of MIS by different stakeholders in transacting MFP in HAT zone
3. To estimate the growth trends in marketing arrivals and prices of MFP in HAT zone
4. To analyze the determinants of strengthening marketing infrastructure, market arrivals and prices of MFP in HAT zone
5. To prioritize different price information sources among the farmers, identify the constraints and suggest appropriate policy measures for effective implementation of MIS among stakeholders in HAT zone.

5.2 SAMPLING DESIGN

Present study was carried out with help of multi-stage sampling design *i.e.* division level, GPCMS level and shandy level to select the representative sample. MFP like hill broom, honey, markingnut, myrobalan, naramamidi bark and seeded tamarind were purposively selected for this study, as these six commodities together accounted for 84.80 per cent share of total value of MFP procured by GPCMS. The tribal farmers generally transact their MFP in shandies, where they transact the produce to either GPCMS or private traders or both depending upon the relative prices offered by these two market players. Thus, 120 farmers from 10 GPCMS 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 and 240 sample farmers transacted produce to private traders in shandies) and 120 traders were selected for this in depth investigation. Primary data are collected from sample farmers, traders and GCC officials.

5.3 TOOLS OF ANALYSIS

Descriptive statistics such as frequency, percentage and mean were used to draw meaningful information from the collected relevant data. Annual CGRs of market arrivals and prices of selected MFP were calculated by using log

linear function. Probit model was used to analyze the factors affecting the use of MIS in the HAT zone and determinants of market prices of MFP. MLRM was carried out to analyze the factors determining strengthening of MIS and market arrivals of selected MFP in GPCMS/PPCs. PSM technique was employed to analyze the impact of MIS on prices realized for selected MFP transacted by tribal farmers. Garrett's ranking test was employed to identify the constraints faced by the farmers regarding implementation of MIS by the PPCs of GPMCS in HAT zone.

5.4 MAJOR FINDINGS

5.4.1 Existing MIS for MFP

Around 57 per cent of selected tribal farmers are women involved in collection and transacting MFP in HAT zone and remaining 43 per cent are men. It is disappointing that 50 per cent of the farmers were illiterates, 21 per cent of them had been to a primary school and only nine per cent had college education. In HAT zone, the existing MIS was regulated by GCC with its Head Office located at Visakhapatnam. It had wide range of network for their operations and dissemination of market information with help of divisional level, GPCMS and PPCs. At market level display boards in GPCMS/PPCs are the most sought among different market information sources (91%) followed by announcements at GPCMS/PPCs (46%) and traders (44%) for the sample farmers. Regarding traders, at market level, traders also access the market information mainly through display boards in GPCMS/PPCs (96%). They also enjoy access through announcements in GPCMS/PPCs (89%), other traders (76%) and bulletins frequently published by GPCMS (51%), unlike the farmers. The farmers are highly aware about prices of MFP in local GPCMS/PPCs (89%) and in local shandies (84%) compared to other GPCMS/PPCs (41%) and other shandies (35%). Regarding traders, they gather market information about arrivals and prices of MFP in GPCMS/PPCs and shandies both in local and non-local areas. Market arrivals and prices (maximum, minimum and modal) were the only two major types of market information documented and made available to the farmers on daily basis in GPCMS/PPCs and weekly conducted Shandies in HAT zone.

5.4.2 Pattern and Extent of the Dissemination and Utilization of MIS

The market information was mainly transmitted through notice boards in GPCMS/PPCs, radio, television and newspapers. It can be clearly seen that majority of the farmers utilize the market information for deciding the nature of MFP to be collected (86.11%) followed by place of its sale *ie.*, either at GPCMS/PPCs or in shandy depending upon the relative prices (68.88%). Education status (EDU) and timely dissemination of price information of MFP (PI) are the most important factors that have positively and significantly (at 1% level) influenced the probability of farmers' MIS_U.

5.4.3 Growth Trends in Marketing Arrivals and Prices

Heartening that CGRs for prices of all selected MFP showed significant (at 1% level) increasing trend except for naramamidi bark in Parvathipuram, Rampachodavaram and Seetampeta divisions. It is disappointing that market arrivals of all selected MFP showed significant declining trends across the selected divisions, except for honey in Chintapalli (3.49**) and Pravathipuram (5.46**) divisions; hill broom (1.41**) and myrobalan (10.18**) in Seetampeta divisions. The educated youth in tribal areas are showing less interest on the activities of collection and transaction of MFP and hence, only the elderly farmers are still continuing these activities, as they are unable to switch other occupations, seasonality of the produce and unsustainable harvesting of MFP are the factors causing decreasing of arrivals of MFP in HAT zone.

5.4.4 Determinants of Infrastructure (MIS), Market Arrivals and Prices

The determinants of strengthening of infrastructure (MIS) in GPCMS/PPCs are market arrivals of MFP in GPCMS/PPCs and funds received from GCC are the major influential factors that are significant at one per cent level. Determinants of market arrivals of MFP in GPCMS/PPCs, revealed that all the considered explanatory variables except rainfall, prices, timely market information and prompt payment of sales proceeds have exerted positive and significant influence on market arrivals of MFP in GPCMS/PPCs. Explanatory

variables *viz.*, access to price information from GPCMS/PPCs in right time, availability of storage facilities in GPCMS/PPCs and investment on MIS in PPCs and GPCMS have positively and significantly influenced the probability of realizing higher prices for MFP in GPCMS/PPCs.

5.4.5 Propensity Score Matching

It was found interesting that access to market information by the tribal farmers has exerted positive and significant impact ($P<0.001$) on treated, as the impact indicator (prices) is higher for them compared to untreated. The treated are significantly benefited from utilizing MIS 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.

5.4.6 Identify the Constraints to Implementation of MIS

In HAT zone, issues with mobile telecommunication was identified the major constraint, consequent to which are the second and third severe constraints, namely delayed updating of market information, followed by price fluctuations.

5.5 CONCLUSIONS

The following conclusions are made from the results of the present study

- In HAT zone of Andhra Pradesh, the existing MIS was regulated by GCC with its Head Office located at Visakhapatnam.
- At village level source of information was mobile phones and farmers still continue to depend on co-farmers, and traders are better in accessing market information over farmers.
- At market level display boards in GPCMS/PPCs are the major source of market information for the both farmers and traders.

- The farmers are highly aware about prices over quality and grades of MFP, where traders have better awareness then farmers about arrivals, prices, grades and standards.

- Market arrivals and prices were the only two major types of market information documented.

- The market information was mainly transmitted through notice boards in GPCMS/PPCs, television, newspapers and radio. Dishearten to say that usages of ICT are rare.

- Majority of the farmers utilize the market information for deciding the nature of MFP to be collected, for realizing higher prices and not in for grading, processing and storage *etc*.

- Education status (EDU) and timely dissemination of price information of MFP (PI) are the most important factors that have positively and significantly (at 1% level) influenced the probability of farmers' for use of MIS.

- Most of the selected MFP market arrivals showed significant declining trends and prices showed increasing trend across the selected divisions

- Market arrivals of MFP in GPCMS/PPCs and funds received from GCC are the major influential factors for strengthening of infrastructure (MIS) in GPCMS/PPCs

- Except rainfall, prices, timely market information and prompt payment of sales proceeds have exerted positive and significant influence on market arrivals of MFP in GPCMS/PPCs.

- Access to price information from GPCMS/PPCs in right time, availability of storage facilities in GPCMS/PPCs and investment on MIS in PPCs and GPCMS - have positively and significantly influenced the probability of realizing higher prices for MFP in GPCMS/PPCs.

- Access to market information by the tribal farmers has exerted positive and significant impact ($P<0.001$) on treated, as the impact indicator (prices) is higher for them compared to untreated.

- It is evident that 'mobile network issue' is the top most prioritized constraint expressed by the tribal farmers in HAT zone.

5.6 POLICY IMPLICATIONS

The following prospective suggestions have emerged after due consideration of findings obtained from this study. They have been presented here under four categories:

5.6.1 Policies directed towards infrastructural improvement

5.6.2 Policies directed towards institutional improvement and support

5.6.3 Policies directed towards pricing strategies and economic boost

5.6.4 Policies directed towards improvement of people's perception, awareness and knowledge of forest produce

5.6.5 Miscellaneous

5.6.1 Policies Directed Towards Infrastructural Improvement

a) Most of the information dissemination means in the studied area still involved high degree of human contact. However, it is necessary to expand those means to faster ones such as SMS, television, internet and radio, whose intangible element stands an advantage to keep the farmers stationed even in the remotest corners of the forest area updated with the latest information pertaining to prices, arrivals, Government schemes and policies. This could be made possible by installation of necessary wireless telecommunication infrastructure that broadcasts timely information to be assimilated by the tribal farmers. If such a technology seems non-feasible and out of practical reach, utilization of fiber internet facilities supporting strategically placed information kiosks at village level could benefit the farmers.

b) The already existing road transportation network in the mountainous terrain consisted of pathways that were responsible for sluggish movement of produce and personnel even at the slightest moist conditions, as the roads become murky. Road connectivity in the studied area needs to be upgraded with pucca roads for improving interconnectivity among the villages and to the outside world. The treacherous terrain of these areas poses great risks to transportation, which reflects on the arrivals and prices of MFP, putting them under constant fluctuation. Hence, improving road transportation might bring about stability to the prices indirectly.

c) Value addition units equipped with proper collection and processing technologies for forest produce need to be established to ensure risk elimination, time conservation, revenue increment and convenience to the tribal farmers. Especially in the places of popularity, where it is considered economically viable for establishment of such units owing to great tourist influx in these divisions.

d) Lack of storage facilities for agricultural and MFP in the study area makes it necessary for construction of complex storage facilities suited to each type of produce based on the nature and shelf life of each commodity. This contributes to better price realization resulting from even seasonal availability of the forest produce.

e) Governments could enter into agreements with telecommunication firms to expand the communication services in the remotest areas. For this, it is suggestible to employ trained local youth for serving the dual purpose of maintaining equipment and educating local HAT zone farmers on all matters tech. This also enables the local populace to treat the equipment responsibly, along with their support towards other such interventions, since they consider local youth being employed as a positive sign of transformation of their localities.

5.6.2 Policies Directed Towards Institutional Improvement and Support

a) It was observed that farmers lacked co-ordination, and traders and GCC held significant control over the pricing and marketing of the forest produce. Farmers have even reported that their collection of forest produce depended on GCC target limits. To address these situations, constitution of co-operative societies and FPOs among the tribal farmers must be given priority to ensure proper marketing of MFP, opening up of new marketing avenues and allocation of human resources to various procurement tasks, along with a front for a unified stand against risks involved.

b) Government support for intensification of MIS in tribal areas is necessary to ensure timely dissemination of market information. Support could be provided from the stand point of building communication infrastructure, logistics and publications.

c) Outreach of Van Dhan Vikas Kendras (VDVK) to greater numbers of tribal farmers for provision of training in all matters related to cultivation practices and forest land utilization.

d) Farmers were caught up in a vicious cycle of debts with the traders to meet their requirements in the off-season, who in turn profit off by procuring MFP from them at cheaper price and resell them at a higher price. Hence, strong co-ordination must exist between ITDA, GCC, Banks and Andhra Pradesh Forest Department for proper planning and effective implementation of Government schemes, off-season sustenance, providing adequate market facilities and financing tribal populace.

e) It is an open secret that along with provision of support to the tribal farmers, GCC must trade with the MFP procured to generate profits, enabling it to sustain itself. However, it could be more productive if GCC brings together consumers and producers to a common venue, which may either by physical or virtual. For both the parties, this creates mutual awareness on the produce, builds trust and encourages competitive pricing. GCC could even charge a nominal amount of fee for this service.

5.6.3 Policies Directed Towards Pricing Strategies and Economic Boost

a) Over the years, tribal farmers have found cashew and coffee plantations more remunerative than the forest produce, which have gradually lost their popularity and awareness overtime. This resulted in more forest area being converted to plantations, which put further strain on the availability of forest produce. So, stringent measures for conversion of forest land need to be in place for rejuvenation of the depleted forest cover and increased MFP output.

b) Transaction costs per unit amount to 30 to 35 per cent of the current price level of unit MFP transacted, leaving the farmers with a smaller margin. Making any attempts towards increasing the prices of the final product seems illogical as it is driven by market forces of supply and demand. A possible solution for this the government should to enter into a buy-back agreement with the farmers, which fetches them remunerative returns. The brunt of risk could be shared by large private conglomerates through a PPP (Public- Private Partnership), which are well-positioned to handle it owing to their economies of scale.

5.6.4 Policies Directed Towards Improvement of People's Perception, Awareness and Knowledge of Forest Produce

a) It takes time for all the farmers to be equipped with information related to pricing, arrivals and demand. This puts them at a disadvantage, necessitating the need for the local extension agencies to be well connected with the MIS and disseminate it to the farmers at the earliest possible. It is observed more in Paderu division, where non-availability of timely market information recorded the highest Garrett score of 73.69. To remediate this, the responsibilities of the State-Government employed tribal Village Agricultural Assistants (VAAs) must be extended to function as the link between the GCCs, Forest Department, MIS and tribal farmers for rapid transmission of information among these elements.

b) Educating the farmers about identification of authenticate sources of market information and differentiate between the facts and any rumors that might have crept in, along with providing assurance that MIS caters to their informational needs.

c) Boosting the morale of the local youth and encouraging them to expand their knowledge on the MFP, and find venues for self-employment and collective revenue-generation activities.

d) Establishment of MFP parks or gardens in tribal tourist places is suggested to increase their awareness among the populace. This may reflect on the quantum of sales of the forest produce as the attitude of the people towards reverting back to nature may improve in some of the aspects of their lives.

e) Ration depots have previously served as the hubs of information dissemination in tribal areas. After the introduction of mobile ration distribution units in the state, the information movement has reduced to a considerable extent. So, it is suggested to install Public Addressing (PA) units on the mobile ration distribution units to enable dual purpose of ration serving and information dissemination to tribal farmers.

f) Farmers must be taught about different forms of information such as local biodiversity and its preservation, biotic interactions and effective utilization of MIS facilities. It should be made clear that focusing on price alone may result in short-term implications of trade, but sustainability results from assimilating and utilizing the rest of the information stated above.

5.6.5 Miscellaneous

a) Tribal farmers have reported GCC to have stalled procurement of MFP after their targets have been met. So, it must be made clear to the GCC staff that the targets set are the minimum levels of produce to be procured, and their responsibility of finding the clientele for the sale of surplus must be fulfilled.

b) GCCs' catalogue must be expanded to procure and market additional types of produce like adda leaves and Mahua, procurement of which was not driven by any targets from the Managing Director's office.

c) A detailed study on biodiversity must be made in the area to understand its loss in the area and to chart out the possible means of its rejuvenation. Biodiversity shift could be computed between the base year and the study year through Shannon-Weaver or Fisher-alpha biodiversity index in the future research studies in HAT zone of Andhra Pradesh.

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