INTEGRATION AND EFFICIENCY OF MARKETS FOR IMPORTANT CROPS IN PUNJAB

Dissertation

Submitted to the Punjab Agricultural University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY
in
AGRICULTURAL ECONOMICS
(Minor Subject: Statistics)

By

Parvinder Jeet Kaur
(L-2011-BS-62-D)

Department of Economics and Sociology
College of Basic Sciences and Humanities

LUDHIANA – 141004

2015

CERTIFICATE I

This is to certify that the dissertation entitled **"Integration and efficiency of markets for important crops in Punjab"** submitted for the degree of **Ph.D.**, in the subject of **Agricultural Economics** (Minor subject: **Statistics**) of the Punjab Agricultural University, Ludhiana, is a bonafide research work carried out by **Parvinder Jeet Kaur (L-2011-BS-62-D)** under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

_____

Major Advisor
Dr. (Mrs.) M. K. Sekhon
Senior Economist (Marketing)
Department of Economics and Sociology
Punjab Agricultural University
Ludhiana - 141004

CERTIFICATE II

This is to certify that the thesis entitled, **"Integration and efficiency of markets for important crops in Punjab"** submitted by **Parvinder Jeet Kaur** (**Admn. No. L-2011-BS-62-D**) to the Punjab Agricultural University, Ludhiana, in partial fulfillment of the requirements for the degree of **Ph.D.** in the subject of **Agricultural Economics** (Minor subject: **Statistics**) has been approved by the Student's Advisory Committee along with Head of the Department after an oral examination on the same.

_____
(Dr. (Mrs.) M. K. Sekhon)
Major Advisor

_____
(Dr. I. P. Singh)
External Examiner
Professor and Head
Department of Agricultural Economics
College of Agriculture,
S.K. Rajasthan Agricultural University,
Bikaner (Rajasthan)

_____
(Dr. Sukhpal Singh)
Head of the Department

_____
(Dr. (Mrs.) Neelam Grewal)
Dean Postgraduate Studies

ACKNOWLEDGEMENT

"Journey of thousand miles starts with one step" became the guiding force for me. It was only his blessing and grace that I have been able to make another remarkable achievement in my life. I bow my head to merciful and compassionate ' Almighty God' for enternal love and blessings.

Indeed the words are adequate, to convey the depth of my feelings of gratitude to my Major adviser, Dr M.K. Sekhon, Senior Economist (Marketing), Department of Economics and Sociology, PAU Ludhiana, without those kind inspiration, keen interest and sustained encouragement, this dissertation could not have been started, much less finished. His valuable guidance, constructive criticism, meticulous attention to details, untiring and ever willing help during the entire period of the study have been of immense help to me in planning and execution of the study. It was indeed a rare privilege for me to work wider with his emending inspiration and indomitable spirit.

With deep sense of gratitude, I am highly indebted and thankful to all my Advisory Committee Members, Dr Manjeet kaur Economist, Dr. J.S. Sidhu Economist, Dr J.M. Singh Department of Economics and Sociology and Dr Amrit Kaur Mahal Associate Professor, Department of Mathematics, Statistics and Physics for valuable suggestions and rendering their help during the course of investigation.

I extend my heartiest appreciation and gratefulness to Dr Sukhpal Singh, Professor-cum head, Department of Economics and Sociology, PAU, Ludhiana, for providing all necessary facilities to carry out this investigation.

I sincerely thank Dr I.P.Singh , Professor cum head, Department of Economics, SKRAU Bikaner, for her inspiring guidance, constructive criticisms, valuable suggestions throughout the course of investigation and helped me whenever I approach his.

I am greatly thankful to H.S. Dhaliwal (DM Markfed) and all officers of Markfed Shri Muktsar Sahib.I am also Grateful to all farmers, officials of various agencies/organizations for providing access to the officials records/data used in this study.

With most humble sense of regards and reverences, I bow my head before my grandfather Mr.Veer Singh and grandmother Angrej Kaur ,I am thankful to my loving father Mr. Malkeet Singh, mother Mrs. Simerjeet Kaur, for their determined support, ordant love and blessing which enabled me to accomplish my studies. My brothers Mr. Interjeet Singh, Bhabi Rupender Kaur ,my sister Rinky .Rammu,my nephew, Ashneet singh, Gurmanpreet Kaur, Gevi.Ash,Sirat,Navi,Abhijot and all my family members deserve deep appreciation for their incessant love, support and encouragement, which brought the present task to completion.

I am very much indebted to my friends Jayashree Sharma,Mahaveer Bishnoi, Opendra Dhayal, Avinash, Narinder Singh, Gursevak Singh, Kanu Priya Sharma, Amanpreet Kaur, Beauty, Sanica, Namami, Jenny, Madhuri for their moral support, joyful company and sustained encouragement provided throughout the study.

I appreciate with thanks the help rendered to me during the period of my study by all those whole names could not be mentioned specially.

Finally, I expressed my sincere faith in Waheguru and Vaishno Devi ma,who made all the circumstances favourable and peaceful for me.

Place : Ludhiana

Dated :……. **(Parvinder Jeet Kaur)**

Title of the thesis	:	Integration and Efficiency of Markets for Important Crops in Punjab
Name of the student and Admission No.	:	Parvinder Jeet Kaur L-2011-BS-62-D
Major Subject	:	Agricultural Economics
Minor Subject	:	Statistics
Name and designation of Major Advisor	:	Dr M.K.Sekhon Sr. Economist (Marketing)
Degree to be Awarded	:	Ph.D.
Year of award of Degree	:	2015
Total Pages in Thesis	:	99+Annexure+Vita
Name of University	:	Punjab Agricultural University, Ludhiana 141004, Punjab, India

Abstract

The present study examines the market integration among different markets at macro level and pricing efficiency of American cotton, maize and paddy in Bathinda, Hoshiarpur and Sangrur district of Punjab respectively using primary data at micro level. The average net returns of paddy for different categories was highest Rs.75384.81.The average annual price variability of American cotton, maize and Paddy was found to be Rs 3922.67 (3.26), Rs.949.53 (4.24) and Rs.2563.33 (3.26) respectively showing that price variability was highest in maize.Pricing efficiency was found to be determined by marketable surplus, operational area and storage pattern in the three crops. While these factors explained 67 percent pricing efficiency in American cotton, it explained as high as 95 per cent in maize and as low as 21 per cent in paddy. The Secondary data were collected from markets of different states to study the market integration. The Vector Error Correction model was used to study the market integration. Among cotton markets, convergence to equilibrium was the lowest in Rajkot market (11 hours). It was found to be the highest in Akola market (19 hours). In maize, the convergence to equilibrium was the highest in Ahmednagar (11 hours) and it was the lowest in Bangalore (10 hours) market. For paddy markets, equilibrium convergence was the highest in Sangrur (14 hours) and it was the lowest in Shahjahanpur (5 hours). The study suggested that price efficiency can be improved with improvements in market infrastructure while market integration can be better achieved by reducing communication bottlenecks.

Key words: Rice, Cotton and Maize, economics of cultivation, marketing, constraints, price trend, market integration and co-integration

_____ _____

Signature of Major Advisor **Signature of the Student**

ਖੋਜ ਦਾ ਸਿਰਲੇਖ	:	ਪੰਜਾਬ ਵਿੱਚ ਮਹੱਤਵਪੂਰਨ ਫ਼ਸਲਾਂ ਲਈ ਮੰਡੀ ਏਕੀਕਰਣ ਅਤੇ ਕੁਸ਼ਲਤਾ ਦਾ ਅਧਿਐਨ
ਵਿਦਿਆਰਥੀ ਦਾ ਨਾਮ ਅਤੇ ਦਾਖਲਾ ਨੰ.	:	ਪਰਵਿੰਦਰ ਜੀਤ ਕੌਰ (ਐਲ-2011-ਬੀ.ਐਸ.-62-ਐਮ)
ਪ੍ਰਮੁੱਖ ਵਿਸ਼ਾ	:	ਖੇਤੀਬਾੜੀ ਅਰਥਸ਼ਾਸ਼ਤਰ
ਸਹਿਯੋਗੀ ਵਿਸ਼ਾ	:	ਅੰਕੜਾ ਵਿਗਿਆਨ
ਪ੍ਰਮੁੱਖ ਸਲਾਹਕਾਰ ਦਾ ਨਾਮ ਅਤੇ ਅਹੁਦਾ	:	ਡਾ. ਐਮ. ਕੇ. ਸੇਖੋਂ ਸੀਨੀਅਰ ਇਕਨਾਮਿਸਟ (ਮਾਰਕੀਟਿੰਗ)
ਡਿਗਰੀ	:	ਪੀ.ਐਚ.ਡੀ.
ਡਿਗਰੀ ਨਾਲ ਸਨਮਾਨਿਤ ਕਰਨ ਦਾ ਸਾਲ	:	2015
ਖੋਜ ਪੱਤਰ ਵਿੱਚ ਕੁੱਲ ਪੰਨੇ	:	99+ਅਨੈਗਜਰ+ਵੀਟਾ
ਯੂਨੀਵਰਸਿਟੀ ਦਾ ਨਾਮ	:	ਪੰਜਾਬ ਖੇਤੀਬਾੜੀ ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ-141 004, ਪੰਜਾਬ, ਭਾਰਤ

ਨਿਚੋੜ

ਮੌਜੂਦਾ ਅਧਿਐਨ ਦੌਰਾਨ ਸੂਖਮ ਪੱਧਰ ਉਪਰ ਮੁਢੱਲੇ ਆਂਕੜਿਆਂ ਦੀ ਵਰਤੋਂ ਕਰਕੇ ਪੰਜਾਬ ਦੇ ਬਠਿੰਡਾ, ਹੁਸ਼ਿਆਰਪੁਰ ਅਤੇ ਸੰਗਰੂਰ ਜ਼ਿਲ੍ਹਿਆਂ ਵਿੱਚ ਕ੍ਰਮਵਾਰ ਅਮਰੀਕਨ ਨਰਮੇ, ਮੱਕੀ ਅਤੇ ਝੋਨੇ ਦੇ ਕੀਮਤ ਕੁਸ਼ਲਤਾ ਅਤੇ ਅਤਿ ਸੂਖਮ ਪੱਧਰ ਉਪਰ ਵੱਖੋ-ਵੱਖਰੀਆਂ ਮੰਡੀਆਂ ਵਿੱਚ ਮੰਡੀ ਏਕੀਕਰਣ ਦਾ ਮੁਲਾਂਕਣ ਕੀਤਾ ਗਿਆ। ਵੱਖੋ-ਵੱਖਰੀਆਂ ਸ਼੍ਰੇਣੀਆਂ ਲਈ ਝੋਨੇ ਤੋਂ ਹੋਣ ਵਾਲੀ ਔਸਤਨ ਸਭ ਤੋਂ ਵਧੇਰੇ 75384.81 ਰੁਪਏ ਸੀ। ਅਮਰੀਕਨ ਨਰਮੇ, ਮੱਕੀ ਅਤੇ ਝੋਨੇ ਦੀ ਔਸਤਨ ਸਲਾਨਾ ਕੀਮਤ ਵਿਭਿੰਨਤਾ ਕ੍ਰਮਵਾਰ 3922.67 ਰੁਪਏ (3.26), 949.53 ਰੁਪਏ (4.24) ਅਤੇ 2563.33 ਰੁਪਏ (3.26) ਸੀ ਜਿਸ ਤੋਂ ਪਤਾ ਚੱਲਿਆ ਕਿ ਮੱਕੀ ਦੀ ਕੀਮਤ ਵਿਭਿੰਨਤਾ ਸਭ ਤੋਂ ਵਧੇਰੇ ਸੀ। ਵਿਕਰੀਯੋਗ ਵਾਧੂ ਫ਼ਸਲ, ਕਾਸ਼ਤ ਅਧੀਨ ਰਕਬਾ ਅਤੇ ਭੰਡਾਰਨ ਸੰਰਚਨਾ ਦੇ ਅਧਾਰ 'ਤੇ ਮੁੱਲ ਸੰਯੋਜਕਤਾ ਦਾ ਅਨੁਮਾਨ ਲਗਾਇਆ ਗਿਆ। ਇਹਨਾਂ ਕਾਰਕਾਂ ਦੇ ਅਧਾਰ ਤੇ ਅਮਰੀਕਨ ਨਰਮੇ ਦੀ ਮੁੱਲ ਸੰਯੋਜਕਤਾ 67 ਪ੍ਰਤੀਸ਼ਤ ਸੀ, ਮੱਕੀ ਵਿੱਚ 95 ਪ੍ਰਤੀਸ਼ਤ ਵਧੇਰੇ ਅਤੇ ਝੋਨੇ ਵਿੱਚ 21 ਪ੍ਰਤੀਸ਼ਤ ਘੱਟ ਸੀ। ਮੰਡੀ ਏਕੀਕਰਣ ਦਾ ਅਧਿਐਨ ਕਰਨ ਲਈ ਵੱਖੋ-ਵੱਖਰੇ ਰਾਜਾਂ ਦੀਆਂ ਮੰਡੀਆਂ ਤੋਂ ਆਂਕੜੇ ਇਕੱਠੇ ਕੀਤੇ ਗਏ। ਮੰਡੀ ਏਕੀਕਰਣ ਦਾ ਅਧਿਐਨ ਕਰਨ ਲਈ ਵੈਕਟਰ ਤਰੁਟੀ ਸਹਿ-ਸਬੰਧਨ ਮਾਡਲ ਦੀ ਵਰਤੋਂ ਕੀਤੀ ਗਈ। ਨਰਮੇ ਦੀਆਂ ਮੰਡੀਆਂ ਵਿੱਚੋਂ ਰਾਜਕੋਟ ਮੰਡੀ (11 ਘੰਟੇ) ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ ਸਭ ਤੋਂ ਘੱਟ ਜਦੋਂਕਿ ਅਕੋਲਾ ਮੰਡੀ ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ (19 ਘੰਟੇ) ਸਭ ਤੋਂ ਵਧੇਰੇ ਸੀ। ਮੱਕੀ ਲਈ ਅਹਿਮਦਨਗਰ ਮੰਡੀ (11 ਘੰਟੇ) ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ ਸਭ ਤੋਂ ਵਧੇਰੇ ਜਦੋਂਕਿ ਬੈਂਗਲੋਰ ਮੰਡੀ ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ (10 ਘੰਟੇ) ਸਭ ਤੋਂ ਘੱਟ ਸੀ। ਝੋਨੇ ਲਈ ਸੰਗਰੂਰ ਮੰਡੀ (14 ਘੰਟੇ) ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ ਸਭ ਤੋਂ ਵਧੇਰੇ ਜਦੋਂਕਿ ਸ਼ਾਹਜਹਾਨਪੁਰ ਮੰਡੀ ਦਾ ਸੰਤੁਲਨ ਸੰਯੋਜਨ (10 ਘੰਟੇ) ਸਭ ਤੋਂ ਘੱਟ ਸੀ। ਅਧਿਐਨ ਦੇ ਨਤੀਜਿਆਂ ਤੋਂ ਇਹ ਤੱਥ ਸਾਹਮਣੇ ਆਏ ਕਿ ਮੰਡੀਆਂ ਦੇ ਬੁਨਿਆਦੀ ਡਾਂਚੇ ਵਿੱਚ ਸੁਧਾਰ ਕਰਕੇ ਕੀਮਤ ਕੁਸ਼ਲਤਾ ਵਿੱਚ ਸੁਧਾਰ ਲਿਆਇਆ ਜਾ ਸਕਦਾ ਹੈ ਜਦੋਂਕਿ ਸੰਚਾਰ ਔਕੜਾਂ ਨੂੰ ਘਟਾ ਕੇ ਮੰਡੀ ਏਕੀਕਰਣ ਨੂੰ ਸੁਧਾਰਿਆ ਜਾ ਸਕਦਾ ਹੈ।

ਮੁੱਖ ਸ਼ਬਦ: ਝੋਨਾ, ਨਰਮਾ ਅਤੇ ਮੱਕੀ, ਕਾਸ਼ਤ ਦੀ ਆਰਥਿਕਤਾ, ਮੰਡੀਕਰਨ, ਔਕੜਾਂ, ਕੀਮਤ ਰੁਝਾਨ, ਮੰਡੀਕਰਣ ਏਕੀਕਰਣ ਅਤੇ ਸਹਿ ਏਕੀਕਰਣ

ਪ੍ਰਮੁੱਖ ਸਲਾਹਕਾਰ ਦੇ ਹਸਤਾਖਰ **ਵਿਦਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ**

CONTENTS

CHAPTER	TOPIC	PAGE NO.
I	INTRODUCTION	1-4
II	REVIEW OF LITERATURE	5-16
III	MATERIAL AND METHODS	17-24
IV	RESULTS AND DISCUSSION	25-88
V	SUMMARY	89-96
	REFERENCES	97-99
	ANNEXURE	i-xxvi
	VITA	

LIST OF TABLES

Table No.	Title	Page No.
3.1	Area under different crops in Punjab, TE 2011 to 2014	18
3.2	Selected crops, districts, block, villages and number of farmers in the study (2013 14)	19
3.3	Categorization of farms in different size groups	19
4.1.1	Compound Growth rates of area, production and yield of American cotton in Punjab, 1960-61 to 2012-13	25
4.1.2	Compound Growth rates of area, production and yield of maize in Punjab, 1960-61 to 2012-13	27
4.1.3	Compound Growth rates of area, production and yield of rice in Punjab, 1960-61 to 2012-13	28
4.2.1	Crop-wise family structure of selected farmers in Punjab, 2013-14	30
4.2.2	Distribution of farmers according to their age	31
4.2.3	Distribution of farmers according to their education	33
4.2.4	Structure and average operational farm size of the selected farmers	35
4.2.5	Distribution of farmers according to the extension contacts	36
4.2.6.1	Source wise magnitude of loan taken by the selected farmers	38
4.2.6.2	Source wise magnitude of loan taken by the selected farmers	39
4.2.6.3	Source wise magnitude of loan taken by the selected farmers	40
4.2.7.1	Cropping pattern on the selected farm holdings	41
4.2.7.2	Cropping pattern on the selected farm holdings	43
4.2.7.3	Cropping pattern on the selected farm holdings	45
4.2.8.1	Breakup of cost of cultivation and returns structure of American cotton, 2013 14	46
4.2.8.2	Breakup of cost of cultivation and returns structure of Maize on sample farm, 2013 14	47
4.2.8.3	Breakup of cost of cultivation and returns structure of paddy on different catogaries of farms 2013 14	49
4.2.9.1	Marketable surplus of farms on different categories, 2013 14	50
4.2.9.2	Marketable surplus of farms on different categories, 2013 14	51
4.2.9.3	Marketable surplus of farms on diferent categories, 2013 14	51
4.2.10	Marketable surplus of selected crop on sample farm	52
4.2.11.1	Variability in average annual American cotton price received by the selected farmers, category wise 2013-14	53

4.2.11.2	Variability in average annual maize price received by the selected farmers, category wise, 2013-14	54
4.2.11.3	Variability in average annual paddy price received by the selected farmers, category wise, 2013-14	54
4.2.12.1	Regression results of variables determining price in the market, 2013-14	56
4.2.12.2	Regression results of variables determining price in the market, 2013-14	58
4.2.12.3	Regression results of variables determining price in the market, 2013-14	59
4.2.13.1	Constraints in production of cotton faced by farmers 2013 14	59
4.2.13.2	Constraints in production of maize faced by farmers , 2013 14	60
4.2.13.3	Constraints in production of paddy faced by farmers, 2013-14	60
4.2.14.1	Constraints in marketing of American cotton faced by farmers, 2013-14	60
4.2.14.2	Constraints in marketing of maize faced by farmers, 2013-14	61
4.2.14.3	Constraints in marketing of paddy faced by farmers, 2013-14	61
4.3.1	Trend in wholesale prices of cotton in selected markets of India, March, 2010 to April, 2014	62
4.3.3	ADF test results of cotton prices in different markets	65
4.3.4	Results of Johansen's Co-integration Analysis	66
4.3.5	Results of Pair-wise Granger Causality test results	66
4.3.6	Results of vector error correction model with four lag periods in different markets	69-70
4.3.8	Trend in wholesale prices of maize in selected markets of India, March 2010 to April 2014	71
4.3.9	ADF test results of maize prices in different markets	74
4.3.10	Estimation of Johansen Co-integration test in different markets of maize	74
4.3.11	Results of Pair-wise Granger Causality test results	75
4.3.12	Results of vector error correction model with four lag periods in different markets	77-78
4.3.14	Trend in wholesale prices of rice in selected markets of India, March 2010 to April, 2014	79
4.3.15	ADF test results of rice prices in different markets	82
4.3.16	Results of Johansen Co-integration Analysis	82
4.3.17	Results of Pair-wise Granger Causality test results	83
4.3.18	Results of vector error correction model with two lag periods in different markets	85-86

LIST OF FIGURES

Figure No.	Title	Page No.
4.3.1	Trend in prices of cotton in Bathinda market	63
4.3.2	Trend in prices of cotton in Mansa market	63
4.3.3	Trend in prices of cotton in Akola market	63
4.3.4	Trend in prices of cotton in Rajkot market	64
4.3.5	Trend in prices of cotton in Surendranagar	64
4.3.4.1	Market integration among cotton markets	67
4.3.6	Trend in prices of maize in Hoshiarpur market	72
4.3.7	Trend in prices of maize in Nawanshahar market	72
4.3.8	Trend in prices of maize in Banglore market	72
4.3.9	Trend in prices of maize in Ahmednagar market	73
4.3.10	Trend in prices of maize in Vijayanagaram market	73
4.3.9.1	Market integration among maize markets	76
4.3.11	Trend in prices of rice in Sangrur market	80
4.3.12	Trend in prices of rice in Burdwan market	80
4.3.13	Trend in prices of rice in Shahjahanpur market	81
4.3.14	Trend in prices of rice in West godavari market	81
4.3.15	Market integration among rice markets	84

CHAPTER I

INTRODUCTION

India is an agricultural country, where 54 per cent workforce is dependent on agriculture. Agriculture not only provides food and raw material but also employment opportunities to a very large proportion of population in our country. This forms the main source of income. The contribution of agriculture in the national income in India is more, hence, it is said that agriculture in India is the backbone of Indian economy. Thus, agriculture contributes 70 per cent in export. Significantly, the marketing system has played its role untiringly in transforming agriculture by stimulating production and consumption as well as accelerating the pace of economic development. The agriculture sector has a share of 14 percent in India's gross domestic product (GDP) and supports more than 60 per cent of the population. Agricultural marketing helps in the growth of agro-based industries as it is the sole supplier of raw materials. Its dynamic functions are of primary importance in promoting economic development.

Punjab state comprising only 1.54 per cent of the total geographical area of country contributes 13-14 per cent towards the total food grain production of the country. State has earned the name of granary of India. Due to the extreme climatic and weather variations, very suitable for a variety of crops like wheat, rice, cotton and maize along with the availability of abundant water resources, the state is known as the food bowl of India. Agriculture continues to be an important sector of the State's economy in terms of employment and contributes about 20.83 % of the Gross State Domestic Product (2013-14). At present, 82 % of the total geographical area of the State is under cultivation and the cropping intensity is around 191 % (Statistical Abstract of Punjab 2013).

Rice is the most important and extensively grown food crop in the world. It is the staple food of more than 60 per cent of the world population. Rice is mainly produced and consumed in the Asian region. India has the largest area under rice in the world and ranks second in the production after China. India has also emerged as a major rice consumer. The major rice growing states in India are West Bengal, Uttar Pradesh, Andhra Pradesh and Punjab etc. More than 50 percent of country's population depends fully or partially on rice as it constitutes the main cereal food. Rice straw is used as cattle feed, for thatching roof and in cottage industry. The husk is used as animal feed, for paper making and as fuel source. Rice bran is used in cattle and poultry feed. The defatted rice bran, which is rich in protein, can be used in the preparation of biscuits. Rice is the most dominating crop enterprise in Punjab accounting for 62 percent of the total cropped area in kharif season. During 2012-13, it was cultivated on 2851 thousand hectares with production of 11267 thousand tonnes respectively (Anonymous 2014). Rice crop was an important component of an exemplary growth of

Punjab agriculture during past four decades. The area under this crop increased from just 3.90 lakh ha in 1970-71 to 28.51 lakh ha in 2013-14 (Anonymous 2014). During the same year, total production of rice in Punjab was the highest in our country. The state has been contributing 29.3 % of rice towards central pool since last four decades (Anonymous, 2014). Basmati, known as king of rice, uses less water and soil nutrients and has high export potential. Its straw is economically used for livestock feed, rather than burning in the field which creates atmospheric pollution (Singh 2011). Basmati is well renowned as the most aromatic rice over the world. Basmati rice captures higher returns as it is priced significantly higher over non-basmati rice in the international as well as in the domestic markets.

Cotton is an immensely important crop for the economy of India and livelihood of the Indian farming community. It is cultivated on about 11.61 million hectares area in the country which accounts for about 30 per cent of the global cotton area and it also contributes to 22 per cent of global cotton produce, currently ranking second after China. About 70 per cent of global production comes from just four countries viz. China holding highest share in global production (27 percent), followed by India (22 per cent), USA (13 per cent) and Pakistan (8 per cent). Cotton plays a vital role in the country's economic growth by providing substantial employment and making significant contribution to export earnings. It accounts for 59 per cent of the fibre used in textile industry. The cotton cultivation in India has not only engage around 6 million farmers but also involve another 40-50 million people related to cotton cultivation, cotton trade and its processing. The annual production of cotton in India during 2012-13 was 33.40 million bales (Anonymous, 2013). During 2012-13, it was cultivated on 481 thousand hectares with total production of 1627 thousand metric tonnes in Punjab (Anonymous 2014).

Maize is one of the most important cereals of the world and provides food for humans, feed for livestock and serves as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and bio-fuel. India is producing only 3 per cent of total world maize production. However, area, production and productivity in the country has increased from last five decades. It is mainly grown during Kharif season in the country and its production largely depends upon monsoon rains. Maize is grown across all the states in India. However, Andhra Pradesh, Karnataka, Rajasthan, Bihar, Maharashtra, Uttar Pradesh and Madhya Pradesh are the major maize producing states. Maize production during 2013-14 was 24.35 million tonnes in India. Punjab has a vast potential in most of its area, to adopt maize as an alternative of paddy crop, which requires a lot of water. It is pertinent to mention here that Punjab was traditionally a maize growing state which changed its status to paddy cultivation during the green revolution era. With changing rural-to-urban population and lifestyles in developing countries, there is a continuous shift to the consumption of wheat, which may influence maize production. Maize is the third most important kharif season crop

after paddy and cotton in Punjab. The area under maize in Punjab has declined from 5.77 lakh hectares in 1975-76 to 1.65 lakh hectares in 2000-01.With an average productivity of 38.98 quintals per hectare and total maize production in the state was 5.07 lakh tonnes during 2013-14 (Anonymous 2014).

An efficient agricultural marketing system leads to the optimization of resource use and output management. It can also contribute to an increase in the marketable surplus by scaling down the losses arising out of transportation, storage and harvesting. Efficient marketing system ensures higher levels of income for the farmers reducing the number of middlemen or by restricting the cost of marketing services and the malpractices. It gives the price signals to the farmers and helps them in planning their production in accordance with the need of the economy. Further, it also helps the farmers in the adoption of new scientific and technical knowledge. It provides employment to millions of people engaged in various activities, such as packaging, transportation, storage and processing. It improves the living standard of the agricultural population, reducing consumer food prices and earning more foreign exchange.Efficient functioning of markets is an essential pre-requisite of a sound marketing system to provide remunerative prices of the produce to the farmer-sellers as well as for providing of goods at reasonable prices to the innumerable consumers. One of the common indicator of the efficient functioning of the markets is the existence of high degree of integration of markets and prices. Integrated market is defined as market in which prices of differentiated products do not behave independently. Markets which are independent must be modeled in a disaggregate manner, while markets which are integrated may be amenable to aggregate analysis. According to Lele (1967), market integration is measured as an interrelationship between price movements for commodity in two or more selected markets of the area. The existence of integration in the markets influences the conduct of the firms of the markets and consequently the marketing efficiency. The behavior of a highly integrated market is different from that of a lesser integrated or dis-integrated market. Markets located in different areas differ in the extent of integration and therefore, variations exist in their degree of efficiency. The spatial price behavior in regional markets is an important indicator of the overall market performance. Markets which are not integrated may convey inaccurate price signals that might distort producer's marketing decisions and contribute to inefficient product movement. Integrated markets are defined as markets in which prices of product in differentiated markets do not behave independently (Monke and petzel, 1984).

In an integrated market, price of a commodity is responsive to price change of the same quality products in other market. As such price difference for a particular variety of product in the different markets of the area as a rule should not exceed the cost involved in transportation and handling of the produce. The analysis of price movements for a variety of the commodity in the corresponding and linked markets helps in judging of the extent of efficiency of the

marketing system in the region for the selected crops. While positive price incentives to farmers help the government to achieve self-sufficiency, fluctuations in agricultural prices spill over to other sectors of the economy, leading to increase in the overall rate of inflation. Sometimes, a steep increase in the prices of agricultural commodities creates serious problems as happened in the case of wheat during 1996, onions and other vegetables during 1998 and many times later on. Large variations in prices have serious consequences. Firstly, they provide enough room for speculators to take advantage of the situation especially in cases where there are restrictions on the movement of commodities and external trade is not permitted. Secondly, they lead to the formulation of flawed policy measures, which ultimately leads to the shoot in cost.

The interest in pricing efficiency in markets rests upon possible inaccurate value determination emanating from a market which, in turn, sends incorrect signals to producers and/or consumers. The extent to which inefficient resource allocation may be caused by pricing inefficiency is of long-standing concern to economists and policymakers. A large portion of research in agricultural economics is concerned with the efficiency of prices in some industry or sub-sector. Efficient prices are the ones that induce an efficient resource allocation, that is, maximize output given the current resource stock. Thus, pricing efficiency is inseparable from, and un important part of, economic efficiency and growth in a broader sense. The analysis of prices and market arrivals over time is important for formulating a sound agricultural price policy. Fluctuations in market arrivals largely contribute to the price instability of agricultural commodities. In order to device the appropriate ways and means for reducing the price fluctuations of agricultural commodities, there is a need to have a thorough understanding of the price behavior over time. The knowledge on the interrelations between prices and arrivals of farm products is required for assessing the extent of price fluctuations over time (Kahlon and Tyagi, 1989).

The analysis of prices over time is important for formulating a sound agricultural price policy. Fluctuations in market arrivals largely contribute to the price instability of selected crops. In order to reduce the instability in price fluctuations of selected crops, there is a need to have a thorough understanding of the price bahaviour over time and space. The long run equilibrium between the market prices of selected crops are indicated by the Vector Error Correction Model (VECM) with a long run relationship in the time series data. Hence,the present study was an attempt in that direction.

This study has been undertaken with following specific objectives:-

i. To examine the market integration among different pairs of markets for important crops
ii. To analyze the determinants of pricing efficiency for important crops and
iii. To suggest measures to improve market efficiency.

CHAPTER II

REVIEW OF LITERATURE

The comprehensive review of literature is an essential part of any scientific investigation. Its main function, apart from determining the work done before, is to provide an insight in to the methods and procedures adopted by other researchers to suggest changes therein. As such, an attempt has been made to present in brief and lucid details the available literature in relation to the present study. The review is presented below under the following heads:

2.1 Pricing efficiency for important crops

2.2 Market integration among different pairs of markets

2.1 Pricing efficiency for important crops

Mehta (1970) studied the movement of American cotton price in Punjab with special reference to Bathinda. The study indicated that most important period for marketing of cotton was November-January in Punjab state when about 89 percent of produce disposed of. The succeeding months February-April account for another 15.60 percent of market arrivals. The seasonal index of cotton price variation was low in the month of September (95.80 percent) and October (99.48 percent) .It began to rise till it reached highest in the month of December (106.40 percent). The index began declining in January till it again reached the lowest in the month of April (93.9 percent), the last month of marketing season.

Sahni (1979) studied the functioning of cotton markets in Punjab. In Punjab, fluctuations in the prices were more in smaller markets compared to those in medium and large markets. It was also found that prices were positively related to degree of competition. It was concluded that cotton market was not conductive to interests of producers. All the markets were poor in terms of efficiency; so there was large number of middlemen who shared large portion of consumer's rupee which resulted in low price to farmers.

Singh *et al* (1995) examined the seasonal variation in arrivals and their effect on price of wheat in Bihar. The study indicates that the farmers in the wheat growing areas of the state bring a substantial part of their produce for sale in the market during post harvest months and get a comparatively lower price for their produce. The seasonal variation in arrivals of wheat is more apparent in primary markets than in secondary markets. As much as one third of variations in annual arrivals of wheat were governed by the variation in prices in both the primary and secondary markets. However, wheat arrivals are more sensitive to their ruling prices in secondary markets than that of secondary markets.

Mundinamani *et al* (1999) analyzed the trend and seasonality in market arrivals and prices of groundnut in Karnataka. The trend of groundnut arrivals showed a mixed pattern. In Bijapur and Talikoti markets, arrivals fluctuated during initial years and showed a substantial

growth in later years. The monthly seasonal indices for groundnut arrivals were higher immediately after harvest in all study markets. The price indices of groundnut were lower during peak arrival months and vice-versa in Bijapur, Talikoti and Gadag markets. However, in Ranebennur, Raichur, and Gangavati markets, no such pattern was noticed.

Singh *et al* (2000) analyzed the prices and arrivals of rapeseed and mustard in Haryana. The indices of prices of rapeseed and mustard from 1985-86 to 1995-96 showed the general tendency of rising with each passing year expect few years, while the arrivals indices indicated great fluctuations from year to year in all markets. The price indices were below hundred from February to June when arrivals were maximum indicating that there was no incentive to the farmers to with hold the stock and sell it in the lean period. The regression coefficients had a negative and non-significant impact on the prices in Hisar and Charkhi Dadri markets, while the same was positive but non-significant in Hansi and Bhiwani markets.The higher indices of arrivals or prices magnitude during the glut months were so strong that it could offset the reverse trend prevalent between arrivals and prices during the lean months.

Kumar and Sharma (2003) analyzed the spatial price integration and pricing efficiency of paddy in Haryana. The study makes an attempt to check efficiency of regulated markets for Haryana state at the micro and macro levels for paddy crop. Market integration has been used as an indicator of market efficiency. The study ascertains the structural and pricing efficiency across farm size at the farm gate level. The main conclusion emerging from the co-integration and error-correlation analysis was that all the four regulated markets were co-integrated and so had a strong long-run relationship. All the farmers sold their produce in the regulated markets. Lack of scientific storage, market intelligence and insufficient institutional credit were the causes of concern as these affected the farmers adversely.

Sreeja *et al* (2004) studied the economics of rice, tapioca, coconut and rubber grown in Kerala by analyzing costs and returns data for the year 2002-03 collected from Kallam district. Analysis of cost of production data for rice revealed that variable cost accounted for 82.37 percent of the total cost and labour cost alone represented 69 per cent of the total cost. The cost-benefit ratio for rice was 1.09 which was the lowest compared to other crops studied indicating that all other crops ensured better income to the farmers. The findings further confirmed the trend of changes in cropping pattern. Area under cereals dropped by 34 per cent from 1982-83 to 2001-02 period mainly due to the reduction in area under paddy which was diverted to other profitable crops.

Khunt *et al* (2006) studied the price behavior of major vegetables in Gujarat state. The study was confined to the major vegetables viz; onion, brinjal, potato, chillies, tomato and cluster bean considering their share in total area of Gujarat state under vegetables. The number of regulated markets was selected by considering the major vegetables growing area

and data availability about prices and arrivals of vegetables. There is seasonality in arrivals and prices of all the major vegetables produced in the state which indicates the need for storage facilities. The inverse relationship was observed between prices and arrivals of most of the vegetables. Arrivals and prices of major vegetables have increased over the period in most of the regulated markets showing the scope for expansion of vegetable cultivation.

Kilima *et al* (2008) the objective of this study was to investigate whether the market reforms have increased the volatility of maize price in Tanzania and to identify regional characteristics that can be attributed to the spatial price volatility. An important policy implication in mitigating spatial volatility of maize prices in Tanzania. The government could expand its investment in infrastructure development to link the regions, thereby offsetting price swings from too much surplus or scarcity. Results show that the reforms have increased farm-gate prices and overall price volatility. Maize prices are lower in surplus and less developed regions than those in deficit and maize-deficit regions, and regions bordering other countries have experienced less volatile price than less developed, maize surplus and non-bordering regions

Rangasamy and Elumalai (2010) carried out a study on future and spot price relation of Pepper in India. The efficiency of price discovery in the future markets and spot markets was assessed by using Johansen's Co-integration analysis and Error correction models. The result revealed that the volume of pepper traded in NCDEX has increased many folds during last two years indicating the increased information flow into the markets and increasing the efficiency of its price discovery. The spot and future prices were found to be co-integrated not only in the short run but also in the long run and inferred that future were efficient in their price discovery process. The results indicate that pepper futures influenced the spot prices indicating its better hedge efficiency for producers to hedge their price risk in the futures platform of exchange.

Singh *et al* (2010) conducted a study on behaviour of arrivals and prices of green chillies in Punjab. The study was conducted in two purposively selected districts having highest area under chilli crop. It has been noticed that area under chilli crop has declined, whereas the area under vegetable crops has increased in Punjab. The time series analysis showed that arrivals of chilli increased over a period of time in the sample markets. It has been found that the seasonal nature of chilli crop creates glut in the market during post harvest season which leads to sharp fall in prices and affects the producers adversely in both the Amritsar and Patiala market. It was noticed during the survey that the major portion of farmer's produce was sold at the lower price in post-harvest period there by lowering their income. The major reason was the perishable nature of produce and the non-availability of stores and storage techniques.

Mavi *et al* (2012), while investigating the efficiency of various marketing models and problems of kinnow growers of Punjab reported the potential of marketing of kinnow in south-western districts of Punjab. The seasonal indices signified that kinnow prices show negative response to arrivals and positive response to lagged prices. The study has shown that the kinnow growers suffered a loss by selling produce to pre-harvest contractors as their share in consumer rupee was low. It has been brought out in the study that kinnow growers would gain financially by selling their produce themselves in the markets. The lack of market information and marketing infrastructure, inadequate processing and post-harvest facilities and frequent price fluctuations have been identified as the major factors which inhibit expansion of kinnow cultivation in the state.

Pandit *et al* (2012) conducted a study on analysis of price behavior of rice in Eastern Indian Markets. The analysis of trend of nominal prices by the application of ordinary least square methods for the period 1975 to 2008 has shown that all the regression coefficients were statistically significant, suggesting that there is significant rise in prices over time in all markets. The month wise price indices constructed and it was found that variations in indices were not so pronounced like perishable commodities. The prices were highest during August or September. Then it showed decreasing trend and prices were generally low during January and March. The seasonal fluctuations in arrivals were more pronounced than those of prices, 52 being lowest index and 168 being highest. Almost in all the markets the highest index was found during December month when the rice from kharif crops arrived at the markets.

2.2 Market integration among different pairs of markets

Baharumshah *et al* (1994) found that the prices of black and white pepper in a market are in parity with prices in a reference market a co integration tests were applied to spatial price relationship among regional pepper markets by using weekly pepper prices for six regional markets in the state of Sarawak, Malaysia. The empirical results suggest that regional pepper markets in Sarawak in Malaysia are highly co integrated. It was observed that the prices of pepper tend to move uniformly across spatial markets. Importantly, the distance between markets was not impediment to efficient adjustment of price to new information. The low transportation and risk associated with transportation may explain why the degree of co integration is unaffected by distance.

Nasurudeen *et al* (1995) analyzed the price integration of oils and oilseeds. The analysis of prices of oils and oilseeds in Bombay market revealed the nature of price integration between oilseeds and oils. The assumption of complete oil price integration could not by fully accepted. Price integration in most cases was bidirectional except in castor oil. The contemporary belief of influence of groundnut oil price on all edible oil prices was also established. The results of vertical integration confirmed the hypothesis that changes in oilseed price in linked to changes in its oil and cake price. The vertical integration in oilseed

price was much quicker as compared to horizontal integration in oil prices .The Bombay oilseed market showed the characteristics of perfect market condition by its quick adjustment to price changes.

Tahir *et al* (1997) study integration of agricultural commodity markets in the South Punjab of Pakistan. The market integration for wheat, cotton and rice was studied in five selected local markets in the South–Punjab. Wheat and cotton are major crops in all selected markets, while rice is grown in the areas with good canal water supply or with salinity problems. The market integration tests for rice market gave mixed results. The rice market of Chishtian and Bahawalnagar were found integrated with the Multan market even in the short-run. However, Hasitpur and Pakpattan markets were found to be segmented from the Multan market. Wheat market was generally found to be integrated in long-run. Short-run integration was rejected for all the wheat markets. The Hasilpur wheat market was found to be isolated from the Multan reference market even in the long-run. .

Behura *et al* (1998) in his study used Bivariate price series correlation and Engle Granger method to analyze the market integration for Orissa marine fish market. The bivariate correlation coefficient (r) for six selected markets pair ranged from 0.60 to 0.85. The highest r value has been observed for Behampur-Chandbali markets (0.85). The lowest r value is observed for market pair of Cuttack and Chandbali. The Augmented Dickey-Fuller (ADF) test has applied first to test the stationarity of the price series. All the six marine fish markets price series are found to be non-stationary when ADF test was carried out on the levels thus necessitating further test on the first difference of price series. The tests revealed that the price series for marine fish in the selected markets in the state are stationary after first difference. The poor market integration observed in this case reveals that marine fish markets in the state are quite uncompetitive. This necessitates strong and extensive government intervention designed to improve competitiveness to enhance market efficiency.

Vani and Krishnaiah (1998) studied the price integration in marketing of chillies in Guntur market (AP). This study was taken up in Guntur district of Andhra Pradesh during 1996-97 to assess the price integration between two regulated markets viz., Guntur and Tadikonda. Ravillion model was adopted to study the price integration. The index of market connection was 0.82 indicated high degree of market integration. The value of Bio is 0.30 which implies that one rupee change in Guntur market price between the current and last year brings about Rs. 0.30 increase in Tadikonda market price during same time period. Guntur market price will influence Tadikonda price with an increase of Rs. 0.63 during the same time period. While it would increase the difference by Rs. 0.63 in Tadikonda market price during last year.

Ashe *et al* (1999) conducted the study on price integration which provides relationship between a product aggregation the Composite Commodity Theorem and the Law

of One Price. This implies that when markets are well integrated, a single aggregate quantity and price for goods in question can be contacted. The Johansen test provides the critical link in empirical work when prices are non stationary, because it allows testing of hypothesis on the co-integration parameters in as framework, in contrast what is possible with the Engle and Granger test. When applied to time series of data for five species of salmon, Atlantic, and four Pacific species, the analysis indicates that (a) these species compete in the market as evidenced by their co-integrated prices, (b) the LOP holds and (c) the generalized Composite Commodity Theorem. These results have implications for findings of previous market analyses of the salmon markets.

Ghosh (2000) conducted a study on co-integration tests and spatial integration of rice markets in India. In India intra state and interstate spatial integration of rice markets examined by testing the long run linear relationship between prices of state specific variety of rice quoted in spatially separated locations in the four states. The co integration results for intra state in Uttar Pradesh indicated that the regional markets are integrated to such an extent that law of one price holds for ARWIT variety of rice. However, no evidence was found in favor of law of one price for common variety of rice marketed in Bihar, Orissa, West Bengal, even though regional rice markets were found to be integrated. The results pertaining to interstate regional integration of rice markets represented by four market centers chosen from the four selected states revealed that even though the markets are integrated, the law of one price does not hold. These results have important policy implications.

Patil (2000) examined the extent of market integration and the relationship between the pattern of market arrivals and the prices of rape-seed and mustard, in selected markets of Mensana district, North Gujarat, India. Time series data on wholesale prices for the period 1975-76 to 1991-92 were oAmericanained. The spatially located primary as well as secondary wholesale markets in Mensana were found to be integrated in terms of movement of prices. There exists normal conspicuous seasonality in prices and arrivals of rape-seed and mustard. Year-wise and market-wise analysis revealed that market arrivals were high on post-harvest months when prices were low and low arrivals were observed in subsequent months when prices were high.

Singh and Agarwal (2000) study market integration for cumin seed in Rajasthan. The five markets such as Mertacity, Nagaur, Madanganj-Kishangarh, Kekri, Jaipur were selected for the study.The selected cumin seed market of the state were found to be integrated vertically to a good extent as 78 per cent firms in Mertacity market, 77 percent firms in Nagaur market and 67 per cent firms in Madanganj-Kishangarh markets, performed more than one function at a time in the marketing process. The firms in Madanganj-Kishangarh and Kekri markets were integrated horizontally to a higher extent than Mertacity and Nagaur markets. Cumin seed markets of Rajasthan were better integrated vertically than horizontally

means thereby that the firms in the markets were more actively related to each other. The selected cumin markets of Rajasthan were found to be having high concentration for market power. The concentration was higher in Madanganj-Kishagarh and Kekri markets as the single largest firm in these markets which purchased 49.54 and 21.89 percent cumin arrival. The single largest firms of Mertacity and Nagour markets purchased only 9.82 and 11.60 per cent of total arrivals of cumin seed and hence, were having no concentration of market power. The value of correlation coefficients in weekly wholesale prices of cumin seed in all the selected paired (Jaipur-Nagaur, Jaipur- Madanganj-kishangarh, Jaipur-Kekri, Mertacity-Nagaur, and Nagaur- Madanganj-kishangarh market) market of Rajasthan were positive and ranged between 0.36 to 0.69.

Alam *et al* (2001) examined the inter market relationship among different varieties of rice prices in selected rice producing districts in Bangladesh. For the study, time series data of annual harvest prices of Aus, Aman and Boro variety of rice during 1972-73 to 1993-94 in Bangladesh were used. Secondary data were used and oAmericanained from various issues of statistical yearbook of Bangladesh .During the study period (1972/73 to 1993/94) prices of all types of rice fluctuated to a greater extent and Aus showed the highest random fluctuations of prices compared to Aman and Boro. During the time period of 1985/86 to 1994/95 selected rice producing districts were found to be well integrated in terms of market integration.

Goodwin and Piggott (2001) examined that analyses conducted by using models appropriate for non-stationary data ignore the transactions costs, which may inhibit price adjustments and thus affect tests of integration. Therefore, threshold auto-regression and co-integration models were applied to account for a neutral band representing transactions cost. The daily price linkages were evaluated among four corn and four soybean markets in North Carolina. Non-linear impulse response functions were used to investigate dynamic patterns of adjustments to shocks and the results confirmed the presence of thresholds and indicate strong support for market integration, though adjustments following shocks may take many days to be complete. In every case, the threshold models suggest much faster adjustments in response to deviations from equilibrium than in the case when threshold behavior is ignored.

Rivera and Helfand (2001) examined the extent, pattern, and degree of integration in a multivariate system with co-integrating restrictions in the Brazilian rice market. The extent of the market integration was studied by identifying locations that are linked by trade and where prices share identical long-run information. The pattern of integration characterizes interdependence and was analyzed by estimating a vector error correction model. The degree of integration was calculated with persistence profiles of the long run relations and observed that bivariate models are inadequate for capturing the spatial dynamics of price adjustment.

Acharya (2003) in his study "Price integration of wholesale markets for food grains and oilseeds in India" revealed that price integration for groundnut showed a higher degree of

co-movement during nineties as compared to that in the eighties. The correlation coefficients were greater than 0.7 for 92 per cent market pairs during the nineties as compared to only 38 per cent market pairs during the eighties. As regards to groundnut oil, the markets were highly integrated both during the eighties and the nineties.

Kar *et al* (2004) conducted the study on market infrastructure and market integration for fruits of Himachal Pradesh. The data has been collected from various secondary sources. To examine the market integration, it is necessary to indentify the stationary of the price data of various markets. For this ADF test for unit root was conducted. The co-integration could be worked out to identify the economic relationship between markets. It is observed from study that many markets such as Delhi, Mumbai have integration with the lag price of Bangalore and Calcutta markets. Similarly Delhi, Mumbai and Chennai apple prices are associated with lag price of Calcutta and Chandigarh. Calcutta market apple price was associated with lag price of Delhi. Other markets did not show any association with the lag price of other markets

Rangasamy *et al* (2010) carried out a study on future and spot price relation of Pepper in India. The efficiency of price discovery in the future markets and spot markets was assessed by using Johansen co-integration analysis and Error correction models. The result revealed that the volume of pepper traded in NCDEX has increased many folds during last two years indicating the increased information flow into the markets and increasing the efficiency of its price discovery. The spot and future prices were found to be co-integrated not only in the short run but also in the long run and inferred that future were efficient in their price discovery process. The results indicate that pepper futures influenced the spot prices indicating its better hedge efficiency for producers to hedge their price risk in the futures platform of exchange

Sivagami (2010) studied integration of production and marketing of maize through contract farming. The study showed that production and marketing of maize was integrated through contract farming. This has also led to increased yield and income. The net income received by the contract farmers was higher by Rs. 19765.72 per hectare than the non contract farmers. Analysis of price spread in the three marketing channels revealed that in channel-I (Producer → Contract buyers)the contract farmers share in consumers rupees was 85.71 percent which was higher than the non contract farmers. The results of the Garrets ranking technique indicated the high pre-announced price was the major factor that motivated the contract farmers.

Bharadwaj (2011) examined the vertical and horizontal co integration between wholesale and retail price of gram in the selected markets of Bhopal, Chittor, Delhi and Ganganagar was carried out. The two statistical tests i.e trace test and eigen value statistics indicated that there existed cointegrating vectors and cointegrating equations which conforms a long run relationship in the gram markets under study. The value of error correction

coefficient γ was observed to be significantly higher in Chittor and Bhopal markets as compared to Ganganagar and Delhi markets. The value of long run multiplier suggest that the equilibrium between the wholesale and retail price of gram in Chittoor market takes a time of 4 days, Bhopal 7 days, Gnaganagar 49 days and Delhi market takes 63 days to attain equilibrium level between wholesale and retail prices. It was observed from the study that markets have a strong association in term of gram prices of different markets.

Manohar *et al* (2012) has examined the degree of spatial market integration in the regional maize markets of Rajasthan. The result indicate that the correlation coefficient in monthly wholesale prices of maize between all the selected market pairs were positive and significantly different from zero. The value of correlation coefficients among prices of maize in most of the market pairs ranged between 0.76 and 0.91 improving thereby that the selected markets were highly integrated. The maize prices in some markets moved independently of the corresponding market which might be due to non-movement of produce from one market area to the other. In order to achieve the goal of integration, government should strengthen the market intelligence and communication within markets. Also, for better integration among the markets, infrastructural facilities should be improved.

Salam *et al.* (2012) conducted a study on price behavior of major cereal crops in Bangladesh. The authors analyzed the extent of the seasonal price fluctuation and spatial price relationship of major cereal crops viz., Boro paddy and wheat in different markets in Bangladesh. The study was based on secondary data from the period of 1986-87 to 2009-10 from different sources. In estimating seasonal price fluctuation of selected crops it was found that crops prices fluctuated in different months within the year. The difference between peak and trough prices was higher for Boro paddy than wheat. The Coefficient of variation was also higher for Boro paddy than wheat. The results of empirical evaluation of spatial price linkage through Engle-Granger Co-integration Method among regional selected markets of Bangladesh using harvest price of Boro paddy and wheat indicate that these markets were well integrated. That means, information about price changes are fully and instantaneously delivered to the other markets in Bangladesh.

Sidhu *et al* (2012) conducted a study on daily wheat prices in markets of Khanna (Punjab), Varanasi (UP), Indore (MP), Kota (Rajasthan), Bangalore (Bangalore), Junagarh (Gujarat) and Sirsa (Haryana) for the period from 2008 to 2011 to examine the co-integration among national wheat markets as well as US wheat market. It clearly indicated that US market come to short run equilibrium through dynamic adjustment correction and about 31 per cent of the disequilibrium was corrected within one month. In both, Indian and US markets, the prices were influenced by their own monthly lags for long run equilibrium. In long run, Indian wheat prices were influenced by one month lagged price in US market and one and four month lags of its own price. Similarly, US wheat prices were influenced by

three, four and seven month lagged price in Indian market as well as one, three and five month lags of its own price.

Sumalatha (2012) carried out price volatility and integration of spot and futures markets of agricultural commodities in India. The study analyzed that the convergence between the spot and futures market by analyzing the long-run relationship between these two markets using Co integration analysis. The results shows that long run relationship between spot and futures prices exists for all commodities expect Guar seed and causality result is unidirectional, where futures market price leads to spot prices for pepper, mustard seed and refreshed soy oil and spot market prices leads to futures price for rubber. The volatility (coefficient of variation was used) analysis for commodities shows that price volatility of the futures market is higher than spot market volatility for guar seed, pepper, rubber, mustard seed and spot market price volatility is higher than futures market for chana and refreshed soy oil.

Ajjan *et al* (2013) analyzed the integration of chicken pea (*cicer arietinum*) markets in India. The study analyzes market integration using monthly modal prices of Chana in six regional markets in Andhra Pradesh, Tamil Nadu, Maharastra, Rajasthan, Karnataka and Gujarat. For each market seasonal index, ADF test, Johansen's Co-integration and Pairwise Granger Causality tests were carried out. The results indicated strong market integration among the Chana markets in India.

Burark *et al* (2013) examined the market integration and price volatility in domestic markets of coraiander in Rajasthan. This study tests the extent of cointegration of wholesale price of coriander among major markets (kota, barn and ramganj mandi) of Rajasthan by using Johansen test, examined the causality tests and also captures the speed of adjustment to deviations in long run equilibrium by using Vector Error Correction Model. Monthly wholesale price data were used for the study. Out of three markets only two markets were co-integrated . The Pairwise Grangers Causality Test for Baran and Ramganj markets was significant at 1 percent level which was indicative of mutual influence exerted by the markets on each other. Whereas unidirectional influence was exhibited by Kota market on Ramganj and Baran markets. The results of price volatility in coriander prices in Baran market were relatively more volatile than Kota and Ramganj market which was confirmed through GARCH estimation.

Sekhon *et al* (2013) conducted study on market margin and spatial integration among different cabbage markets. Augmented Dicky fuller (ADF) test was applied to the weekly price series of cabbage in Delhi, Ludhiana and Adampur market. It was observed that data were found non-stationary at levels, but become stationary determining the price series at l(1). The value of unit root was calculated as -10.09 for Ludhiana market, -7.44 for Adampur and -7.33 for Azadpur (Delhi) market, and were significant at 5 per cent level. The markets were

also found to be integrated with certain degree of price transmission from one market to another. The coefficient of price elasticity of cabbage was 0.65, 0.62 and 0.1 of price transmission from one market to another. The coefficient of price elasticity of cabbage was 0.65, 0.62 and 0.14 between Ludhiana-Azadpur, Ludhiana-Adampur and Delhi-Adampur markets respectively.

Sendhil *et al* (2013) conducted the study on price discovery, transmission and volatility. The study analyzed that the convergence between the spot and futures market by analyzing the long-run relationship between the markets using Co integration analysis. The results shows that long run relationship between spot and futures prices exists for all commodities expect barley. The study also indicates the efficient performance of futures trading in wheat and maize. The extent of volatility in spot prices due to futures trading, as measured by the coefficients of GARCH model, had indicated the persistence of volatility in spot markets, but not of the explosive type.

Zakari S and Ying L (2014) investigated the spatial integration of Niger cereal markets using monthly retail prices of four staple crops consumed daily in the country. We used co-integration techniques to analyze the price relationship between six main markets. The results revealed high co-integration in Millet and Maize market pairs. On the Contrary, the study indicates also high absence of co-integration in most of Rice and Sorghum markets. Many factors such as poor infrastructures, government interventions, may be major impediments to spatial integration between markets. Development of private grain marketing will help to improve trading between markets, thereby increasing competition and circulation of grain from surplus areas to supply deficit areas.

Mahalle *et al* (2015) analyzed the integration of wheat markets in Maharastra. The market performance of wheat in state has been studied on the basis of monthly arrivals and wholesale prices data for 15 years (1997 to 2011).Both market arrivals and prices of wheat have depicted increasing trends in almost all the selected markets of Maharashtra.The seasonality in arrivals of wheat has been found higher than the seasonality in the market prices, indicating a rise in market instability. Out of the seven, four markets have been found spatially integrated.Some market pairs have shown bidirectional causality, while others have depicted unidirectional causality. Almost all the selected wheat markets have shown long run equilibrium relationship and existence of co integration among them.

Wani *et al* (2015) studied integration and price forecasting of apple in India. The study has made an attempt to investigate the strength of spatial market integration of five potential apple markets of India using co-integration and error correction models on the weekly wholesale prices of apple collected from September 2005 to February 2013. The results reveal that apple markets are perfectly integrated and the Delhi market is the dominant one. In short run, a disequilibrium ranges from 2.1 to 96.9 per cent among all the varieties and

grades of the selected fruits. However, the study finds no co-integration within two pairs of markets (Delhi-Srinagar and Banglore-Kolkata) for the American super variety and within one pair (Banglore –Kolkata) for Moharaji special. The Granger Causality test reveals 39 and 18 Bi-directional and uni-directional causations respectively under different market situations. Further, Vector Error Correction Model (VECM) results reveal a combination of positive and negative coefficients exceed the negative coefficients.

The above survey provides a brief review of the food grains viz rice, maize, cotton and vegetables and the factors that affect the market and economy of the crops. Mostly the authors have focused on the factors like the pre harvest and post harvest periods, the seasonal variations which affect the crops, the price rise, the trend and seasonality, pricing efficiency at the micro and macro levels, the structural and pricing efficiency, growing area and data availability about prices and arrivals of crops analysis of price behavior. Analyzing all these factors and how they affect the economy is the base of the study conducted. Another important aspect which has been analyzed by the authors is the spatial and market integration of various crops and their relationship with the unregulated and the regulated market supply. Some studies on the market co-integration provided evidence in favour of spatial integration of the regional food grain market. Even though regional markets are geographically dispersed, prices across different market centers within and across states have exhibited long-run spatial linkages, suggesting that all the exchange locations are integrated and that prices provide relevant market signals. There are, however, regional variations in the extent of market integration, which could be due to regional disparities in infrastructure and the institutional structure of food grain markets. Therefore, this dissertation was undertaken because the market integration has been used as an indictor of mrket efficiency. The present study tries to ascertain the structural and pricing efficiency across farm size, hence, converging to conclude that the market is integrated which has been proved through co-integration and error correction analysis

CHAPTER III

METHODOLOGY

In order to accomplish the objectives, the study was conducted for the selected major crops of Punjab state. Methodological framework of the study is discussed under the following sections:

3.1 Locale of the study

3.2 Sampling design

3.3 Collection of Data

3.4 Statistical framework.

3.1 Locale of the study

The study was conducted in the state of Punjab. There are three zones in Punjab i.e. sub-mountainous zone, central zone and south western zone with such cropping patterns as maize-wheat, paddy-wheat and cotton-wheat, respectively. Cotton, Maize and Paddy are important kharif crops of the Punjab state. The south western zone was selected for the study of cotton because cotton-wheat cropping pattern prevailed in this zone. Bathinda district of south western zone was selected purposively as it ranked first in area under cotton. The total production was 1602 thousand bales. The average lint yield for the state as a whole was 577 kg per hectare during 2012 13. The district wise area under paddy,American cotton and maize crops is shown in Table 3.1. The sub-mountainous zone was selected for the study as the maize-wheat cropping pattern prevailed in this zone. Hoshiarpur district of sub-mountainous zone was selected purposively as it ranked first in area under maize. Maize is the third most important kharif season crop after paddy and cotton in Punjab. Maize production was 482 thousand tonnes in Punjab state.The average yield per hectare was 36.8 quintal per hectare during 2012 13.The central zone was selected for the study as the paddy-wheat cropping pattern prevailed in this zone. Sangrur district of central zone was selected purposively as it ranked first in area under paddy.Paddy is the most dominating crop in Punjab accounting for about 62 per cent of total cropped area in kharif season. Paddy production was 11390 thousand tonnes and average yield was 3998 kg per hectare during 2012 13. Punjab produces 11 per cent of the nation's paddy and most of it is exported to other states and countries, therefore, it has strategic importance in term of food security.

Table 3.1: Area under different crops in Punjab, TE 2011 to 2014 (000' ha)

Districts	Paddy	American cotton	Maize
Sangrur	274.33	9.33	0.33
Ludhiana	257.00	1.00	2.00
Firozpur	235.67	78.00	-
Patiala	232.67	0.67	2.33
Gurdaspur	191.67	-	7.00
Amritsar	183.00	-	1.00
Tarn Taran	176.00	0.67	1.00
Moga	175.33	2.33	-
Jalandhar	165.67	-	8.00
Kapurthala	117.33	-	2.67
Shri Muktsar Sahib	115.33	89.00	-
Bathinda	106.33	147.30	-
Barnala	106.00	8.67	-
Faridkot	102.33	14.33	-
Fatehgarh Sahib	86.00	-	1.33
Mansa	77.67	88.67	-
Hoshiarpur	71.33	-	59.33
S.B.S. Nagar	56.33	-	13.00
Rupnagar	37.67	-	22.33
S.A.S.Nagar	30.00	-	7.00
Fazilka	30.67	32.00	-
Pathankot	9.67	-	3.00

3.2 Sampling framework

This involves the selection of study area, selection of blocks and villages, selection of farmers and sample of farmers.

3.2.1 Selection of study area

For the purpose of study, three districts namely Bathinda, Hoshiarpur and Sangrur having high concentration of area under cotton, maize and paddy crops were selected purposively from the south- western zone, sub-mountainous zone and central zone of Punjab repectively.

3.2.2 Selection of the block and villages

Multi-stage random sampling technique was used for the selection of the respondents. Three districts were selected at first stage, three blocks as the second, six villages as the third and the farmers as the fourth and the ultimate unit of the study. In the first stage , three districts were selected on the basis of highest area under selcted crops.In the second stage , one block was selected randomly from each selected district. Two villages were randomly selected from each block in the third stage. In the fourth stage, 30 farmers were selected randomly from each selected village.In this way, the total sample comprised of 180 farmers. The detail in this regard is given in Table 3.2.

Table 3.2: Selected crops, districts, block, villages and number of farmers in the study (2013 14)

Crops	Selected Districts	Selected Blocks	Selected villages	No. of farmers
Cotton	Bathinda	Bathinda	1. Baluana 2. Bahman Diwana	60
Maize	Hoshiarpur	Hoshiarpur	1.Phuglana 2.Rajpura paeya	60
Paddy	Sangrur	Dhuri	1.Benra 2.Birdwal	60
Grand Total				180

3.1.3 Selection of farmers

From each village, 30 farmers were selected using simple random sampling technique. Therefore, a total sample of 180 farmers covering 6 villages, three blocks and three districts of selected crops of Punjab were finally chosen for the ultimate analysis. The sample respondents were categorized into different categories using the classification standards given by the Government of Punjab**.**

The farmers were categorized in to three groups on the basis of their operational holdings i.e. Small farmers (up to 2 hectare), Medium farmers (2 10 hectare). The medium and semi medium famers have been clubbed into the medium farmers category. The large farmers are classified as (> 10 hectare).

Table 3.3: Categorization of farms in different size groups

Districts	Farmers Categories			Total number of farmers
	Small (Up to 2 ha)	Medium (2-10 ha)	Large (Above 10 ha.)	
Bathinda	16	36	8	60
Hoshiarpur	16	36	8	60
Sangrur	16	36	8	60
Total framers	48	108	24	180

3.3 Collection of Data

The study was based on secondary as well as primary data. The secondary data related to area, production and yield, time series data pertaining to the prices of paddy, maize and cotton were collected from the office of the market committees of the sample markets. Weekly data on wholesale prices for the period March, 2010 to April, 2014 were taken from the records maintained by the APMC and AGMARKNET of selected markets. The number of observations were 190, 188 and 207 for rice, American Cotton and maize respectively. From each state, one market was selected on the basis of availability of prices data. Secondary data of cotton was collected from different states i.e. Bathinda (Punjab), Mansa (Punjab) , Akola (Maharastra), Rajkot (Gujrat) and Surendranagar (Gujrat) markets of India. Maize wholesale price data were collected from Hoshiarpur (Punjab), Nawanshahar (Punjab), Bangalore (Karnataka), Vijayanagaram (A.P.) and Ahmednagar (Maharastra) markets. Rice wholesale price data were collected from Sangrur (Punjab), Burwan (West Bengol), Shahjahanpur (U.P.) and West godavari (A.P.). The primary data of paddy (basmati), cotton (American) and maize (Kharif) were collected from the farmers through personal interview method using schedules regarding net price, total production, total cost, marketable surplus, farm size, credit, distance from market, market services, price of the commodities, storage facility, transportation facility, net operated area, etc

3.4 Statistical Analysis

In order to achieve the stipulated objectives of the present study, statistical techniques such as averages and percentages were applied in the analysis along with Augmented Dickey Fuller test, Johanson co-integration test, Pair-Wise Granger causality and Error Correction Method were used to work out integration.

3.4.1 Growth rates

To study growth in area, production and productivity of paddy,cotton and maize in major growing districts and the state as a whole, compound growth rates (CGR) were worked out by using the following formula:

$$yt = ab^t Ut$$

Where,

yt is area/production/productivity of paddy, cotton and maize in time period t

t is time element which takes the value 1,2,3…….n

a and b are parameters to be estimated and

b= (1+g) ,where g is the rate at which y grows every year in relation to its value in preceding year.

U_t is the disturbance term.

On logarithmic transformation of equation (i) we get

Log yt = log a+ t log b +log Ut

This can be expressed as :

y*t = a*+b*t+U*t

Where y*t=log yt; a*=log a; b*=log b and U*t= log Ut

The estimate of compound growth rate can be oAmericanained as

g=(antilog b*- 1)x100

3.4.2 Variability in prices

The variability in prices has been computed for the selected crop.The variability has been computed by using the following formula:

Coefficient of variation (CV %) = $\frac{Standard\ Deviation}{Mean} \times 100$

3.4.3. Pricing efficiency

The pricing efficiency refers to the structural characteristics of the marketing system, where the sellers are able to get the true value of their produce and consumers receive true worth of their money. In the present study, the factors considered in the determination of price in the regulated market were operational area, marketable surplus, education, institutional/ non-institutional loan and pattern of the produce sold. The price received by the farmers was taken as the dependent variable. Linear model was the best fit.

$Y = \alpha+\beta_1 X_1+\beta_2 X_2 +\beta_3 X_3+\beta_4 X_4 +\beta_5 X_5+\beta_6 X_6 +e$

Where, Y = Price received by the farmers

α = Constant term

X_1 = Operational area (ha)

X_2 = Marketable surplus (qtl)

X_3 = Time of sales (Sell Immediately after harvest=0, with hold produce and sell later=1)

X_4= Use of dryer (only used for maize crop) (Use dryer=1, Not use dryer=0)

X_5 = Education (up to V^{th} =0, others=1)

X_6 = Non-institutional loan (Non- institutional loan=1, Institutional loan=0)

β_1, β_2, β_3, β_4, β_5 and β_6 are regression coefficients of X_1 to X_6.

3.4.4 . Market integration

Market integration is central to design of any agricultural policy in many developing countries and has been an important area of agricultural market research. The literature on market co-integration can be divided into four broad categories:

1. Unit root test – Augmented Dickey-Fuller test (ADF test) – To check the stationarity.
2. Johanson co-integration test - to check the number of co-integrated markets

3. Pair-Wise Granger causality Test- to test the direction of causality among markets (unidirectional and bi-directional)
4. Vector Error Correction Model- to check extent of influence of one market and another.

3.4.4.1 To Check the Series for Stationarity:

A Time series is stationary, its mean, variance and auto covariance at various lags remain same that is they are time invariant. It is often assumed that the economic time series are stationary and relations between stationary series are in the state of equilibrium.

The unit root test is used to find the order of integration in order to know whether a series is stationary or not. Dickey fuller (1979 and 1981) have proposed a test statistic that is different from the conventional 't' test statistic for testing the presence of unit root in univariate series. Dickey and Fuller have shown that under the null hypothesis $H_0 : \gamma = 0$ the estimated value of the coefficient of P_{it-1} in equation (1) follows the (tau) statistic. Later on the tau statistic or test has come to be known as Dickey- Fuller (DF) test statistic.

$$\Delta p_{it} = a_0 + \gamma p_{it-1} + \varepsilon_t \qquad \text{.....(1)}$$

In conducting DF test, it was assumed that the error term ε_t was uncorrelated in equation (1). But when this assumption is violated Dickey and Fuller have developed a Augmented Dickey Fuller (ADF) test.

Markets are considered to be integrated when a long-term equilibrium exists between them. However, price series need to be stationary to establish such relationship. In the absence of stationarity, the estimated relationship may be spurious, without any significant meaning. The relationship is also expected to hold good when price series are found stationary at the same level of differencing. The Augemented Dickey-Fuller (ADF) is the test for the unit-root in a time series sample.The autoregressive formulation of the ADF test with a drift term is given by equation (2).

$$\Delta p_{it} = a_0 + \gamma P_{it-1} + \sum_{i=2}^{n} \beta_i \Delta p_{it-j+1} + \varepsilon_t \qquad \text{..... (2)}$$

where p_{it} is the price in market i at the time t, $\Delta p_{it} = (p_{it} - p_{it-1})$ and a_0 is the intercept or drift term.The joint hypothesis to check the presence of unit root is: $H_0 : \gamma = a_0 = 0$ using ϕ_1 statistics. Failure of the rejection of null hypothesis means that the series is non-stationary.

3.4.4.2 Co-integration Test

For co integration analysis, the Johansen (1988) maximum likelihood estimator was chosen over the Engle and Granger (1987) two step procedure.The Johansen procedure is a multivariate generalization of the Dickey Fuller test and formulation is as follows:

$$p_{it} = A_1 p_{it-1} + \varepsilon_t \qquad \text{..... (3)}$$

So that

$$\Delta p_{it} = A_1 p_{it-1} - p_{it-1} + \varepsilon_t \quad \text{.....(4)}$$

$$\Delta p_{it} = (A_1 - I) p_{it-1} + \varepsilon_t \quad \text{.....(5)}$$

$$\Delta p_{it} = \pi p_{it-1} + \varepsilon_t \quad \text{.....(6)}$$

where, p_{it} and ε_t are (n×1) vectors; A_1 is an (n×n) matrix of parameters;I is an (n×n) identity matrix and π is the $(A_1 - 1)$ matrix.

The rank of $(A_1 - 1)$ matrix equals the number of co-integrating vectors.The crucial thing to check is whether $(A_1 - 1)$ consists of all zeroes or not.If it does,then it implies that all the (p_{it}) in the above matrix are unit root processes,and there is one linear combination of which is stationary,and hence the variables are not co integrated. The rank of matrix π is equal to the number of independent co integrating vectors.

Trace test was used to determine the presence of co integrating relationship between the price series.Using the estimates of the characterstic roots, the test for the number of characteristic roots that are insignificantly diifferent from unity was conducted using the following statistics:

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{n} \ln\left(1 - \hat{\lambda}_j\right) \quad \text{.....(7)}$$

where, λ_j denotes the estimated values of the characteristic roots (eigen value) oAmericanained from the estimated π matrix; and T is the number of usable observations.The Eigen values representing the strength of the correlation between the first difference and error-correction.

3.4.4.3 To test the direction of causality among markets:

When a co-integration relationship is present for variables, Granger causality test (Granger,1969) can be used to analyze the direction of this co movement relationship. Whether market p_1 Granger causes market p_2 or vice versa was checked using equation (8):

$$p_{it} = c + \sum_{j}^{n} \left(\phi p_{1t-j} + \delta_j p_{2t-j}\right) + \varepsilon_t \quad \text{.....(8)}$$

A simple test of the joint significance of δ_j was used to check the Granger causality, i.e.

$H_0 : \delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$

3.4.4.4 To check extent of influence of one market and another :

Vector Error Correction Model (VECM) to find the short-term disturbance and the adjustment mechanism to estimate the speed of adjustment.The ECM explains the difference in y_t and $y_{t\,1}$ (i.e.Δy_i) by equation (9):

$$\Delta y_t = a + \mu\left(y_{t-1} - \beta x_{t-1}\right) + \sum_{i=0}^{i=1} \delta_i \Delta x_{t-i} + \sum_{i=1}^{i=t} \gamma_i \Delta y_{t-i} \quad \text{.....(9)}$$

It includes the lagged differences in both x and y, which have a more immediate impact on the value of Δy_t. For example,if Δx_t increases by one percentage point, then Δy_t would increase by same percentage point. The value of β indicating the percentage point would change in the long run in response to change in x. Therefore, part of change in Δy_t could be explained by y correcting itself in each period to ultimately reach the long-~~run~~ path with x. The amount by which the value of y changes in each period is signified by μ. This coefficient (μ) indicates the percentage of the remaining amount that y has to move to return to its long run path with x. In explaining changes in a variable ,the ECM accounts for its long run relationship with other variable. The coefficient of error-correction term indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long-run equilibrium and if it is positive and zero, the series diverge from equilibrium.

The advantage of the error correction model is that it allows for short run dynamics as well as an assessment of the degree of convergence towards the long run relation as shown by the co integration. The model is formulated by including the respective variables in their first differences, their lagged values and lagged residuals from the cointegration equation.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter gives an overview of the results and discussion, which are presented in the following sections:

Section I: Information related to selected crops in Punjab

Section II: Analysis of prices at farm level

Section III: Market integration among selected markets for important crops,

Section IV: Suggest measures to improve market efficiency.

Section I: INFORMATION RELATED TO SELECTED CROPS IN PUNJAB

4.1.1.1 Scenario of Cotton Production in Punjab

The analysis of year-wise area under American cotton in Punjab Area was highest in 1988-89. The production of American cotton in Punjab varied from 339 thousand hectare in 1962-63 to 2572 thousand hectare in 2006-07. The productivity of American cotton in Punjab varied between 269 kg per hectare (1960-61) to 763 kg per hectare (2006-07). (ANNEXURE-I)

Table 4.1.1 Compound Growth rates of area, production and yield of American cotton in Punjab, 1960-61 to 2012-13

Period	Compound Growth Rates					
	Area		Production		Yield	
	Coefficient	t value	Coefficient	t value	Coefficient	t value
1960-61 to 1969-70	-0.3678^{NS}	-0.451	3.0431**	2.488	3.6058*	7.699
1970-71 to 1979-80	9.7552*	12.12	8.6315*	7.020	-1.3152**	-2.985
1980-81 to 1989-90	2.4441^{NS}	1.435	11.2793*	4.021	8.6129**	2.889
1990-91 to 1999-2000	-3.6589**	-2.387	-13.2342*	-4.308	-9.9278 *	-3.371
2000-2001 to 2012-13	2.0460***	1.991	5.1089**	2.252	3.0083***	1.892

*, **, *** Significant at 1,5 and 10 per cent level of significance
Source: Statistical Abstract of Punjab (various issues)

The above Table 4.1.1 shows that the area has maximum value in the year of 1970-71 to 1979-80 at the C.G.R.s of 9.7552 per cent per annum while it fluctuates in the other considered years. The maximum downfall is in the year 1990-91 to 1999-2000 at the value -3.6589 per cent per annum . The maximum production occurs in the year 1980-81 to 1989-90 having the value of 11.2793 per cent annum while the trough value was -13.2342 per cent per annum. The peak value of yield occurs in the year 1980-81 to 1989-90 having value of 8.6129

per cent per annum while the crest value is -9.9278 per cent per annum in the year 1990-91 to 1999-2000.

The table reveals that the American cotton crop registered a decline in growth of area by 0.37 percent and which were non-significant The production of American cotton registered positive growth of 3.04 percent per annum in state. These growth rates were found significant at 10 percent level of significant. The decline in area under American cotton has been compensated by increase in productivity during 1960-61 to 1969-70.During 1970-71 to 1979-80, the compound growth rate of area of cotton was 9.75 percent and production (8.63) which were significant, while the C.G.R.s of yield (-1.31) was significant. During the next decade i.e. 1980-81 to 1989-90, the growth rate of area (2.44) was positive and non-significant while the C.G.Rs of production (11.27) and yield (8.61) were found to be significant. During the next decade i.e. 1990-91 to 1999-2000, the growth rates turned to be negative. The C.G.R.s of area (-3.66), production (-13.23) and yield (-9.98) were found to be significant. The pest problem of cotton crop became serious in nineties causing fast deceleration in yield at -9.98 per cent. This was a period of serious turmoil for cotton growers pushing a number of them in heavy dept and even in suicide trap. However, revival of cotton crop due to introduction of Bt strains since 2002 has given a new lease life to them. Consequently, during the decade of 2000-01 to 2012-13, the growth rates of area (2.05 %), production (5.11%) and yield (3.01%) were positive and significant.

4.1.1.2 Scenario of Maize Production in Punjab

In this section, an attempt has been made to highlight the present scenario of maize in the Punjab state. The area under maize in Punjab has been consistently decreasing over the period of time. The area under maize decreased from 577 thousand hectares in 1975-76 to 131 thousand hectares in 2012-13, the area under maize decreased consistently with some variations.With the continuous increase in productivity of rice from 850 Kg per hectare in 1962-63 to 3981 Kg per hectare in 2011-12 along with increase in production during the period of 1962-63 to 1972-73, the production of maize jumped from 308 thousand mt tonnes to 906 thousand mt tones.(ANNEXURE-II)

The following analysis of table 4.1.2 clearly reveals that the area has maximum value in the year of 1960-61 to 1969-70 at the C.G.R. of 5.8703 per cent per annum. The maximum downfall was in the year 1980-81 to 1989-1990 at the value -5.6449 per cent per annum. The maximum production occurs in the year 1960-61 to 1969-70 having the value of 9.8714 per cent per annum while the valley value is -6.8324 per cent per annum in the year 1980-81 to 1989-90. The peak value of yield occurs in the year 2000-2001 to 2012-13 having value of 3.9162 per cent while the crest value is -1.2646 per cent per annum.

The CGR's of area, production and productivity was 5.87, 9.87 and 3.78 per cent respectively and significant during 1960-61to 1969-70.During the period 1970-71 to

1979-80 area and production were estimated to -3.66, -3.47 were found to be negative and significant and 0.18 per cent which were non-significant.During the period 1980-81 to 1989-90 the growth rate of area and production of maize was estimated to -5.64, -6.83, per cent and productivity -1.26 per cent which was non-significant. In the period 1990-91 to 1999-2000 area -2.04 per cent found to be negative and significant, production 0.45 and yield 2.61 pec cent were found to be positive and significant.During the 2000-01 to 2012-13, the growth rates of area (-1.96) was negative and significant while the C.G.Rs of production (1.89) and yield (3.91) were found to be significant.Punjab has shown declining trend in area in all decades except first decade 1960-61 to 1969-70, where area increase significantly. There was a persistent decline in the area under maize during post *Green Revolution* period because the attention was shifted to the cultivation of wheat and paddy in the state. The average productivity of maize in all decade was found to be positive and significant except second and third decade. At the state level, it was also found positively significant decades after decades. The introduction, awareness and adoption of improved cultivars were responsible in this increase in productivity of maize in Punjab.

Table 4.1.2 Compound Growth rates of area, production and yield of maize in Punjab, 1960-61 to 2012-13

Period	Compound Growth Rates					
	Area		Production		Yield	
	Coefficient	t value	Coefficient	t value	Coefficient	t value
1960-61 to 1969-70	5.8703 *	12.533	9.8714 *	5.587	3.7845***	1.970
1970-71 to 1979-80	-3.6581 *	-4.058	-3.4726*	-3.432	0.1762NS	0.125
1980-81 to 1989-90	-5.6449 *	-10.260	-6.8324 *	-4.595	-1.2646 NS	-0.726
1990-91 to 1999-2000	-2.0416 *	-4.361	0.5738 NS	0.453	2.6147**	2.289
2000-2001 to 2012-13	-1.9601*	-7.038	1.8862***	2.100	3.9162 *	4.938

*, ** , *** Significant at 1,5 and 10 per cent level of significance
Source: Statistical Abstract of Punjab (various issues)

4.1.1.3 Scenario of Rice Production in Punjab

In this section, an attempt has been made to highlight the present scenario of paddy in the Punjab state. The trends rice crops with respect to area, production and productivity has been examined. Over the last few years, the Punjab state has undergone a numerous changes in agriculture sector paddy cultivation in particular. Therefore, the results corresponding to

the growth pattern of area, production and productivity of rice in the Punjab state during 1960 to 2013.

The areas under rice in Punjab has been consistently increasing in the last few years. The area under rice increased from 228 thousand hectares in 1960-61 to 293 thousand hectares in 1965-66 but after this year a decrease in area under rice was observed during the years 1966-67, the area under rice increased consistently with some variations. The highest area under rice was noticed during the year 2012-13. With the continuous increase in productivity of rice from 1035 Kg per hectare to 3998 Kg per hectare along with increase in production during the period of 2007 to 2013, the production of rice jumped from 10138 thousand mt tonnes to 11390 thousand mt tonnes.(ANNEXURE-III)

The following analysis in table 4.1.3 shows that the all decades area under rice crop showed positive and significant growth rate in the Punjab state.Highest growth in area, was observed during seventies when growth rate was 12.6938 per cent per annum, while it fluctuates in the other considered years. The minimum value is in the year 2000-2001 to 2012-13 at the value 1.0208 per cent per annum. The maximum production occurs in the year 1970-71 to 1979-80 having the value of 18.6593 per cent per annum, while the valley value is 1.9869 per cent per annum in the year 2000-2001 to 2012-13. The peak value of yield occurs in the year 1970-71 to 1979-80 having value of 5.2854 per cent per annum, while the crest value is 0.0179 per cent per annum in the year 1990-91 to 1999-2000.

Table 4.1.3: Compound Growth rates of area, production and yield of rice in Punjab, 1960-61 to 2012-13

Period	Compound Growth Rates					
	Area		Production		Yield	
	Coefficient	t value	Coefficient	t value	Coefficient	t value
1960-61 to 1969-70	5.2711*	13.493	9.3428*	8.662	3.8739*	4.483
1970-71 to 1979-80	12.6938*	11.031	18.6593*	14.048	5.2854*	5.892
1980-81 to 1989-90	5.3390*	8.557	6.6917*	5.441	1.2957NS	1.655
1990-91 to 1999-2000	2.5174*	5.776	2.5353*	4.397	0.0179 NS	.040
2000-2001 to 2012-13	1.0208*	6.853	1.9869*	6.551	0.9558*	3.355

*, **, *** Significant at 1,5 and 10 per cent level of significance
Source: Statistical Abstract of Punjab (various issues)

Table 4.1.3 showed that During 1960-61 to 1969-70, the compound growth rate of area, production and yield were 5.27, 9.34 and 3.87 per cent per annum, which were significant. During the next decade i.e. 1970-71 to 1979-80, the growth rates of area, production and yield were 12.69, 18.66 and 5.28 percent which were positive and significant. During the decade i.e. 1980-81 to 1989-90 the growth rates of area and production were 5.34 and 6.69 per cent which were positive and significant. While the C.G.R. of yield was 1.29 percent which was non-significant. During the next decade i.e. 1990-91 to 1999-2000 the growth rates of area and production were 2.51 and 2.53 per cent which were positive and significant while the C.G.R. of yield was 0.02 again non-significant. During the last decade i.e., the growth rates of area, production and yield were 1.02, 1.99 and 0.95 percent which were positive and significant.

Section II: ANALSIS OF PRICES AT FARM LEVEL

4.2 Socio economic profile of sample farmers

The pricing efficiency refers to the structural characteristics of the marketing system, where the seller are able to get the true value of their produce and the consumers receive true worth of their money. Before going for discussion on price efficiency in selected crops, it is relevant here to have an overview of the socio-economic characteristics of the respondents. The socio-economic characteristics of selected crops growers includes structure of family size, age, education,operational farm size, extension contacts, debt position of farmers,cropping pattern, cost and returns structure and marketable surplus.

4.2.1 Family Size

The family composition of the sample households for the American cotton crop is shown in Table 4.2.1. The average farm household had 5.65 members comprising 1.86 member male, 1.79 member female and 2.00 children. Category wise, small, medium and large farm households had family size of 6.12, 5.81 and 4.99 respectively. The average number of male members per household varied from 1.62 on large farms to 2.06 on the small farms. Similarly the average number of female members per household varied from 1.50 on large farms to 1.94 on small farms. The average numbers of children per household were the highest on large farms (1.87) and the least on small farms (2.12).Thus, in all the farm size categories mentioned above, average male members were found to be more than their female counterparts.

Table 4.2.1: Crop-wise family structure of selected farmers in Punjab, 2013-14

(Number)

Family Structure	Small	Medium	Large	Overall
American Cotton				
Male	2.06	1.89	1.62	1.86
Female	1.94	1.92	1.5	1.79
Children	2.12	2.00	1.87	2.00
Family Size	6.12	5.81	4.99	5.65
Maize				
Male	2.05	2.14	2.00	2.06
Female	1.83	2.22	2.12	2.05
Children	2.00	2.72	1.75	2.16
Family Size	5.88	7.08	5.87	6.28
Paddy				
Male	2.06	1.83	1.87	1.92
Female	1.75	1.86	2.00	1.87
Children	2.37	2.44	1.62	2.14
Family Size	6.18	6.13	5.49	5.93

Table 4.2.1 indicated that the average family size for the maize crop. An average farm was worked at by 6.28 members, while the same was 5.88, 7.08 and 5.87 members on small, medium and large farms respectively. On an average farm, 32.80 percent of total family members were male, while 32.64 and 34.39 percent were female and children respectively. The proportions of children were higher than that of female and male. This proportion came to be 31.23 percent on small farms, 37.60 percent on medium farms and 31.17 percent on large farms.

The family composition of the sample households for Basmati paddy crop is shown in Table 4.2.1. The average farm household had 5.93 members comprising 1.92 member male, 1.87 member female and 2.14 children. Category wise, small, medium and large farm households had family size of 6.18, 6.13 and 5.49 respectively. The average number of male members per household varied from 1.83 on medium farms to 2.06 on the small farms. Similarly the average number of female members per household varied from 1.75 on small farms to 2 on large farms. The average numbers of children per household were the highest on large farms (1.62) and the least on medium farms (2.44).Thus, in all the farm size categories

mentioned above, average female members were found to be more than their male counterparts except small category.

4.2.2 Age

The table focuses on the age factor for the American cotton crop. Table 4.2.2 showed that majority i.e. 53.33 percent of the total farmers belonged to the age group of 35-55 years, followed by 25 percent belonging to the age group of up to 35 years. The remaining 21.67 percent were in the age group of above 55 years. Size wise analysis revealed the similar pattern as was observed in case of overall situation. The majority of farmers were in the age group of 35-55 years. This proportion came to be 43.75, 55.56 and 62.5 percent of small, medium and large farmers respectively.

Table 4.2.2: Distribution of farmers according to their age

Age (years)	Small		Medium		Large		Overall	
	No.	%age	No.	%age	No.	%age	No.	%age
American Cotton								
Up to 35	5	31.25	8	22.22	2	25.00	5.00	25.00
35-55	7	43.75	20	55.56	5	62.50	10.67	53.33
Above 55	4	25.00	8	22.22	1	12.50	4.330	21.67
Maize								
Up to 35	5	31.25	8	22.22	2	25.00	15	25.00
35-55	8	50.00	18	50.00	5	62.50	31	51.67
Above 55	3	18.75	10	27.78	1	12.50	14	23.33
Paddy								
Up to 35	4	25.00	9	25.00	3	37.50	5.33	29.17
35-55	7	43.75	20	55.56	4	50.00	10.33	49.77
Above 55	5	31.25	7	19.44	1	12.50	4.33	21.66

The information given in Table 4.2.2 focuses on maize crop showing that majority i.e. 51.67 percent of the total farmers belonged to the age group of 35-55 years, followed by 25 percent belonging to the age group of up to 35 years. The remaining 23.33 percent were in the age group of above 55 years. Size wise analysis revealed the similar pattern as was observed in case of overall situation. The majority of farmers were in the age group of 35-55 years. This proportion came to be 50, 50 and 62.5 percent small, medium and large farmers respectively.

Table 4.2.2 concentrating on Basmati paddy crop showed that majority i.e. 49.77 percent of the total farmers belonged to the age group of 35-55 years, followed by 29.17

percent belonging to the age group of up to 35 years. The remaining 21.66 percent were in the age group of above 55 years. Size wise analysis revealed the similar pattern as was observed in case of overall situation. The majority of farmers were in the age group of 35-55 years. This proportion came to be 43.75, 55.56 and 50 percent of small, medium and large farmers respectively.

4.2.3 Educational profile

The education of the family members particularly the household head gives impetus to the adoption of new farm initiatives. Among the selected households for American cotton crop, the households' head refers to family member who is responsible for important farm decisions. Education profile of the sample households is presented in Table 4.2.3. Out of the total sample of 60, of the famers i.e. 15.04 per cent were found to be illiterate. The proportion of overall farmers who attained education at up to five, matriculation, sr. secondary and graduation level of education were 26.16 per cent, 14.35 per cent, 29.17 per cent and 15.28 per cent respectively.

It has been observed that level of illiteracy was more in small (31.25 per cent) as compared to medium (13.89 per cent).The percentage of farmers who have the education up to 5th standard were 43.75, 22.22 and 12.5 in case of small, medium and large farmers respectively. The farmers having the education level up to matriculation were 12.50 and 30.56 per cent small and medium farmers respectively. The percentage of farmers who have the education up to sr. secondary standard were 12.50, 25 and 50 in case of small, medium and large farmers respectively.The percentage of farmers who have the education up to graduation and above were 8.33 and 37.5 in case of medium and large farmers respectively.

The education level of the head of the families of various farm size categories for maize crop is presented in the table (4.2.3). It was observed that at the overall level 32 per cent farmers have the matriculation level of education, 11 per cent of the farmers have got the education up to 5th class, 22 per cent were illiterate, 17 per cent farmers have the sr. secondary level of education and around 18 per cent farmers have the graduation level of education.

It has been observed that level of illiteracy was more in small (37.5 per cent) as compared to medium (16.67 per cent), large (12.5) per cent. The percentage of farmers who have the education up to 5th standard were 25, 5.56, and 12.5 in case of small, medium and large farmers respectively. The farmers having the education level up to matriculation go for the profession of farming due to less opportunity for non-agricultural employment.

Table 4.2.3: Distribution of farmers according to their education

Education	Small		Medium		Large		Overall	
	No.	%age	No.	%age	No.	%age	No.	%age
American Cotton								
Illiterate	5	31.25	5	13.89	0	0.00	3.33	15.04
Up to 5	7	43.75	8	22.22	1	12.50	5.33	26.16
Matric	2	12.50	11	30.56	0	0.00	4.34	14.35
Sr. Secondary	2	12.50	9	25.00	4	50.00	5.00	29.17
Graduation and above	0	0.00	3	8.33	3	37.50	2.00	15.28
Total	16	100	36	100	8	100	20	100
Maize								
Illiterate	6	37.5	6	16.67	1	12.5	13	21.67
Up to 5	4	25	2	5.56	1	12.5	7	11.67
Matric	2	12.5	16	44.44	1	12.5	19	31.66
Sr. Secondary	3	18.75	5	13.89	2	25	10	16.67
Graduation and above	1	6.25	7	19.44	3	37.5	11	18.33
Total	16	100	36	100	8	100	60	100
Paddy								
Illiterate	3	18.75	7	19.44	0	0.00	3.33	16.67
Up to 5	5	31.25	7	19.44	1	12.50	4.33	21.67
Matric	4	25.00	13	36.11	1	12.50	6.00	30.00
Sr. Secondary	3	18.75	6	16.67	4	50.00	4.33	21.66
Graduation and above	1	6.25	3	8.34	2	25.00	2.00	10.00
Total	16	100	36	100	8	100	20	100

The education of the family members particularly the household head gives impetus to the adoption of new farm initiatives. Among the selected households for Basmati paddy crop, the households' head refers to family member who is responsible for important farm decisions. Education profile of the sample households is presented in Table 4.2.3. Out of the total sample of 60, majority of the famers i.e. 16.67 per cent were found to be illiterate. The proportion of overall farmers who attained education at up to five, matriculation, sr. secondary and graduation level of education were 21.67 per cent, 30 per cent, 21.66 per cent and 10 per cent respectively.

It has been observed that level of illiteracy was more in small (18.75 per cent) as compared to medium (19.44 per cent).The percentage of farmers who have the education up to 5th standard were 31.25,19.44 and 12.5 in case of small, medium and large farmers respectively. The farmers having the education level up to matriculation were 25, 36.11 and 12.5 per cent small medium and large farmers respectively. The percentage of farmers who have the education up to sr. secondary standard were 18.75, 16.67 and 50 in case of small, medium and large farmers respectively.The percentage of farmers who have the education up to graduation and above were 6.25 ,8.34 and 25 percent in case of small,medium and large farmers respectively.

4.2.4 Structure of Operational Farm Size

An adequate farm size may improve the operational efficiency of the farm and hence enhance the farm productivity. Table 4.2.4 shows the structure of operational area of sample farm household for American cotton. Table shows that small farmers owned 1.24 ha, medium farmers 4.87 ha and large farmers 13.05 ha of total operational area. Small farmers leased in 0.46 ha and medium farmers 0.56 ha of total operational area. Only medium farmers leased-out 0.20 hectare of the total owned land.The total operational area in the case of small, medium and large farmer worked out to be 1.70 ha, 5.23 ha, and 13.05 ha respectively. The overall operational area on respondent farmers was 6.66 hectares. The proportion of owned land, leased-out and leased in land on average farm was 6.39 ha, 0.07 ha and 0.34 ha respectively. The proportion of owned land in operational area was 1.24 ha, 4.67 ha and 13.05 ha respectively on small, medium and large farm. The overall operational area on respondent farmers was 6.32 hectares.

The data given in Table 4.2.4 for maize crop showed that the operational area on small farms was 1.44 hectares. Out of this, 1.31 hectares was owned land while 0.13 hectare was leased-in land. Similarly, the operational area on medium farms came to be 5.30 hectare, of which 4.38 hectares was owned land and the remaining 1.30 hectare was leased-in land. However, the medium farmers leased-out 0.38 hectare of owned land. The operational area of medium farms was found to 4 hectare in the district.

Similarly, the operational area of large farmers was 13.40 hectare, where 11.84 hectare was owned land and 1.80 hectare was leased-in land. Overall the operational farm size worked at 6.77 hectare. The owned land accounted for 5.83 hectare of the operational area, while remaining 1.15 hectare was leased-in land. However, only 0.21 hectare of owned land was leased-out. This showed that leased-in area was in direct relationship with the farm size i.e. it increased with the increase in farm size. This may be due to higher level of resources with the larger farmers as compared to the smaller ones.

Table 4.2.4: Structure and average operational farm size of the selected farmers (ha)

Particulars	Small	Medium	Large	Overall
American Cotton				
(1) Owned Land	1.24	4.87	13.05	6.39
(2) Leased-out land	0.00	0.20	0.00	0.00
(3) Owned Operational Land 3 =(1-2)	1.24	4.67	13.05	6.32
(4) Leased-in Land	0.46	0.56	0.00	0.34
Total Operational Land (3+4)	1.70	5.23	13.05	6.66
Maize				
(1) Owned Land	1.31	4.38	11.84	5.83
(2) Leased-out land	0.00	0.38	0.24	0.21
(3) Owned Operational Land 3 =(1-2)	1.31	4.00	11.60	5.62
(4) Leased-in Land	0.13	1.30	1.80	1.15
Total Operational Land (3+4)	1.44	5.30	13.40	6.71
Basmati paddy				
(1) Owned Land	1.26	5.39	12.24	6.30
(2) Leased-out land	0.00	0.13	0.61	0.25
(3) Owned Operational Land 3 =(1-2)	1.26	5.26	11.63	6.05
(4) Leased-in Land	0.28	0.28	0.00	0.19
Total Operational Land (3+4)	1.54	5.54	11.63	6.24

An adequate farm size may improve the operational efficiency of the farm and hence enhance the farm productivity. Table 4.2.4 shows the structure of operational area of sample farm household for Basmati paddy crop. Table shows that small farmers owned 1.26 hectares, medium farmers 5.39 hectares and large farmers 12.24 hectares of total operational area. Small farmers leased in 0.28 hectares and medium farmers 0.28 hectares of total operational area. Only medium and large farmers leased out 0.13 hectare and 0.61 hectare of the total owned land.The total operational area in the case of small, medium and large farmer worked out to be 1.54 hectares, 5.54 hectares, and 11.63 hectares respectively. The overall operational area on respondent farmers was 6.24 hectares. The proportion of owned land, leased out and leased in land on average farm was 6.30 hectares, 0.25 hectares and 0.19 hectares respectively. The proportion of owned land in operational area was 1.26 hectares, 5.26 hectares and 11.63 hectares respectively on small, medium and large farm. The overall operational area on respondent farmers was 6.05 hectares.

4.2.5 Extension Contacts

The results presented in Table (4.2.5) showed that highest proportion for American cotton crop was that 45 percent of total farmers were having extension contacts with PAU experts, followed by 40 per cent at TV programmes and 31.66 percent with KVK/RRS. The lowest proportion i.e. 30 percent and 28.33 percent each was having extension contacts with ADO/ASI and Kisan fairs. The size wise analysis also depicted the similar pattern of extension contacts. The highest proportion having extension contacts with PAU was 43.75, 44.44 and 50 percent of small, medium and large farmers respectively. The second major extension contact was TV for small and medium farmers followed by KVK/RRS for small and medium farmers.

Table 4.2.5: Distribution of farmers according to the extension contacts

(Multiple Response)

Extension Contacts	Small		Medium		Large		Overall	
	No.	%age	No.	%age	No.	%age	No.	%age
American Cotton								
ADO/ASI	4	25.00	11	30.55	3	37.50	18	30.00
PAU	7	43.75	16	44.44	4	50.00	27	45.00
KVK/RRS	5	31.25	12	33.33	2	25.00	19	31.66
TV	6	37.50	14	38.88	4	50.00	24	40.00
Fair	4	25.00	10	27.78	3	37.50	17	28.33
Maize								
ADO/ASI	6	37.50	12	33.33	3	37.50	21	35.00
PAU	8	50.00	12	33.33	3	37.00	23	38.33
KVK/RRS	4	25.00	8	22.22	2	25.00	14	23.33
TV	6	37.50	7	19.44	4	50.00	17	28.33
Fair	5	31.25	9	25.00	2	25.00	16	26.67
Paddy	--							
ADO/ASI	7	43.75	11	30.56	4	50.00	22	36.67
PAU	9	56.25	13	36.11	5	62.50	27	45.00
KVK/RRS	5	31.25	7	19.44	3	37.50	15	25.00
TV	4	25.00	8	22.22	3	37.50	15	25.00
Fair	5	31.25	10	27.78	2	25.00	17	28.33

A perusal of Table 4.2.5 shows that for maize crop the highest proportion was that 38.33 percent of total farmers were having extension contacts with PAU experts, followed by 35 percent with ADOs/ASIs and 28.33 percent in the TV programmes. The lowest proportion i.e. 23.33 percent and 26.67 percent each was having extension contacts with KVK/RRS and *Kisan* fairs. The size wise analysis also depicted the similar pattern of extension contacts. The highest proportion having extension contacts with PAU was 50, 33.33 and 37 percent of small, medium and large farmers respectively. The second major extension contact was TV for small and large farmers while the same was ADO/ASI for small and medium farmers.

The results presented in Table 4.2.5 showed that highest proportion for Basmati paddy growes 45 percent were having extension contacts with PAU experts, followed by 36.67 per cent at ADO/ASI and 28 percent with fair. The lowest proportion i.e. 25 percent each was having extension contacts with KVK/RRS and TV. The size wise analysis also depicted the similar pattern of extension contacts. The highest proportion having extension contacts with PAU was 56.25, 36.11 and 62.50 percent of small, medium and large farmers respectively. The second major extension contact was ADO/ASI for small, medium and large farmers while the same was KVK/RRS for small and large farmers.

4.2.6.1 Loan obtained by American cotton growers

It is clear from Table 4.2.6.1 for American cotton crop that per hectare total debt on an average farmer worked out to be Rs.33931 per hectare. Of this, Rs. 23705.67 were taken from institutional sources while the remaining Rs. 10225.33 from non-institutional sources. Among institutional sources the highest amount of debt of the order of Rs. 13409.67 was found to be taken from commercial banks, whereas it was cooperatives from whom Rs. 8953.67 were taken as loan by the farmers. An average farmer took loan of the order of Rs. 6718.67 per hectare from money lenders. Other than these two major sources of loan, there were sources like R.R.B (3.96%), landlords (8.09%) and other non-institutional sources (2.24%).

Total amount of loan was Rs. 41961 per hectare on small farms, Rs. 33559 on medium farms and Rs. 25273 on large farms. Per hectare debt showed an inverse relationship with the farm size. Out of total loan, Rs. 27095, Rs. 23874 and Rs. 19148 on small, medium and large farms respectively was taken from institutional sources. Similar was the trend in case of institutional sources. The smaller size of land holdings may be responsible for the increasing per hectare loan on small farmers as compared to that on larger farmers. This showed that the larger farmers had greater access to institutional sources as compared to the small farmers. That is why the small farmers have to go to the non-institutional sources for getting loan. Out of total loan 35.43, 28.86 and 23.31 per cent on small, medium and large farms respectively was taken from non-institutional sources

Table 4.2.6.1: Source wise magnitude of loan taken by the selected farmers (Rs./ha)

Source of loan	Small		Medium		Large		Overall	
	Amt	%age	Amt	%age	Amt	%age	Amt	%age
(i) Institutional								
Commercial Banks	15245	36.33	13424	40	11560	44	13409.67	39.52
Cooperatives Societies	10236	24.39	9115	27.16	6510	28.59	8953.67	26.39
R.R.B	1614	3.85	1335	3.98	1078	4.1	1342.33	3.96
Total Institutional	27095	64.57	23874	71.14	19148	76.69	23705.67	69.87
(ii) Non-Institutional								
Money Lenders/CA	9346	22.27	6470	19.28	4340	16.52	6718.67	19.8
Landlords	4560	10.87	2450	7.3	1225	4.66	2745	8.09
Others	960	2.29	765	2.28	560	2.13	761.67	2.24
Total Non-Institutional	14866	35.43	9685	28.86	6125	23.31	10225.33	30.13
Total loan (i)+(ii)	41961	100	33559	100	25273	100	33931	100

4.2.6.2 Loan obtained by maize grower

It is clear from Table 4.2.6.2 that per hectare total debt on an average farmer worked at Rs.25676 per hectare. Of this, Rs. 16529.33 were taken from institutional sources while the remaining Rs. 9146.67 from non-institutional sources. Among institutional sources the highest amount of deAmerican of the order of Rs. 9264.67 was found to be taken from commercial banks, whereas it was money lender/commission agents from whom Rs. 6558.67 were taken as loan by the farmers. An average farmer took loan of the order of Rs. 6388 per hectare from cooperatives. Other than these two major sources of loan, there were sources like R.R.B (3.41%), landlords (7.15%) and other non-institutional sources (2.93%).

Total amount of loan was Rs. 33228 per hectare on small farms, Rs. 25169 on medium farms and Rs. 18631 on large farms. Per hectare debt showed an inverse relationship with the farm size. Out of total loan, Rs. 20248, Rs. 16436 and Rs. 12904 on small, medium and large farms respectively was taken from institutional sources. Similar was the trend in case of institutional sources. The smaller size of land holdings may be responsible for the increasing per hectare loan on smaller farmers as compared to that on larger farmers. This showed that the larger farmers had greater access to institutional sources as compared to the smaller farmers. That is why the smaller farmers have to go to the non-institutional sources for getting loan. Out of total loan 39.06, 34.7 and 30.74 per cent on small, medium and large farms respectively was taken from non- institutional sources.

Table 4.2.6.2: Source wise magnitude of loan taken by the selected farmers (Rs./ha)

Source of loan	Small		Medium		Large		Overall	
	Amt	%age	Amt	%age	Amt	%age	Amt	%age
(i) Institutional								
Commercial Banks	11288	33.97	9328	37.06	7178	38.53	9264.67	36.08
Cooperatives societies	7880	23.72	6158	24.47	5126	27.51	6388	24.88
R.R.B	1080	3.25	950	3.77	600	3.22	876.67	3.41
Total Institutional	20248	60.94	16436	65.3	12904	69.26	16529.33	64.38
(ii) Non-Institutional								
Money Lenders/CA	9420	28.35	6128	24.35	4128	22.16	6558.67	25.54
Landlords	2580	7.76	1865	7.41	1065	5.72	1836.67	7.15
Others	980	2.95	740	2.94	534	2.87	751.33	2.93
Total Non-Institutional	12980	39.06	8733	34.7	5727	30.74	9146.67	35.62
Total loan (i)+(ii)	33228	100	25169	100	18631	100	25676	100

4.2.6.3 Loan obtained by paddy grower

It is clear from Table 4.2.6.3 that per hectare total debt on an average farmer worked at Rs. 22576.33 per hectare. Of this, Rs. 15075.33 were taken from institutional sources while the remaining Rs. 7501 from non-institutional sources. Among institutional sources the highest amount of debt of the order of Rs. 8305 was found to be taken from commercial banks, whereas it was cooperatives from whom Rs. 5528.67 were taken as loan by the farmers. An average farmer took loan of the order of Rs. 5323.33 per hectare from money lenders. Other than these two major sources of loan, there were sources like R.R.B (5.50 %), landlords (7.12 %) and other non-institutional sources (2.52 %).

Total amount of loan was Rs. 28424 per hectare on small farms, Rs. 22460 on medium farms and Rs. 16845 on large farms. Per hectare debt showed an inverse relationship with the farm size. Out of total loan, Rs. 18401, Rs. 14970 and Rs. 11855 on small, medium and large farms respectively was taken from institutional sources. Similar was the trend in case of institutional sources. The smaller size of land holdings may be responsible for the increasing per hectare loan on smaller farmers as compared to that on larger farmers. This showed that the larger farmers had greater access to institutional sources as compared to the smaller farmers. That is why the smaller farmers have to go to the non-institutional sources for getting loan. Out of total loan 35.26, 33.35 and 29.62 per cent on small, medium and large farms respectively was taken from non-institutional sources.

Table 4.2.6.3: Source wise magnitude of loan taken by the selected farmers (Rs./ha)

Source of loan	Small		Medium		Large		Overall	
	Amt	%age	Amt	%age	Amt	%age	Amt	%age
(i) Institutional								
Commercial Banks	10240	36.03	8245	36.71	6430	38.17	8305	36.79
Cooperatives societies	6721	23.64	5490	24.44	4375	25.98	5528.67	24.49
R.R.B	1440	5.07	1235	5.50	1050	6.23	1241.67	5.50
Total Institutional	18401	64.74	14970	66.65	11855	70.38	15075.33	66.78
(ii) Non-Institutional								
Money Lenders/CA	7125	25.07	5280	23.51	3565	21.16	5323.33	23.58
Landlords	2118	7.45	1660	7.39	1045	6.20	1607.67	7.12
Others	780	2.74	550	2.45	380	2.26	570	2.52
Total Non-Institutional	10023	35.26	7490	33.35	4990	29.62	7501	33.22
Total loan (i)+(ii)	28424	100	22460	100	16845	100	22576.33	100

4.2.7.1 Cropping Pattern of American cotton growers

Table 4.2.7.1 shows the cropping pattern and cropping intensity on sample farms. Table depicts the both *kharif* season and *Rabi* season. In *kharif* season the area under cotton is more than the area under other crops. The overall area under cotton was 22.92 per cent of the GCA. The area under maize is less than all other crops. In *Rabi* season the area under wheat is more than all other crops. Table also depicts about gross cropped area and net sown area.

On an average farm, during *kharif* season the highest area of the order of 3.04 hectare i.e. 22.92 percent of gross cropped area was under cotton followed by basmati paddy (12.96 per cent), paddy (7.16 per cent) and sugarcane (2.87 per cent).The lowest area to the tune of 0.32 ha (2.41%) under fodder, followed by 0.15 (1.14 %) under maize and 0.07 ha (0.55%) was under miscellaneous crops. It can be observed that in the case of large farmers, the cotton crop occupied highest percentage of gross cropped area (GCA) is 23.21 per cent followed by basmati paddy 12.43 per cent, paddy 7.37 per cent. The sugercane, maize, miscellaneous and fodder crop covered 3.11, 1.34, 0.58 and 1.96 per cent of GCA respectively. Medium farmers grew cotton on 22.40 per cent of the GCA followed by basmati paddy (13.56 per cent), paddy (7.60 per cent) sugarcane (2.21 per cent). The lowest area to the tune of 0.06 ha (0.58%) was under miscellaneous crops followed by 0.10 ha (0.96%) under maize and 0.28 ha (2.69%) under fodder.In case of small farmer,the cotton crop occupied highest percentage of gross cropped area (GCA) was 22.31 per cent followed by,basmati paddy 15.18 per cent, paddy 4.17 per cent and sugercane 2.98 per cent. The lowest area to the tune of 0.17 ha (5.06%) was under fodder crop followed by 0.01 ha (0.30%) under miscellaneous crops.

Table 4.2.7.1: Cropping pattern of cotton growers in Punjab (ha)

Crop	Small		Medium		Large		Overall	
	Area	**%age**	**Area**	**%age**	**Area**	**%age**	**Area**	**%age**
Kharif								
Cotton	0.75	22.31	2.33	22.40	6.05	23.21	3.04	22.92
Paddy	0.14	4.17	0.79	7.60	1.92	7.37	0.95	7.16
Basmati	0.51	15.18	1.41	13.56	3.24	12.43	1.72	12.96
Sugarcane	0.10	2.98	0.23	2.21	0.81	3.11	0.38	2.87
Maize	0.00	0.00	0.10	0.96	0.35	1.34	0.15	1.14
Kharif Fodder	0.17	5.06	0.28	2.69	0.51	1.96	0.32	2.41
Miscellaneous	0.01	0.30	0.06	0.58	0.15	0.58	0.07	0.54
Kharif Cropped Area	1.68	50	5.2	50	13.03	50	6.64	50
Rabi								
Wheat	1.40	41.67	4.61	44.33	11.57	44.39	5.86	44.13
Sugarcane	0.10	2.98	0.23	2.21	0.81	3.11	0.38	2.87
Rabi Fodder	0.16	4.76	0.28	2.69	0.51	1.96	0.32	2.40
Miscellaneous	0.02	0.59	0.08	0.77	0.14	0.54	0.08	0.60
Rabi Cropped Area	1.68	50	5.20	50	13.03	50	6.64	50
Total Cropped Area	3.36	100	10.40	100	26.06	100	13.27	100
Operational Area	1.70		5.23		13.05		6.66	
Cropping Intensity	197.7		198.9		199.7		199.25	

The analysis of the pattern of crops as a whole revealed that wheat crop occupied highest area .Wheat was the most important *Rabi* crop in the selected district covering about 44.13 per cent of the gross cropped area (GCA) followed by 2.87 per cent sugercane,2.40 per cent fodder crops and 0.60 per cent miscellaneous crops. It was observed that in case of large farmers, the wheat crop occupied highest percentage of GCA was 44.39 per cent followed by sugarcane 3.11 per cent. The *Rabi* fodder and miscellaneous crops 1.96 and 0.54 per cent of GCA respectively. In case of medium farmer,the wheat crop occupied highest percentage of gross cropped area (GCA) is 44.33 per cent followed by sugarcane 2.21 per cent, fodder crop 2.69 per cent and miscellaneous 0.77 per cent.Small farmers grew wheat on 41.67 per cent of the GCA followed sugarcane (2.98 per cent), rabi fodder 4.76 per cent and Miscellaneous 0.59 per cent.

It was clear that wheat and cotton were the two most important crops of *rabi* and *kharif* seasons respectively. At the overall level wheat was observed as the predominant

crop in the cropping pattern followed by cotton and basmati paddy with the percentage.Only those farmers go in for paddy crop that have sufficient availability of irrigation water. The preference for cotton over paddy, as indicated by the area allocated to these two crops, can be due to deliberate selection of cotton grower as respondents of the study. Given the trade off between the cotton and paddy, the small farmers supposedly the resource poor farmers, gave preference to cotton because of comparatively higher input requirements in the case of paddy crop. The cropping intensity of the sample farmers was 197.7, 198.9 and 199.7 per cent in case of small, medium and large farmers. And overall percentage of cropping intensity is 199.25.

4.2.7.2 Cropping Pattern of maize growers

The season wise cropping pattern presented in Table 4.2.7.2 indicated that on an average farm, during *kharif* season the highest area of the order of 2.66 hectare i.e. 19.32 percent of gross cropped area was under maize followed by paddy (7.91 per cent), basmati paddy (7.62 per cent) and sugercane (7.55 per cent). The lowest area to the tune of 0.29 ha (2.11%) under fodder, followed by 0.57 ha (4.14%) was under miscellaneous crops.

It was observed that in case of large farmers, the maize crop occupied highest percentage of gross cropped area (GCA) is 19.41 per cent followed by sugercane 8.46 per cent basmati paddy 6.77 per cent and paddy 6.62 per cent. The Miscellaneous and fodder crop covered 5.08 and 1.84 per cent of GCA respectively. Medium farmers grew maize on 18.71 per cent of the GCA followed by paddy (10.48 per cent), basmati paddy (10.29 per cent) sugarcane (5.61 per cent). The lowest area to the tune of 0.22 ha (2.05%) was under miscellaneous crops followed by 0.25 ha (2.34%) under fodder. In case of small farmer,the maize crop occupied highest percentage of gross cropped area (GCA) is 20.77 per cent followed by paddy 10.92 per cent ,basmati paddy 6.34 per cent and sugercane 5.99 per cent. The lowest area to the tune of 0.07 ha (2.46%) was under miscellaneous crops followed by 0.10 ha (3.52%) under fodder crop.

Wheat was the most important *Rabi* crop in the selected district covering about 27.81 per cent of the gross cropped area (GCA) followed by mustard 9.95 per cent, sugercane 7.55 per cent, fodder crops 1.89 per cent and miscellaneous crops 1.45 per cent. It can be observed that in the case of large farmers, the wheat crop occupied highest percentage of GCA was 26.72 per cent followed by mustard 10.44 per cent and sugarcane 8.46 per cent. The *Rabi* fodder and miscellaneous crops 1.51 and 1.05 per cent of GCA respectively. In case of medium farmer,the wheat crop occupied highest percentage of gross cropped area (GCA) is 30.87 per cent followed by mustard 8.7 per cent, sugarcane 5.61 per cent, fodder crop 2.34 per cent and miscellaneous 1.96 per cent.Small farmers grew wheat on 27.11 per cent of the GCA followed by mustard (10.21 per cent), sugarcane (5.99 per cent), rabi fodder 4.23 per cent and Miscellaneous 2.46 per cent.The analysis of the composition of crops as a whole revealed that

wheat crop occupied highest area to the tune of 27.81 per cent which was followed by maize with 19.32 per cent of the GCA. It is very clear that wheat and maize were the two most important crops of *rabi* and *kharif* seasons respectively.

At the overall level wheat was observed as the predominant crop in the cropping pattern followed by maize and paddy.Only those farmers go for paddy crop that have sufficient availability of irrigation water. The preference for maize over paddy, as indicated by the area allocated to these two crops, can be due to deliberate selection of maize grower as respondents of the study. Given the tradeoff between the maize and paddy, the small farmers supposedly the resource poor farmers, gave preference to maize because of comparatively higher input requirements in the case of paddy crop. The cropping intensity of the districts is 197.22, 201.70 and 207.24 per cent in case of small, medium and large farmers. And overall percentage of cropping intensity is 205.22

Table 4.2.7.2: Cropping pattern of maize growers in Punjab (ha)

Crop	Small		Medium		Large		Overall	
	Area	**%age**	**Area**	**%age**	**Area**	**%age**	**Area**	**%age**
Kharif								
Maize	0.59	20.77	2	18.71	5.39	19.41	2.66	19.32
Paddy	0.31	10.92	1.12	10.48	1.84	6.62	1.09	7.91
Basmati	0.18	6.34	1.1	10.29	1.88	6.77	1.05	7.62
Sugarcane	0.17	5.99	0.6	5.61	2.35	8.46	1.04	7.55
Kharif Fodder	0.1	3.52	0.25	2.34	0.51	1.84	0.29	2.11
Miscellaneous	0.07	2.46	0.22	2.05	1.41	5.08	0.57	4.14
Kharif Cropped Area	1.42	50	5.29	49.48	13.38	48.18	6.7	48.65
Rabi								
Wheat	0.77	27.11	3.3	30.87	7.42	26.72	3.83	27.81
Mustard	0.29	10.21	0.93	8.7	2.9	10.44	1.37	9.95
Sugarcane	0.17	5.99	0.6	5.61	2.35	8.46	1.04	7.55
Rabi Fodder	0.12	4.23	0.25	2.34	0.42	1.51	0.26	1.89
Miscellaneous	0.07	2.46	0.21	1.96	0.29	1.05	0.2	1.45
Rabi Cropped Area	1.42	50	5.29	49.48	13.38	48.18	6.7	48.65
Spring maize	0	0	0.11	1.04	1.01	3.64	0.37	2.7
Gross Cropped Area	2.84	100	10.69	100	27.77	100	13.77	100
Operational Area	1.44		5.3		13.4		6.71	
Cropping Intensity	197.22		201.7		207.24		205.22	

4.2.7.3 Cropping pattern of paddy growers

Table 4.2.7.3 shows the cropping pattern and cropping intensity on sample farms. Table depicts the both *kharif* season and *Rabi* season. In *kharif* season the area under basmati paddy is more than the area under other crops. The overall situation of basmati paddy is 29.98 per cent. The area under maize is less than all other crops. In Rabi season the area under wheat is more than all other crops. Table also depicts about gross cropped area and net sown area.

On an average farm, during *kharif* season the highest area of the order of 3.73 hectare i.e. 29.98 percent of gross cropped area was under Basmati paddy followed by paddy (12.46 per cent). The lowest area to the tune of 0.28 hectare (2.25 per cent) under sugercane followed by 0.32 ha (2.57 %) under fodder, 0.22 (1.77%) under maize and 0.12 ha (0.97%) was under miscellaneous crops. It can be observed that in the case of large farmers, the basmati paddy crop occupied highest percentage of gross cropped area (GCA) is 31.05 per cent followed by paddy 11.54 per cent, and sugercane 2.41 per cent. The maize, Miscellaneous and fodder crop covered 1.94, 0.86 and 2.20 per cent of GCA respectively. Medium farmers grew basmati paddy on 28.17 per cent of the GCA followed by paddy (14.31 per cent). The lowest area to the tune of 0.31 ha (2.81%) was under fodder followed by 0.20 ha (1.81%) under maize, 0.20 ha (1.81 per cent) under sugarcane and 0.12 ha (1.09 %) under miscellaneous crops.In case of small farmer,the basmati paddy crop occupied highest percentage of gross cropped area (GCA) is 28.62 per cent followed by paddy 12.83 per cent. The lowest area to the tune of 0.14 ha (4.61%) was under fodder crops followed by 0.07 ha (2.30%) under sugercane and 0.05 ha (1.64 %) under miscellaneous crop.

The analysis of the composition of crops as a whole revealed that wheat crop occupied highest area .Wheat was the most important *Rabi* crop in the selected district covering about 44.37 per cent of the gross cropped area (GCA) followed by 2.25 per cent sugercane,2.49 per cent fodder crops and 0.89 per cent miscellaneous crops. It can be observed that in the case of large farmers, the wheat crop occupied highest percentage of GCA was 44.66 per cent followed by sugarcane 2.41 per cent. The *Rabi* fodder and miscellaneous crops 2.15 and 0.78 per cent of GCA respectively.In case of medium farmer,the wheat crop occupied highest percentage of gross cropped area (GCA) is 44.47 per cent followed by fodder crop 2.72 per cent, sugarcane 1.81 per cent, and miscellaneous 1.00 per cent. Small farmers grew wheat on 42.10 per cent of the GCA followed by rabi fodder 4.28 per cent ,sugarcane (2.30 per cent), and miscellaneous 1.32 per cent.

It was clear that wheat and basmati paddy were the two most important crops of rabi and kharif seasons respectively. At the overall level wheat was observed as the predominant crop in the cropping pattern followed by basmati paddy and paddy with the percentage. The cropping intensity of the district is 197.40, 199.28 and 199.66 per cent in case of small, medium and large farmers. And overall percentage of cropping intensity is 199.36.

Table 4.2.7.3: Cropping pattern of paddy growers in Punjab (ha)

Crop	Small		Medium		Large		Overall	
	Area	%age	Area	%age	Area	%age	Area	%age
Kharif								
Basmati	0.87	28.62	3.11	28.17	7.21	31.05	3.73	29.98
Paddy	0.39	12.83	1.58	14.31	2.68	11.54	1.55	12.46
Sugarcane	0.07	2.3	0.2	1.81	0.56	2.41	0.28	2.25
Maize	0	0	0.2	1.81	0.45	1.94	0.22	1.77
Kharif Fodder	0.14	4.61	0.31	2.81	0.51	2.2	0.32	2.57
Miscellaneous	0.05	1.64	0.12	1.09	0.2	0.86	0.12	0.97
Kharif Cropped Area	1.52	50	5.52	50	11.61	50	6.22	50
Rabi								
Wheat	1.28	42.1	4.91	44.47	10.37	44.66	5.52	44.37
Sugarcane	0.07	2.3	0.2	1.81	0.56	2.41	0.28	2.25
Rabi Fodder	0.13	4.28	0.3	2.72	0.5	2.15	0.31	2.49
Miscellaneous	0.04	1.32	0.11	1	0.18	0.78	0.11	0.89
Rabi Cropped Area	1.52	50	5.52	50	11.61	50	6.22	50
Total Cropped Area	3.04	100	11.04	100	23.22	100	12.44	100
Operational Area	1.54		5.54		11.63		6.24	
Cropping Intensity	197.4		199.28		199.66		199.36	

4.2.8.1 Breakup of cost of cultivation for American cotton

The information regarding cost return aspects of American cotton has been presented in Table 4.2.8.1 Table showed that average per hectare total variable cost on cotton cultivation farms. Human labour was the most important component of the cost in all the categories. On an average, the total cost, it was observed to Rs. 42457.47 per hectare constituted about 59.37 per cent of the total variable cost.

It was Rs.25561.41 on small farm, Rs.25242.03 on medium farms and Rs.24823.50 on large farms.Overall machine labour was observed to be Rs. 5192.20 per hectare in total variable cost. It was Rs. 5145.32 on small farm, Rs. 5197.98 on medium farms and Rs. 5233.31 on large farms. Plant protection chemical on these farms observed at Rs. 4475.33 on small,Rs 4639.48 on medium and Rs. 4835.02 on large farms per hectare respectively.Other main components in cost of American cotton cultivation was on seed, FYM and fertilizer, irrigation and marketing cost at Rs.2840.69, Rs.2849.42, Rs.445.18 and Rs 438.55 respectively. Per hectare gross return from crop had been recorded at Rs. 84900.12, Rs

95090.14 and Rs. 102219.92 per hectare on small, medium and large farms respectively. The per hectare return over variable cost from American cotton have been recorded at Rs. 42261.67, Rs. 52655.45 and Rs. 59920.65 per hectare on small, medium and large farms respectively.

The average yield of cotton was about 23.25 quintal per hectare**.**The per hectare yield from American cotton was recorded at 22.53, 22.87, 25.79 quintal per hectare on small, medium and large farms respectively.Overall the gross return from cotton had been recorded at Rs. 99866.42 per hectare**.** It was Rs. 94503.08 on small farm, Rs. 98544.96 on medium farms and Rs. 112572.01 on large farms**.**Overall the per hectare return over variable cost from cotton was recorded at Rs. 57408.95**.**

Table 4.2.8.1: **Breakup of cost of cultivation and returns structure of American cotton, 2013-14** **(Rs./ha)**

Item		**Size of holdings**			
		Small	**Medium**	**Large**	**Overall**
1. Machine labour		5145.32	5197.98	5233.31	5192.2
2.Human labour		25561.41	25242.03	24823.50	25208.98
3.Seed and seed treatment		2803.12	2812.08	2906.87	2840.69
4.FYM and Fertilizer		2943.16	2833.30	2771.80	2849.42
5.Plant protection Chemical		4475.33	4639.48	4835.02	4649.94
6.Irrigation charges		421.25	443.05	471.25	445.18
7.Transportation and marketing charges		452.81	434.72	428.12	438.55
8.Interest on working capital @ 8% for 4 months		836.05	832.05	829.4	832.5
A. Total Variable cost		42638.45	42434.69	42299.27	42457.47
Main Product	Average yield (qtl/ha.)	22.53	22.87	25.79	23.25
	Average Price (Rs/qtl)	3882.50	3995.28	4068.75	3982.18
	Returns (i)	87472.72	91372.05	104933.06	92585.68
By Product	Average yield (qtl/ha.)	36.93	37.10	39.15	37.73
	Average Price (Rs/qtl)	190.37	193.34	195.12	192.94
	Returns (ii)	7030.36	7172.91	7638.95	7280.74
B. Gross Returns (i + ii)		94503.08	98544.96	112572.01	99866.42
Returns over variable costs (B-A)		51864.63	56110.27	70272.74	57408.95

4.2.8.2 Breakup of cost of cultivation for maize

Various costs incurred in the cultivation of maize on sample farms on different size holdings are presented in Table 4.2.8.2. On an average, the total cost per hectare of maize cultivation was Rs. 33239.40 per hectare on different sized farms. It was Rs. 33128.97on small, Rs. 33161.21 on medium and Rs. 33428.04 per hectare on large farm respectively. Human labour was the most important component of the cost in all the categories. Out of the total cost, it accounted for 38.99 per cent. It was 39.51 per cent on small farm, 38.68 percent on medium farms and 38.79 percent on large farms.Fertilizer and FYM was the second most important component in all the categories. It accounted for 25.38 per cent of total cost. Fertilizer and FYM cultivation on these farms observed at Rs. 8522.66 on small,Rs 8485.75 on medium and Rs. 8297.66 on large per hectare respectively.

Table 4.2.8.2: Breakup of cost of cultivation and returns structure of Maize on sample farm, 2013 14 (Rs./hectare)

Item		Size of holdings			
		Small	**Medium**	**Large**	**Overall**
1. Machine labour		5216.87	5301.94	5411.25	5310.02
2.Human labour		13090.31	12827.92	12965.73	12961.32
3.Seed and seed treatment		3022.66	3213.74	3467.23	3234.54
4.FYM and Fertilizer		8522.66	8485.75	8297.66	8435.36
5.Plant protection Chemical		1219.06	1303.19	1338.12	1286.79
6.Irrigation charges		508.12	502.22	426.87	479.07
7.Transportation and marketing charges		899.70	876.23	865.73	880.55
8.Interest on working capital @ 8% for 4 months		649.59	650.22	655.45	651.75
A. Total Variable cost		33128.97	33161.21	33428.04	33239.40
Returns					
Main Product	Average yield (qtl/ha.)	46.81	49.40	50.00	48.74
	Average Price (Rs/qtl)	898.44	1019.03	1155.62	1024.36
	Returns (i)	42055.98	50340.08	57781	49927.31
By Product	Average yield (qtl/ha.)	49.50	50.71	51.40	50.54
	Average Price (Rs/qtl)	81.15	81.25	81.12	81.17
	Returns (ii)	4016.92	4120.19	4169.57	4102.23
B. Gross Returns (i + ii)		46072.90	54460.27	61950.57	54029.54
Returns over variable costs (B-A)		12943.93	21299.06	28522.53	20790.14

Machine labour was observed to be Rs. 5216.87, 5301.94 and Rs. 5411.25 per hectare on small, medium and large farms respectively in total variable cost. Other main components in cultivation of maize on large farms were expenditure on seed, plant protection chemical, irrigation, and transportation and marketing charges at Rs. 3467.23, Rs. 1338.12, Rs. 426.87, and Rs. 865.73respectively.Medium farms were expenditure on seed, plant protection chemical, irrigation, and transportation and marketing charges at Rs. 3213.74, Rs. 1303.19, Rs. 502.22, and Rs. 876.23 respectively.Small farms were expenditure on seed, plant protection chemical, irrigation, and transportation and marketing charges at Rs. 3022.66, Rs. 1219.06, Rs. 508.12, and Rs. 899.70 respectively.

Per hectare gross return from crop was recorded at Rs. 46072.90, Rs 54460.27 and Rs. 61950.57 per hectare on small, medium and large farms respectively. The per hectare return over variable cost from maize have been recorded at Rs. 12943.93, Rs. 21299.06 and Rs. 28522.53 per hectare on small, medium and large farms respectively.

4.2.8.3 Breakup of cost of cultivation of paddy crop

Economics of basmati paddy has been worked out on the basis of primary data collected from 60 farmers representing different farm size categories. The results regarding to various cultivation practices being followed by the sample farmers, along with returns and costs involved in cultivation are given in detail in this section.

The per hectare costs and returns of basmati paddy cultivation calculated at current prices have been presented in Table 4.2.8.3. Variable cost includes the cost for machine labour, human labour seed and seed treatment, manures and fertilizers, plant protection, irrigation, transportaion and marketing chaeges and interest on working capital. The variable cost incurred by the sample farmers in basmati paddy cultivation was worked out and the results are given in Table 4.2.8.3.

It could be observed from the Table 4.2.8.3 that overall variable cost of the sample respondents was Rs. 29142.92 per hectare. It was Rs. 29298.77on small, Rs. 29143.5 on medium and Rs. 28986.49 on large farms. Of the overall variable cost, human labour accounted for highest proportion with 42.03 per cent to the total variable cost followed by machine labour with 17.81 per cent and FYM and fertilizer with 15.46 per cent. These three operations together accounted for nearly two third of the total variable cost. Seed and seed treatment, plant protection chemical , irrigation charges accounted for a lesser proportion to total variable cost.

Human labour was the most important component of the cost in all the categories. It was Rs. 12446.56 on small farm, Rs. 12221.86 on medium farms and Rs. 12075.62 on large farms respectively.Machine labour was the second most important component in all the categories. Machine labour on these farms observed at Rs. 5032.01 on small,Rs. 5207.42 on medium and Rs. 5327.37 on large per hectare respectively.FYM and fertilizer was the third

most important component in all the categories. FYM and fertilizer on these farms observed at Rs. 4667.62 on small,Rs. 4507.92 on medium and Rs. 4345.12 on large per hectare respectively.

Table 4.2.8.3: **Breakup of cost of cultivation and returns structure of paddy on different catogaries of farms 2013-14** **(Rs./ha.)**

Item		Size of holdings			
		Small	**Medium**	**Large**	**Overall**
1. Machine labour		5032.01	5207.42	5327.37	5188.93
2. Human labour		12446.56	12221.86	12075.62	12248.01
3. Seed and seed treatment		1027.58	1096.81	1123.88	1082.76
4. FYM and Fertilizer		4667.62	4507.92	4345.12	4506.89
5. Plant protection Chemical		3417.09	3479.86	3538.27	3478.41
6. Irrigation charges		1163.12	1128.75	1098.75	1130.21
7. Transportation and marketing charges		970.31	929.44	909.12	936.29
8. Interest on working capital @ 8% for 4 months		574.48	571.44	568.36	571.43
A. Total Variable cost		29298.77	29143.5	28986.49	29142.92
Main Product	Average yield (qtl/ha.)	39.09	39.34	40.42	39.62
	Average Price (Rs/qtl)	2534.37	2565.83	2610	2570.07
	Returns (i)	99068.52	100939.80	105496.20	101834.82
By Product	Average yield (qtl/**ha.**)	43.09	44.00	44.31	43.80
	Average Price (Rs/qtl)	60.87	61.69	61.87	61.48
	Returns (ii)	2622.89	2714.36	2741.46	2692.90
B. **Gross Returns (i + ii)**		101691.41	103654.10	108237.66	104527.73
Returns over variable costs (B-A)		72392.64	74510.61	79251.17	75384.81

Other main components in cultivation of basmati paddy on large farms were expenditure on plant protection chemical, seed, irrigation, and transportation and marketing

charges at Rs. 3538.27, Rs. 1123.88, Rs. 1098.75 and Rs. 909.12 respectively.Medium farms were expenditure on plant protection chemical, seed, irrigation, and transportation and marketing charges at Rs. 3479.86, Rs. 1096.81, Rs. 1128.75, and Rs. 929.44 respectively. Small farms were expenditure on plant protection chemical, seed, irrigation, and transportation and marketing charges at Rs. 3417.09, Rs. 1027.58, Rs. 1163.12, and Rs. 970.31 respectively.

Per hectare gross return from crop was recorded at Rs. 101691.41, Rs 103654.10 and Rs. 108237.66 per hectare on small, medium and large farms respectively. The per hectare return over variable cost from basmati paddy have been recorded at Rs. 72392.64, Rs. 74510.61 and Rs. 79251.17 per hectare on small, medium and large farms respectively.

4.2.9.1 Marketable surplus of crops on cotton farms

The analysis of marketable surplus of crops per farm (Table 4.2.9.1) indicates that on small farm, the marketable surplus was 78.17 quintals. In case of medium and large farm, it was 367.70 quintals and 1364.47 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs of the farmers, they sell the in immediately after harvest and not store to sell in the lean period.

Table 4.2.9.1: Marketable surplus of all crops on cotton farms, 2013 14 (Qtl/Farm)

Farm Size	Marketable surplus		
	Production	Total requirements (Farm and Home)	Marketable surplus
Small	130.43 (100)	52.56 (40.28)	78.17 (59.92)
Medium	435.53 (100)	67.83 (15.58)	367.70 (84.42)
Large	1469.53 (100)	105.06 (7.15)	1364.47 (92.85)
Overall	678.5 (100)	75.15 (11.05)	603.5 (88.95)

Figures in the parentheses are percentages to their respective total

4.2.9.2 Marketable surplus of all crops on maize farms

The analysis of marketable surplus of crops per farm (Table 4.2.9.2) indicates that on small farm, the marketable surplus was 273.91 quintals. In case of medium and large farm, it was 804.04 quintals and 2830.26 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs in the post-harvest period, the farmers did not stock for sale in lean months.

Table 4.2.9.2: Marketable surplus of all crops on maize farms in Punjab, 2013 14 (Qtl/farm)

Farm Size	Marketable surplus		
	Production	Total requirements (Farm and Home)	Marketable surplus
Small	296.41 (100)	22.5 (7.59)	273.91 (92.41)
Medium	849.54 (100)	45.5 (5.36)	804.04 (94.64)
Large	2913.76 (100)	83.5 (2.87)	2830.26 (97.13)
Overall	1353.24 (100)	50.50 (3.73)	1302.74 (96.27)

Figures in the parentheses are percentages to their respective total

4.2.9.3 Marketable surplus of crops on paddy farms

The analysis of marketable surplus of crops per farm (Table 4.2.9.3) indicates that on small farm, the marketable surplus was 154.92 quintals. In case of medium and large farm, it was 720.28 quintals and 1775.08 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs in immediate post-harvest period, the farmers did not store crops for sale in lean months.

Table 4.2.9.3: Marketable surplus of crops on paddy farms in Punjab, 2013 14 (Qtl/farm)

Farm Size	Marketable surplus		
	Production	Total requirements (Farm and Home)	Marketable surplus
Small	193.42 (100)	38.50 (19.91)	154.92 (80.09)
Medium	771.32 (100)	51.04 (6.62)	720.28 (93.38)
Large	1867.08 (100)	92.00 (4.93)	1775.08 (95.07)
Overall	943.94 (100)	60.51 (6.41)	883.43 (93.59)

Figures in the parentheses are percentages to their respective total

4.2.10 Marketable surplus of selected crops

The analysis of marketable surplus of cotton crop per farm (Table 4.2.10) indicates that on small farm, the marketable surplus was 16.90 quintals. In case of medium and large farm, it was 53.29 quintals and 156.03 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs in the post-harvest period, the farmers did not stock for sale in lean months. Therefore, there was no difference in marketable and marketed surplus of American cotton.

Table 4.2.10: Marketable surplus of selected crop on sample farm, 2013 14 (Qtl/Farm)

Farm Size	Marketable surplus		
	Production	Total requirements (Farm and Home)	Marketable surplus
American Cotton			
Small	16.90	0	16.90
Medium	53.29	0	53.29
Large	156.03	0	156.03
Overall	70.68	0	70.68
Maize			
Small	27.62 (100)	4.12 (14.92)	23.50 (85.08)
Medium	98.80 (100)	10.64 (10.77)	88.16 (89.23)
Large	269.50 (100)	18.66 (6.92)	250.84 (93.08)
Overall	129.65 (100)	11.14 (8.59)	118.51 (91.41)
Paddy			
Small	34.01 (100)	1.14 (1.96)	32.87 (98.04)
Medium	122.35 (100)	2.73 (1.57)	119.62 (98.43)
Large	291.43 (100)	5.37 (1.18)	286.06 (98.82)
Overall	147.78 (100)	3.08 (1.35)	144.70 (98.65)

The analysis of marketable surplus of maize per farm (Table 4.2.10) indicates that on small farm, the marketable surplus was 23.50 quintals. In case of medium and large farm, it was 88.16 quintals and 250.84 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs in the post-harvest period, the farmers did not stock maize for sale in lean months. Therefore, there was no difference in marketable and marketed surplus of maize.

The analysis of marketable surplus of basmati paddy crops per farm (Table 4.2.10) indicates that on small farm, the marketable surplus was 32.87 quintals. In case of medium and large farm, it was 119.62 quintals and 286.06 quintals, respectively. The marketable surplus showed a tendency to increase with increase in farm size. Due to cash needs in the post-harvest period, the farmers did not stock for sale in lean months. Therefore, there was no difference in marketable and marketed surplus of basmati paddy.

4.2.11.1 Variability in American cotton price received by different categories of farmers

A perusal of Table 4.2.11.1 showed that maximum average price of the order of Rs. 4150 per quintal was received by medium farmers, followed by Rs. 4140 per quintal by large and Rs. 4000 per quintal by the small farmers while the minimum price to the tune of Rs. 3700 per quintal by the small farmers. The range of price received was Rs. 3700 to Rs. 4000.00 by small farmers with a coefficient of variation of 2.26 percent, Rs. 3755 to Rs. 4150 by medium farmers and Rs. 3980 to Rs. 4140 by large farmers. The overall range came to be Rs. 3700 to Rs. 4150 with C.V. of 3.26 percent. This indicated that minimum price was received by small farmers and the maximum price was received by medium farmers. It was observed from the findings that all farmers have not sell their produce at the same time.

Table 4.2.11.1: Variability in average annual American cotton price received by the selected farmers, category wise 2013-14 (Rs./qtl)

Parameters of price Received	Small	Medium	Large	Overall
Mean	3834.06	3930.14	4065	3922.67
Minimum	3700	3755	3980	3700
Maximum	4000	4150	4140	4150
C.V.	2.26	3.16	1.33	3.26

4.2.11.2 Variability in maize price received by different categories of farmers

The data given in Table 4.2.11.2 indicated that maximum average annual price of the order of Rs. 1050 per quintal was received by medium farmers, followed by Rs. 990 per quintal by large and Rs. 950 per quintal by the small farmers while the minimum price to the tune of Rs. 850 per quintal by the medium farmers. The range of price received was Rs.

920 to Rs. 950 by small farmers with a coefficient of variation of 1.09 percent, Rs. 850 to Rs. 1050 by medium farmers and Rs. 970 to Rs. 990 by large farmers. The overall range came to be Rs. 850 to Rs. 1050 with C.V. of 4.24 percent. This indicated that minimum price was received by medium farmers and the maximum price was received by medium farmers.

Table 4.2.11.2: Variability in average annual maize price received by the selected farmers, category wise, 2013-14 (Rs./qtl)

Parameters of price Received	Small	Medium	Large	Overall
Mean	940.12	946.67	981.25	949.53
Minimum	920	850	970	850
Maximum	950	1050	990	1050
C.V.	1.09	5.17	0.89	4.24

4.2.11.3 Variability in basmati paddy price received by different categories of farmers

Variation was observed in all categories. A perusal of Table 4.2.11.3. showed that maximum average annual price of the order of Rs. 2680 per quintal was received by medium farmers, followed by Rs. 2650 per quintal by large and Rs. 2630 per quintal by the small farmers while the minimum price to the tune of Rs. 2290 per quintal by the medium farmers. The range of price received was Rs. 2470 to Rs. 2630 by small farmers with a coefficient of variation of 2.13 percent, Rs. 2290 to Rs. 2680 by medium farmers and Rs. 2560 to Rs. 2650 by large farmers. The overall range came to be Rs. 2290 to Rs. 2680 with C.V. of 3.26 percent. This indicated that minimum price was received by medium farmers and the maximum price was received by medium farmers.

Table 4.2.11.3: Variability in average annual paddy price received by the selected farmers, category wise, 2013-14 (Rs./qtl)

Parameters of price Received	Small	Medium	Large	Overall
Mean	2534.37	2565.83	2610	2563.33
Minimum	2470	2290	2560	2290
Maximum	2630	2680	2650	2680
C.V.	2.13	3.78	1.21	3.26

4.2.12 Pricing Efficiency of selected crops among different size groups

The pricing efficiency refers to the structural characteristics of the marketing system, where the seller are able to get the true value of their produce and the consumers receive true

worth of their money. Regulated agricultural markets have been playing a pivotal role in procurement of farm produce. With rising agricultural production, growth of regulated market facilities reveals that Punjab has been a leading state in development of marketing infrastructural facilities for orderly marketing of agricultural produce in the best interest of both producers and consumers .There are 151 regulated markets in the state during 2013-14 which include 275 sub yards. Average number of villages per regulated market are 81 and area served per regulated market is 334 sq.km.Availability of suitable and adequate storage is an integral part of an efficient marketing stategy. State-owned storage capacity of 245.84 lakh tonnes includes coverd capacity ,hired storage capacity and open capacity. There are no sufficient scientific storage facilities in the state. Market connectivity is also a major factor which influences the level of development of village economy.In this regard, village economy is widely linked with markets through village/link roads.In an agrarian economy , link/approach roads are very essential for timely marketing of produce. In the state, road lengh per square km of area is 115 and number of villages linked with roads were 12284 during 2013 14. The network of markets has helped farmers to realise a fair and better price for their produce.

4.2.12.1 Pricing Efficiency of cotton across different farm size groups

The main purpose in creating regulated markets was to standardize the sale and purchase of agricultural products, create conditions for fair competition and ensure a squre deal to farmers. Thus, to make agricultural marketing more orderly and efficient, the institution of the regulated market has a role to play. Bathinda district was well connected with the marketing network, there were 9 regulated markets and 23 sub yards operating in Bathinda district during 2013 14.Almost all the farmers sold their produce in the regulated markets. Farmers also reported the sheds facility available in the market.The unloading, cleaning and dressing charges were at the rate of Rs 6.58, Rs. 5.40 and Rs.2.63 per quintal.The farmers didn't have to pay any commission and market fee,which were charged from the buyers by the commission agents. Regulated markets of the district had no facility for grading. Thus, the farmers with better quality of produce were deprived of a higher price due to lack of grading practices.It was also observed that the farmers were completely lacking in scientific storage facilities. Most of the farmers sell their produce immediately after picking. The produce was stored either in the open or in the rooms and verandahs of the kachha or pucca house by some farmers. Cotton produce was stored by almost all the large and some medium farmers. They hold down their produce by a month or more for getting higher price of produce. However,some malpractices were observed in the surveyed markets. All categories of farmers in the district were found heavily indeAmericaned to arhatias or commission agents. As a result, the farmers lost their bargaining power and were compelled

to sell their produce to the same commission agents even if it meant getting a lower price for their produce.

The district had a very developed transportation system. Baluana 16 km and Bahman Diwana village 12 km far from markets.Selected villages in Bathinda district were connected to the markets centres by pucca or metalled roads. Therefore, all the households or cultivators had easy access to market centres. In both the villages, tractor trolley and tempos had become the more popular means for bringing in the produce from the village to the market centres. Among the surveyed farmers, the tractor trolley was observed to be the main source of transportation for produce. Large farmers and some medium farmers use their own tractor trolley for transportation while small and some medium farmers generally hired this facility from the large farmers to transport their produce.The tempos was also used as a source of transportation.

The results of multiple regression analysis carried out for identifying factors affecting price received are presented in Table 4.2.12.1. Price received by the farmers was taken as the dependent variable.Independent variables in the model were marketable surplus (Qtl) ,operational area (ha).The dummy for time of sale with value zero for those who sell immediately after picking of American cotton and one for those who hold down and sell later was also included in the model. The regression coefficients of marketable surplus, operational area and time of sale were significantly positive. It is clear from table that the important factor affecting the price was storage pattern. The value of the coefficient indicates that there was a considerable increase in the net price received by the farmers if they delayed their sale by a month or more.The farmers got quintal more price than those who do ~~not-h~~old down their produce. Economic status of the farmer, which is indicated by the size of operational holding also contributes positively.

Table 4.2.12.1: Regression results of variables determining price in the market, 2013-14

Variable	Coefficient	Standard error	t value
Constant	3505.523	169.7548	20.6505
Marketable surplus	14.02319***	7.783699	1.801611
Operational Area	6.629619***	3.948856	1.678871
Storage pattern	173.6212*	23.58624	7.361125
Education	4.096461^{NS}	28.99037	0.141304

* significant at 1% level ; ***significant at 10 % level and ^{NS} Non-significant

R^2 = 0.676643, **f value** = 22.59962

4.2.12.2 Pricing Efficiency of maize across different farm size groups

---- In the Hoshiarpur district under study, which was well connected with the marketing network, there were 5 regulated markets and 14 sub yards operating in Hoshiarpur district during 2013 14. Almost all the farmers sold their produce in the regulated markets.The unloading and cleaning charges were Rs 5 per quintal.The farmers didn't have to pay any commission and market fee,which were charged from the buyers by the commission agents. There was lack of grading facilities which was reported by the all farmers of the sample. Thus, the farmers with better quality of produce were deprived of a higher price due to lack of grading practices. Farmers also reported inadequancy of sheds. Lack of proper scientific storage facilities. All the farmers have the demand for availability of storage facilities so that they can store their produce in peak season, to sell it at higher price in the lean season. Due to the lack of storage facilities, the farmers have to sell their produce immediately after harvesting at lower prices due to higher moisture content in the maize grains. The produce was stored either in the open or in the rooms and verandahs of the kachha or pucca house by some medium and large farmers. They hold down their produce by a month or more for getting higher price of produce. However,some malpractices were observed in the surveyed markets. All categories of farmers in the district were found indebted to arhatias or commission agent. As a result, the farmers lost their bargaining power and were compelled to sell their produce to the same commission agents even if it meant getting a lower price for their produce. Distance from Phuglana village to market was15 km and Rajpura to Paeya village, it was 18 km.There were metalled (pucca) roads connecting the villages with the markets and the farmers had sufficient transportation facilities. Among the surveyed, generally the tractor trolley was observed to be the main source of transportation for produce. Large farmers and some medium farmers use their own tractor trolley for transportation while small and some medium farmers generally hired this facility from the large farmers to transport their produce.

The results of multiple regression analysis carried out to ascertain the volume and direction of factors entering into price formation in Maize are presented in Table 4.2.12.2 Price received by the farmers, was taken as the dependent variable.Independent variables in the model were marketable surplus, operational area (ha) and dummy for dryers with value zero for those who do not use dryer and one for those who use dryer to reduce moisture. The dummy for time of sale with value zero for those who sell immediately after harvest and one for those who hold down and sell later was also included in the model. The regression coefficients of operational area, use of dryers and time of sale were significantly positive. It is clear from table that the important factor affecting the price was time of selling the produce. The value of the coefficient indicates that there was a considerable increase in the price received by the farmers if they delayed their sale.The other most important factor affecting the price was use of dryer for produce. The value of the coefficient indicates that there was a

considerable increase in the price received by the farmers if they used dryer.The farmers got more price than those who do not use dryer.The regression analysis further displayed significant coefficient of marketable surplus with a positive sign

Table 4.2.12.2: Regression results of variables determining price in the market, 2013-14

Variable	Coefficient	Standard error	t value
Constant	1045.199	87.20915	11.98497
Marketable surplus	4.05274**	1.916052	2.11515
Operational Area	3.605715*	1.325473	2.720322
Use dryers	229.9076*	10.65801	21.57134
Time of sale	52.25789*	12.25457	4.264361
Education	9.096276^{NS}	10.70445	0.849766

* significant at 1% level ; **significant at 5 % level and ^{NS} Non-significant

$\mathbf{R^2}$ = 0.958584, **F value** = 204.4507

4.2.12.3 Pricing Efficiency of basmati paddy across different farm size groups

In the Sangrur district under study, which was well connected with the marketing network, there were 15 regulated markets and 19 sub-yards operating in Sangrur district during 2013 14. Almost all the farmers sold their produce in the regulated markets. Farmers also reported inadequancy of sheds.The unloading and cleaning charges were Rs 7 per quintal.The farmers didn't have to pay any commission and market fee,which were charged from the buyers by the commission agents. Regulated markets of the district had no facility for grading and most of the paddy was exchanged without any sort of grading. It was also observed that the farmers had no scientific storage facilities on account of which they sold their produce immediately after harvest even if it yielded them lower prices. Among the surveyed farmers, it was found that some medium and large farmers stored paddy either in the open or in the bags, which were stacked in room and verandahs of the kachha or pucca house. They stored their produce for a month or more for getting higher price of produce. It was also observed that the institutional credit provided to the farmers was far lesser than their requirements. The small,medium and large farmers were compelled to take loans from commission agent or arhatias. Small farmers took more amount of loan than medium and large farmers.Distance from Benra village to market was 5 km and Birdbal village, it was 6 km. There were metalled (pucca) roads connecting the villages with the markets and the farmers had sufficient transportation facilities. Among the surveyed farmers, the tractor trolley was observed to be the main source of transportation for produce. Large farmers and some medium farmers use their own tractor trolley for transportation while small and some medium farmers generally hired this facility from the large farmers to transport their produce.

The regression analysis revealed in Table 4.2.12.3 that coefficient of operational area of basmati paddy was significantly positive. The value of coefficients of marketable surplus was non-significant. The dummy for time of sale with value zero for those who sell immediately after harvesting and one for those who hold down and sell later was also included in the model. Time of sale was significantly positive. It is clear from table that the important factor affecting the price was time of selling the produce. The value of the coefficient indicates that there was a considerable increase in the price received by the farmers if they delayed their sale.

Table 4.2.12.3: Regression results of variables determining price in the market, 2013-14

Variable	Coefficient	Standard error	t value
Constant	2211.484	287.4319	7.693943
Marketable surplus	6.420917^{NS}	6.945701	0.924445
Operational Area	7.543335***	4.194922	1.798206
Time of sale	65.78425*	23.52915	2.795861
Education	36.69132^{NS}	44.82412	0.818562

* significant at 1% level ; ***significant at 10 % level and NS=non significant

. **R^2**= 0.216897 , **f value** = 2.991294

4.2.13 Production constraints of selected crops

An attempt has been made to find out the important constraints in the cultivation of American cotton. The results pertaining to production constraints are presented in Table 4.2.13.1. 70 percent farmers reported high cost of cultivation. Labour was not available at the peak period, 75 per cent farmers at overall level of the district reported it. 90 percent farmers reported high cost of agrochemical. 80 percent farmers faced the problem of high price fluctuations. 85 percent farmers reported high cost of labour.

Table 4.2.13.1: Constraints in production of cotton faced by farmers 2013 14 (per cent)

Constraints	Farmer's response
High cost of cultivation	70
Shortage of hired human labour for picking	75
High cost of labour	85
High cost of agrochemical (Insecticide, weedicide and fertilizers)	90
High fluctuation in prices	80

The important constraints in the cultivation of maize crop (Table 4.2.13.2) revealed that on an average, 80 percent farmers reported high cost of cultivation. Almost all farmers faced the problem of high cost of labour. 65 percent farmers reported the problem of shortage of hired

human labour for sowing and harvesting. There were wide fluctuations in the price of maize. Further, 90 per cent of the farmers reported the price of maize changes daily in the same market.

Table 4.2.13.2: Constraints in production of maize faced by farmers , 2013-14 (per cent)

Constraints	Farmer's response pattern (in percent)
High cost of cultivation	80
Shortage of labour	65
High cost of labour	100
Price of maize not remunerative	90

The study of production constraints of Basmati paddy (Table 4.2.13.3.) revealed that on an average, 75 percent farmers reported high cost of cultivation. 85 per cent farmers faced the problem of high cost of labour. 70 percent farmers reported the problem of poor quality of insecticide/pesticide. There were wide fluctuations in the price of basmati paddy. Further, 80 per cent of the farmers reported the price of basmati paddy changes daily in the same market.

Table 4.2.13.3: Constraints in production of paddy faced by farmers, 2013-14 (per cent)

Constraints	**Farmer's response pattern (in percent)**
High cost of cultivation	75
High cost of labour	85
Quality of insecticide/pesticide poor	70
High fluctuation in prices	80

4.2.14 Marketing constraints of selected crops

The various constraints related to the marketing of American cotton produce are presented in this section. Problems pertaining to the marketing component of American cotton was given in the Table 4.2.14.1. 25 percent farmers faced the problem of covered area in the market. Almost all farmers faced the problem of storage and grading facilities.

Table 4.2.14.1: Constraints in marketing of American cotton faced by farmers, 2013-14 (per cent)

Constraints	**Farmer's response pattern (in percent)**
Lack of covered area in market-yard	25
Lack of storage facility	100
Lack of grading facilities	100

Table 4.2.14.2 shows constraints in marketing of maize in the study area. This table reveals that the major constraint faced by the farmers in marketing of maize was lack of storage facilities. On an overall basis, 100 per cent farmers reported this as a major constraint. 65 percent of the farmers faced the problem of transportation. Almost all farmers faced the problem of storage facility, covered area in market yard (shed) and grading facility.On an average, 75 percent farmers faced the problems of low capacity dryers.

Table 4.2.14.2: Constraints in marketing of maize faced by farmers, 2013-14 (per cent)

Constraints	Farmer's response pattern (in percent)
Poor marketing facility	65
Lack of covered area in market-yard	100
Lack of storage facility	100
Lack of low capacity dryers	75
Lack of grading facilities	100

Table 4.2.14.3 shows constraints in marketing of basmati paddy in the study area. This table reveals that the major constraint faced by the farmers in marketing of basmati paddy was lack of covered area in market-yard. On an overall basis, 90 per cent farmers reported this as a major constraint. Almost all farmers faced the problem of storage facility and grading facility.On an average, 75 percent farmers faced the problems of malpractices in the mandi.

Table 4.2.14.3: Constraints in marketing of paddy faced by farmers, 2013-14 (per cent)

Constraints	**Farmer's response pattern (in percent)**
Lack of covered area in market-yard	90
Lack of storage facility	100
Lack of grading facilities	100
Malpractices in the mandi	75

Section III: Market integration among different pairs of markets for important crops,

Integration shows the relationship of the firms in a market. The extent of integration influences the conduct and consequently their efficiency. Markets differ in the extent of integration and therefore, there is a variation in their degree of efficiency.

4.3.1 Trend in prices of cotton markets

Price in general as volatile, never remain constant.Price plays an important role in agricultural dominating economies. They have profound effect on growth, equity and stability in developing economies.

Analysis of trend component in series of prices involves ascertaining the general direction of movement of prices over time.Table 4.3.1 shows that during the study period wholesale prices of cotton increased in all the selected markets. The increase in market price was highest in Rajkot followed by Surendranagar, Bathinda, Akola and Mansa. The main observation is that the value of coefficient is highest at 5.544 in Rajkot market followed by Surendranagar at 4.743. For Bathinda, Mansa, Akola , Rajkot and Surendranagar the trend in prices is shown in Fig 4.3.1, 4.3.2, 4.3.3, 4.3.4 and 4.3.5. Prices vary in different markets with different magnitude.

Table 4.3.1: Trend in wholesale prices of cotton in selected markets of India, March, 2010 to April, 2014

Markets	Intercept	Coefficient	R^2
Bathinda	4025	4.283	0.113
Mansa	4051	4.059	0.090
Akola	3892	4.063	0.101
Rajkot	3948	5.544	0.168
Surendranagar	3964	4.743	0.128

4.3.2: Market efficiency

The integration tests elaborated above were carried out on log weekly wholesale prices of selected markets in India. The evaluation of market efficiency by co-integration analysis recognizes that the time series of price for various markets are usually non-stationary. Therefore, it is necessary to examine time-series properties of the variables. Further, to establish the long-run equilibrium relation among the price series, it is necessary to co-integrate them. Co-integration among the variables, in turn, requires checking the order of integration among variables and variables cannot be integrated in the presence of unit root, the same can be examined through conducting a stationarity test. The price movement, volatility within the market and integration between market were studied with time series data collected from market committee and AGMARKNET .Augmented Dickey-Fuller test (ADF) was applied to check whether the price series of selected crops are stationary in their level, followed by their first difference.

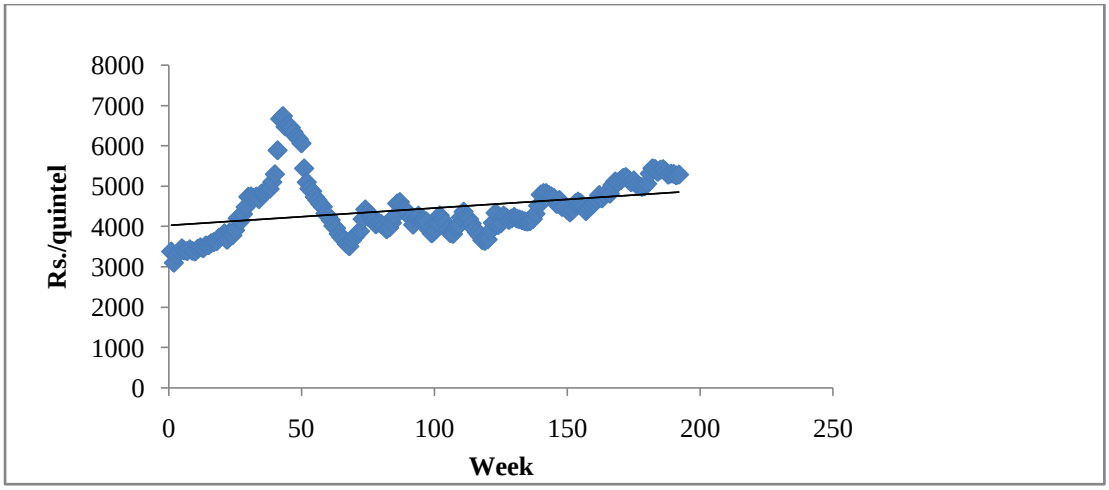

Fig 4.3.1: Trend in prices of cotton in Bathinda market

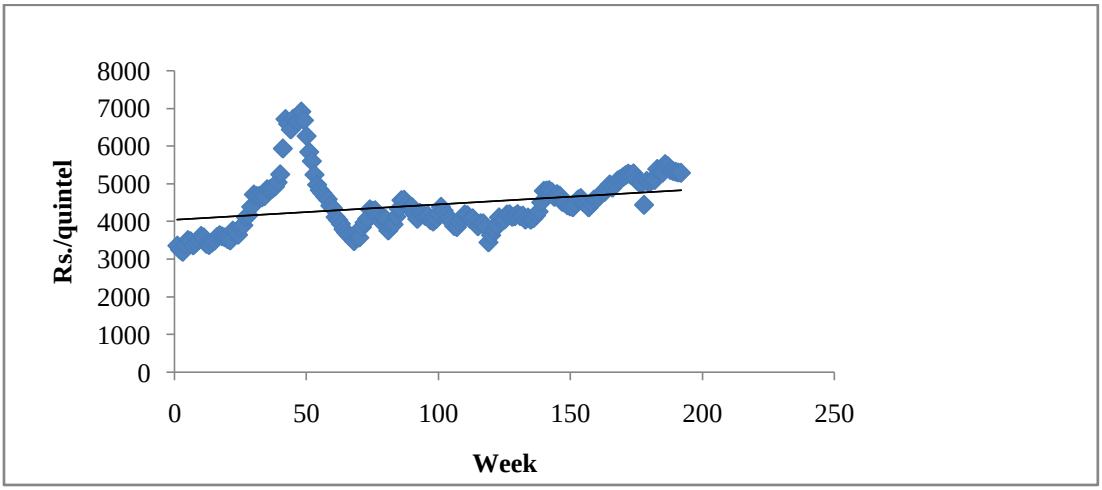

Fig 4.3.2: Trend in prices of cotton in Mansa market

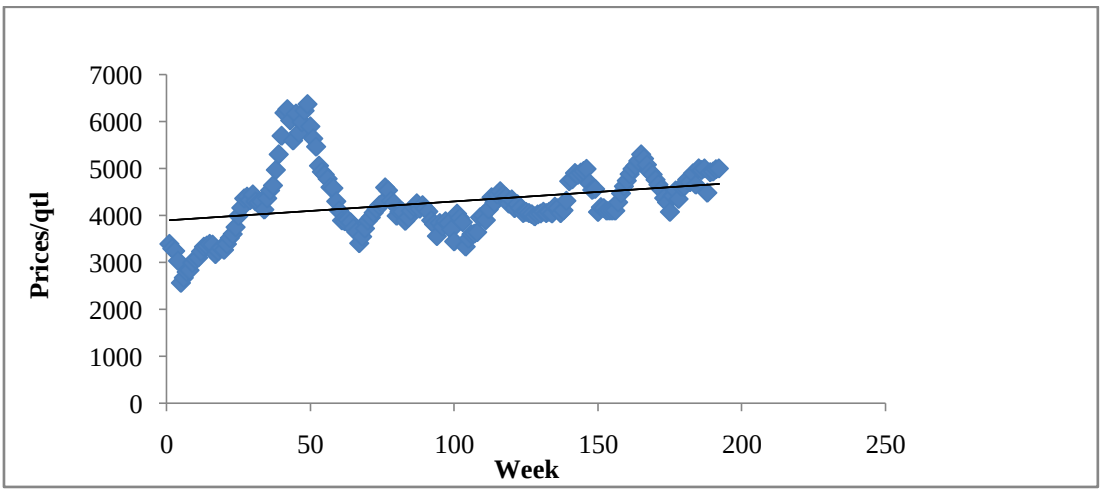

Fig 4.3.3: Trend in prices of cotton in Akola market

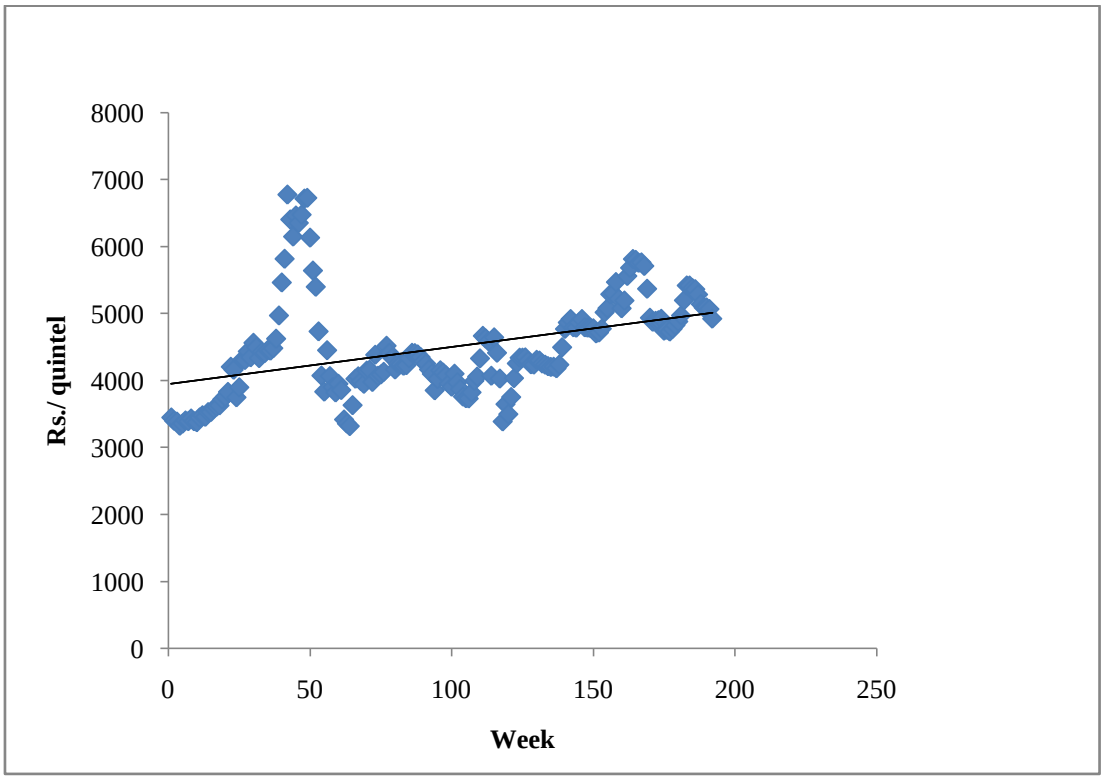

Fig 4.3.4: Trend in prices of cotton in Rajkot market

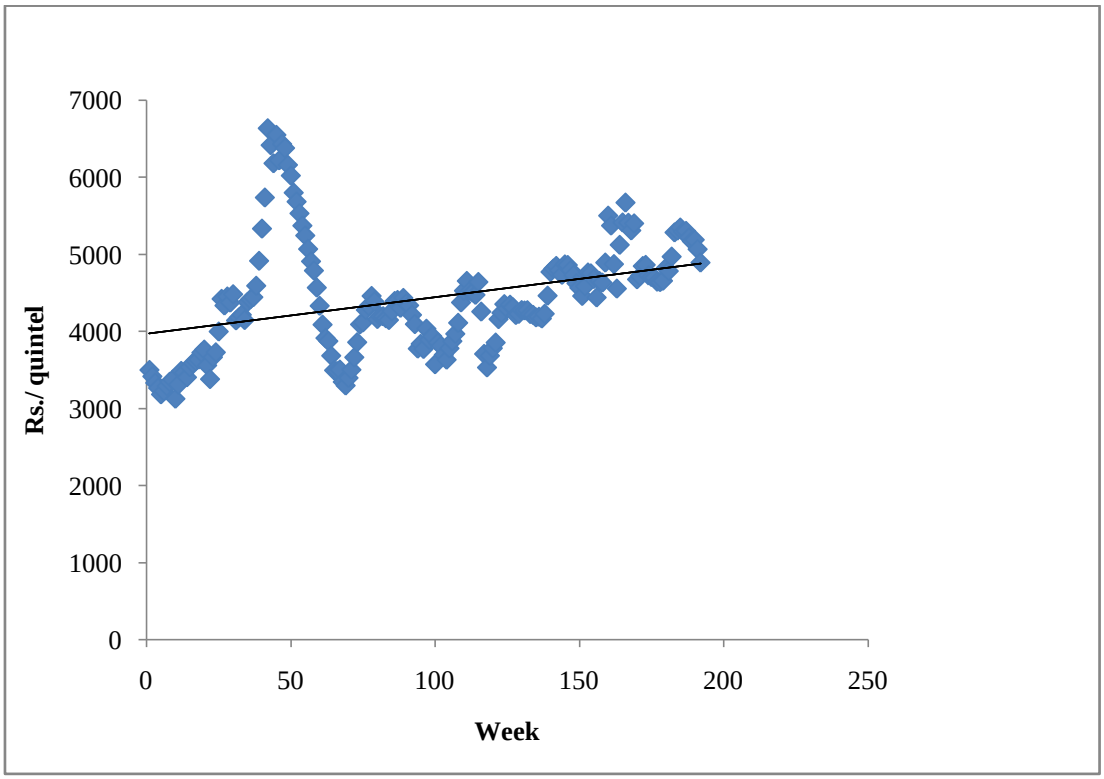

Fig 4.3.5: Trend in prices of cotton in Surendranagar

4.3.2 Integration among Cotton Markets

In economic analysis, it is often assumed that the economic time series are stationary and the relations between stationary series are in the state of equilibrium.For that purpose it is required to identify whether it is stationary series or not.

The Augmented Dickey Fuller (ADF) based unit root test procedure was conducted to check whether the wholesale price series of cotton among different markets such as Akola (Maharastra),Rajkot (Gujrat),Surendranagar (Gujrat),Bathinda (Punjab) and Mansa (Punjab) markets of India are stationary.

It is evidently clear from the results of Table 4.3.3 that in the case of cotton prices in levels,the ADF test does not reject the unit root hypothesis at the 5 percent level during the period.In case of the first difference of the series, the hypothesis was, however, rejected in the period mostly at the one percent level of significance,suggesting that the price series were free from the consequences of unit root.This implied that the price series were stationary at the first difference level.

Table 4.3.3: ADF test results of cotton prices in different markets

Markets	At Level	Stationarity	At First difference	Stationarity	Critical values (at 1% level)
Akola	-1.984697	Non-stationary	-7.726356	Stationary	-4.007084
Rajkot	-2.735968	-do-	-11.29436	-do-	
Surendranagar	-2.527728	-do-	-11.07229	-do-	
Bathinda	-2.614903	-do-	-8.895403	-do-	
Mansa	-2.202827	-do-	-10.44084	-do-	

4.3.4 Co-integration among markets

To determine the long run relationship between the price series from a range of five price series, Johansen's Multiple Co-integration test was employed and the results presented in Table 4.3.4, reveal that out of five markets, four were cointegrated at 5 per cent level of significance.This imply that the selected cotton markets had long-run equilibrium relationship.The concept of co integration is developed from the notion of equilibrium relations between the pairs of series. The price of cotton were in equilibrium relations and there existed co integration among these markets. It may be due to market forces or due to producer/seller behavior because co-integration does not require that the long run equilibrium relationship has to be generated by market forces or the behavior of individuals.

Table 4.3.4: Results of Johansen's Co-integration Analysis

Hypothesized No. of CE(S)	Eigen value	Trace Statistic	0.05 Critical value	Prob**
None *	0.248631	140.8104	88.80380	0.0000
At most 1 *	0.175814	87.92656	63.87610	0.0001
At most 2 *	0.118620	52.15509	42.91525	0.0047
At most 3 *	0.098059	28.79584	25.87211	0.0210
At most 4	0.051096	9.702749	12.51798	0.1413

Trace test indicates 4 cointegrating eqn(s) at 5 per cecent levels,
*denotes rejection of the null hypothesis at 5 per cent levels

4.3.5 Causality in different markets

The causal relationship between the prices series in cotton markets were approached through Granger Causality technique. The results of the analysis showing the relationship between cotton markets are presented in Table 4.3.5 and figure 4.3.4.1.

Table 4.3.5: Results of Pair-wise Granger Causality test results

Null Hypothesis	Obs	F-Statistic	Prob
RAJKOT does not Granger Cause AKOLA	188	2.52851	**0.0424**
AKOLA does not Granger Cause RAJKOT		3.03874	**0.0188**
SURENDRANAGAR does not Granger Cause AKOLA	188	0.99616	0.4111
AKOLA does not Granger Cause SURENDRANAGAR		5.26050	**0.0005**
BATHINDA does not Granger Cause AKOLA	188	1.87175	0.1175
AKOLA does not Granger Cause BATHINDA		4.33177	**0.0023**
MANSA does not Granger Cause AKOLA	188	1.67935	0.1569
AKOLA does not Granger Cause MANSA		2.27534	**0.0631**
SURENDRANAGAR does not Granger Cause RAJKOT	188	3.26575	**0.0130**
RAJKOT does not Granger Cause SURENDRANAGAR		4.15556	**0.0030**
BATHINDA does not Granger Cause RAJKOT	188	3.98124	**0.0040**
RAJKOT does not Granger Cause BATHINDA		1.18522	0.3189
MANSA does not Granger Cause RAJKOT	188	4.08769	**0.0034**
RAJKOT does not Granger Cause MANSA		3.34546	**0.0114**
BATHINDA does not Granger Cause SURENDRANAGAR	188	4.87080	**0.0009**
SURENDRANAGAR does not Granger Cause BATHINDA		2.64465	**0.0352**
MANSA does not Granger Cause SURENDRANAGAR	188	5.04891	**0.0007**
SURENDRANAGAR does not Granger Cause MANSA		3.30387	**0.0122**
MANSA does not Granger Cause BATHINDA	188	7.52972	**1.E-05**
BATHINDA does not Granger Cause MANSA		10.5592	**1.E-07**

The co-integration tests performed indicate only the existence of the long run relationship among the wholesale prices of cotton crop in different markets. The direction of relationship among price series and markets is equally important for which Granger Causality test are performed.Theoretically, a variable is said to Granger-Cause another variable, inferred the flow of information related to prices among different markets.

- Rajkot and Akola market prices have a bidirectional influence.
- Akola market prices influence the prices at Surendranagar market and not vice-versa.
- Akola market prices influence the prices at Bathinda market and not vice-versa.
- Akola market prices influence the prices at Mansa market and not vice-versa.
- Surendranagar and Rajkot market prices have a bidirectional influence.
- Bathinda market prices influence the prices at Rajkot market and not vice-versa.
- Mansa and Rajkot market prices have a bidirectional influence.
- Bathinda and Surendranagar market prices have a bidirectional influence.
- Mansa and Surendranagar market prices have a bidirectional influence.
- Mansa and Bathinda market prices have a bidirectional influence.

The unidirectional relationships where prices of one market lead to the price of other market without having a reciprocal impact on the prices would imply that such markets are not very efficient in term of influencing the price of other markets.

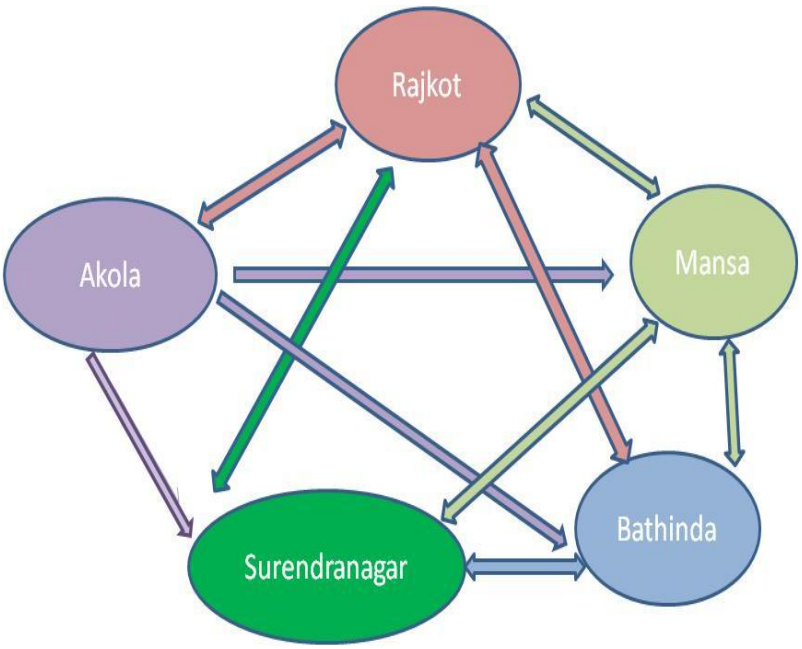

Figure 4.3.4.1 Market integration among cotton markets

4.3.6 Estimation of Vector error correction model

The VECM model is estimated to know how far among the prices from the equilibrium level are and to account for this kind of adjustment vector error correction model could be an approprite tool that takes into account. Different cotton markets are integrated in the long run, it is important to study the short and long run association for equilibrium among the markets.Hence Vector Error Correction model (VECM) was employed to know the speed of adjustments among markets for long run equilibrium.The Results are shown in Table 4. 3.6

The results revealed that in short run Akola market converges to its original equilibrium price level within 19 hours. Rajkot market converges to its original equilibrium price level within 11 hours and Mansa market converges to its original equilibrium price level within 15 hours.In case of the Akola market price model of cotton, the coefficient of two week (0.21) lagged and four week (0.24) lagged own price was positive and significant.Akola market price model, the coefficient of one week (-0.47) and three week (0.49) lagged Bathinda market price was negative and significant at 5 per cent level.The coefficient of one week (0.40) and three week (0.35) lagged Mansa market price was positive and significant. In case of long run Akola market price was influenced by the Bathinda market and Mansa market with one and three lag period. Akola market was influenced by its own price too. It means that the price discovery occurred in the markets and was transmitted to Akola market. Rajkot market price model of cotton, the coefficient of 1 week (0.41) lagged Mansa market price was positive and significant at 5 per cent level. In case of Rajkot market, price was influence by Mansa market with with 1 week lag period. It means that the price discovery occurred in the markets and was transmitted to Rajkot market.Surendranagar market price model, the coefficient of two week (0.28) lagged Akola market price was positive and significant and the coefficient of two week (0.20) lagged own price was negative and significant. The Surendranagar market price was influenced by its own price and Akola market price with two week lag period. It means that the price discovery occurred in the markets and was transmitted to Surendranagar market.Bathinda market price model, the coefficient of one week (0.44) lagged Mansa market price was positive and significant at five percent level.Bathinda market, price was influence by Mansa market with one week lag period. It means that the price discovery occurred in the markets and was transmitted to Bathinda market.Mansa market price model, the coefficient of one week (0.15) lagged Akola market price and one week (0.38) lagged own price was positive and significant. The Mansa market was influenced by Akola market price and its own price too with one week lag period. It means that the price discovery occurred in the markets and was transmitted to Mansa market. The kind of adjustment in the short run and long run disequilibrium of prices in the distantly located markets.

Table 4.3.6: Results of vector error correction model with four lag periods in different markets

Markets	No. of lags	D(AKOLA)	D(RAJKOT)	D(SURENDRANAGAR)	D(BATHINDA)	D(MANSA)
CointEq1		**-0.115234**	**-0.064925**	-0.041265	0.004851	**-0.088247**
		(0.02718)	**(0.03191)**	(0.02908)	(0.01838)	**(0.01987)**
		[-4.24014]	**[-2.03454]**	[-1.41918]	[0.26386]	**[-4.44189]**
D(AKOLA(-1))	1	0.079954	0.194172	0.122298	0.117821	**0.153690**
		(0.08960)	(0.10521)	(0.09587)	(0.06061)	**(0.06550)**
		[0.89232]	[1.84554]	[1.27573]	[1.94383]	**[2.34634]**
D(AKOLA(-2))	2	**0.206089**	0.154184	**0.280168**	0.026962	0.043886
		(0.08790)	(0.10321)	**(0.09404)**	(0.05946)	(0.06426)
		[2.34458]	[1.49385]	**[2.97912]**	[0.45344]	[0.68296]
D(AKOLA(-3))	3	-0.045747	0.008511	0.025541	-0.024850	0.110074
		(0.09041)	(0.10616)	(0.09673)	(0.06116)	(0.06610)
		[-0.50597]	[0.08017]	[0.26403]	[-0.40629]	[1.66537]
D(AKOLA(-4))	4	**0.242870**	0.049955	0.167613	0.030738	0.112428
		(0.09545)	(0.11207)	(0.10212)	(0.06457)	(0.06977)
		[2.54461]	[0.44574]	[1.64139]	[0.47608]	[1.61133]
D(RAJKOT(-1))	1	-0.031867	-0.027798	-0.046396	0.009360	0.010792
		(0.08102)	(0.09514)	(0.08668)	(0.05481)	(0.05923)
		[-0.39331]	[-0.29219]	[-0.53523]	[0.17077]	[0.18221]
D(RAJKOT(-2))	2	-0.135274	-0.147016	-0.040250	-0.054007	-0.082967
		(0.07917)	(0.09296)	(0.08470)	(0.05355)	(0.05787)
		[-1.70872]	[-1.58154]	[-0.47521]	[-1.00847]	[-1.43359]
D(RAJKOT(-3))	3	0.085943	-0.139409	0.144780	0.012578	0.014047
		(0.07815)	(0.09177)	(0.08361)	(0.05287)	(0.05713)
		[1.09969]	[-1.51917]	[1.73151]	[0.23791]	[0.24587]
D(RAJKOT(-4))	4	-0.124168	0.087137	-0.039358	0.001842	-0.085710
		(0.07912)	(0.09290)	(0.08465)	(0.05352)	(0.05784)
		[-1.56939]	[0.93795]	[-0.46496]	[0.03441]	[-1.48190]
D(SURENDRANAGAR(-1))	1	0.093638	0.044098	0.056564	0.041871	0.035569
		(0.08957)	(0.10518)	(0.09583)	(0.06059)	(0.06548)
		[1.04538]	[0.41927]	[0.59023]	[0.69102]	[0.54320]
D(SURENDRANAGAR(-2))	2	-0.059924	0.048840	**-0.201809**	0.047080	0.071276
		(0.08741)	(0.10263)	**(0.09352)**	(0.05913)	(0.06390)
		[-0.68557]	[0.47587]	**[-2.15799]**	[0.79624]	[1.11546]

D(SURENDRANAGAR(-3))	3	0.063706	0.102158	-0.103761	0.088398	0.061466
		(0.08642)	(0.10148)	(0.09246)	(0.05846)	(0.06318)
		[0.73713]	[1.00669]	[-1.12217]	[1.51204]	[0.97289]
D(SURENDRANAGAR(-4))	4	0.001447	-0.081060	-0.151161	-0.084609	-0.052365
		(0.08892)	(0.10441)	(0.09513)	(0.06015)	(0.06500)
		[0.01627]	[-0.77639]	[-1.58895]	[-1.40664]	[-0.80560]
D(BATHINDA(-1))	1	**-0.466884**	-0.191905	-0.043545	0.057446	-0.049178
		(0.20057)	(0.23551)	(0.21459)	(0.13568)	(0.14663)
		[-2.32773]	[-0.81483]	[-0.20292]	[0.42339]	[-0.33540]
D(BATHINDA(-2))	2	-0.200493	0.231722	0.072218	-0.129185	-0.177970
		(0.18978)	(0.22284)	(0.20305)	(0.12838)	(0.13874)
		[-1.05643]	[1.03984]	[0.35567]	[-1.00625]	[-1.28278]
D(BATHINDA(-3))	3	**-0.486965**	0.083188	-0.045338	-0.017947	-0.115813
		(0.16889)	(0.19831)	(0.18070)	(0.11425)	(0.12347)
		[-2.88330]	[0.41948]	[-0.25091]	[-0.15709]	[-0.93803]
D(BATHINDA(-4))	4	-0.017937	-0.086221	0.197602	0.073148	0.014252
		(0.15304)	(0.17969)	(0.16373)	(0.10352)	(0.11187)
		[-0.11721]	[-0.47982]	[1.20687]	[0.70659]	[0.12740]
D(MANSA(-1))	1	**0.396087**	**0.410260**	0.312184	**0.438392**	**0.385109**
		(0.16911)	**(0.19857)**	(0.18093)	**(0.11440)**	**(0.12363)**
		[2.34215]	**[2.06604]**	[1.72541]	**[3.83212]**	**[3.11509]**
D(MANSA(-2))	2	0.125247	-0.286845	-0.122842	0.003438	-0.121147
		(0.16564)	(0.19450)	(0.17722)	(0.11205)	(0.12109)
		[0.75612]	[-1.47478]	[-0.69315]	[0.03068]	[-1.00047]
D(MANSA(-3))	3	**0.349177**	0.063042	0.065808	0.102184	0.128381
		(0.15746)	(0.18489)	(0.16846)	(0.10652)	(0.11511)
		[2.21757]	[0.34097]	[0.39063]	[0.95933]	[1.11532]
D(MANSA(-4))	4	-0.156330	-0.129983	-0.179646	-0.176838	-0.161050
		(0.13687)	(0.16072)	(0.14644)	(0.09259)	(0.10006)
		[-1.14215]	[-0.80877]	[-1.22676]	[-1.90991]	[-1.60956]
C		14.96025	4.037354	5.631471	3.304055	8.993037
		(13.3256)	(15.6469)	(14.2570)	(9.01431)	(9.74140)
		[1.12267]	[0.25803]	[0.39500]	[0.36653]	[0.92318]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (-1),(2),(3) and (4) indicate number of lags.

The results of VECM model show that some of the estimated coefficient are positive for selected markets. The coefficient measure the ability the prices for adjustment to deviation term the long run equilibrium , which could be removed in every period of week.

4.3.7.Market Integration among Maize Markets

4.3.8 Trend in prices of maize markets:

Analysis of trend component in series of prices involves ascertaining the general direction of movement of prices over time. The general direction should be such that movement in short period among from this direction have the tendency to return in subsequent period.Market trend was work out for wholesale prices of maize for selected markets.Several studies have been done empirically using linear trend techniques which concern the market trend of agricultural commodities in India (Yogisha *et al.,*2007; Shruthi *et al., 2013)*, only a little work has been carried out on the empirical evaluation of maize market trend. Trend analysis of prices of maize in Hoshiarpur, Nawanshahar, Banglore, Ahmednagar and Vijayanagaram markets is presented in Table 4.3.8.

The main observed that the value of coefficient highest 2.644 in Vijayanagaram market followed by Ahmednagar 2.532. For Hoshiarpur, Nawanshahar, Banglore, Ahmednagar and Vijayanagaram, the trend in prices was shows in Fig 4.3.6, 4.3.7, 4.3.8, 4.3.9 and 4.3.10. Price vary in different markets with different magnitude.

Table 4.3.8: Trend in wholesale prices of maize in selected markets of India, March 2010 to April 2014

Markets	**Intercept**	**Coefficient**	**R^2**
Hoshiarpur	954.90	1.348	0.247
Nawanshahar	948.50	1.554	0.296
Banglore	940.10	2.402	0.630
Ahmednagar	902.00	2.532	0.782
Vijayanagaram	807.00	2.644	0.900

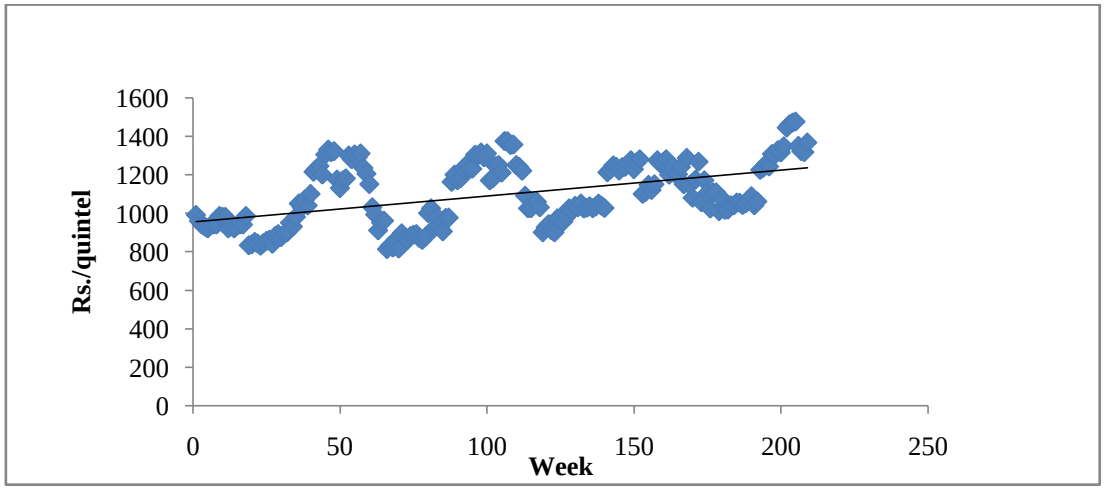

Fig 4.3.6: Trend in prices of maize in Hoshiarpur market

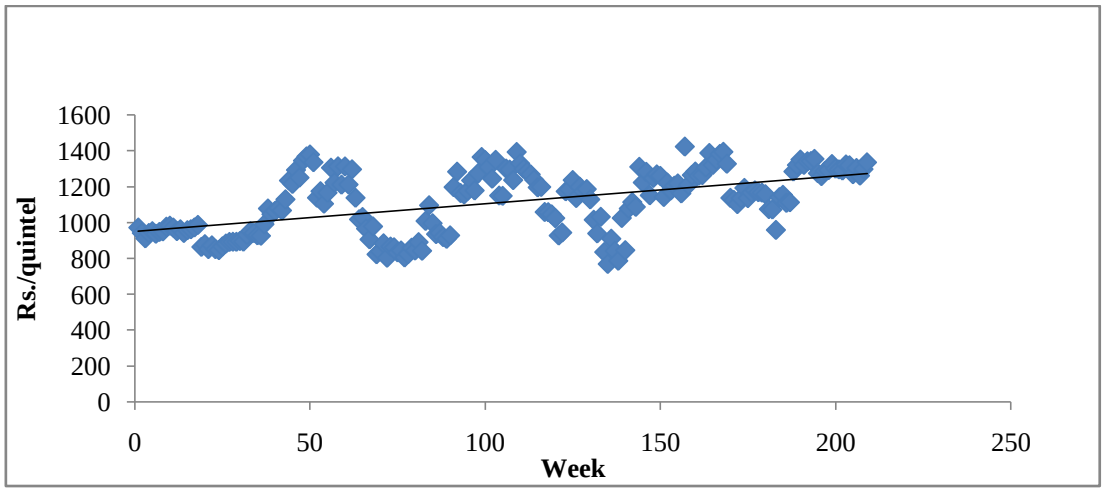

Fig 4.3.7: Trend in prices of maize in Nawanshahar market

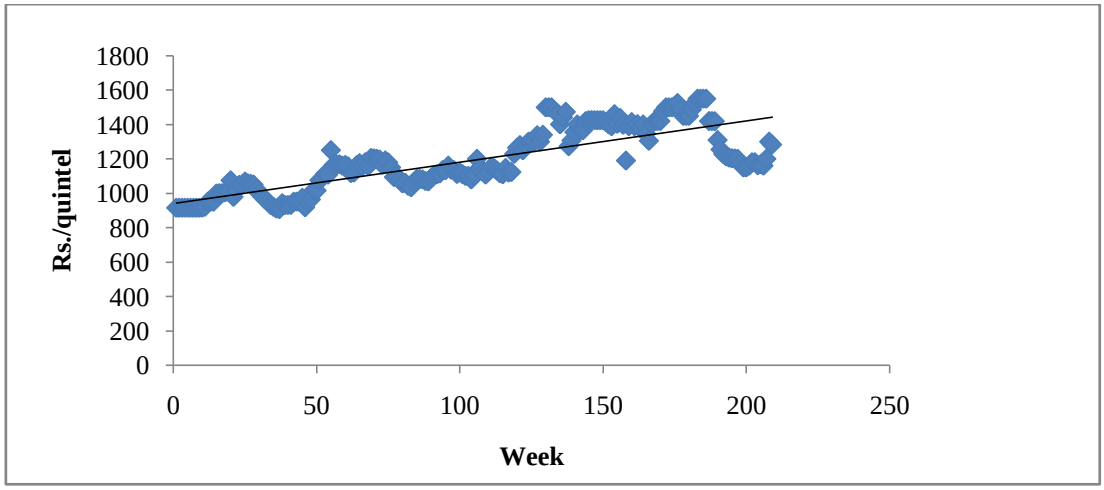

Fig 4.3.8: Trend in prices of maize in Banglore market

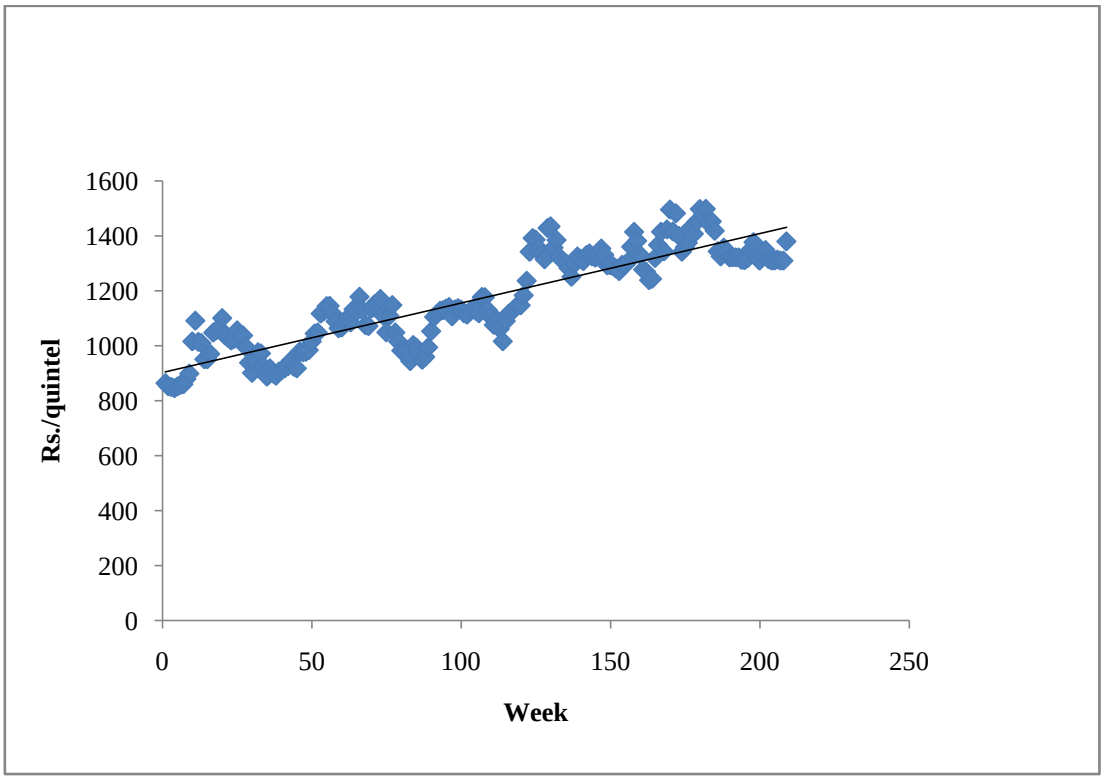

Fig 4.3.9: Trend in prices of maize in Ahmednagar market

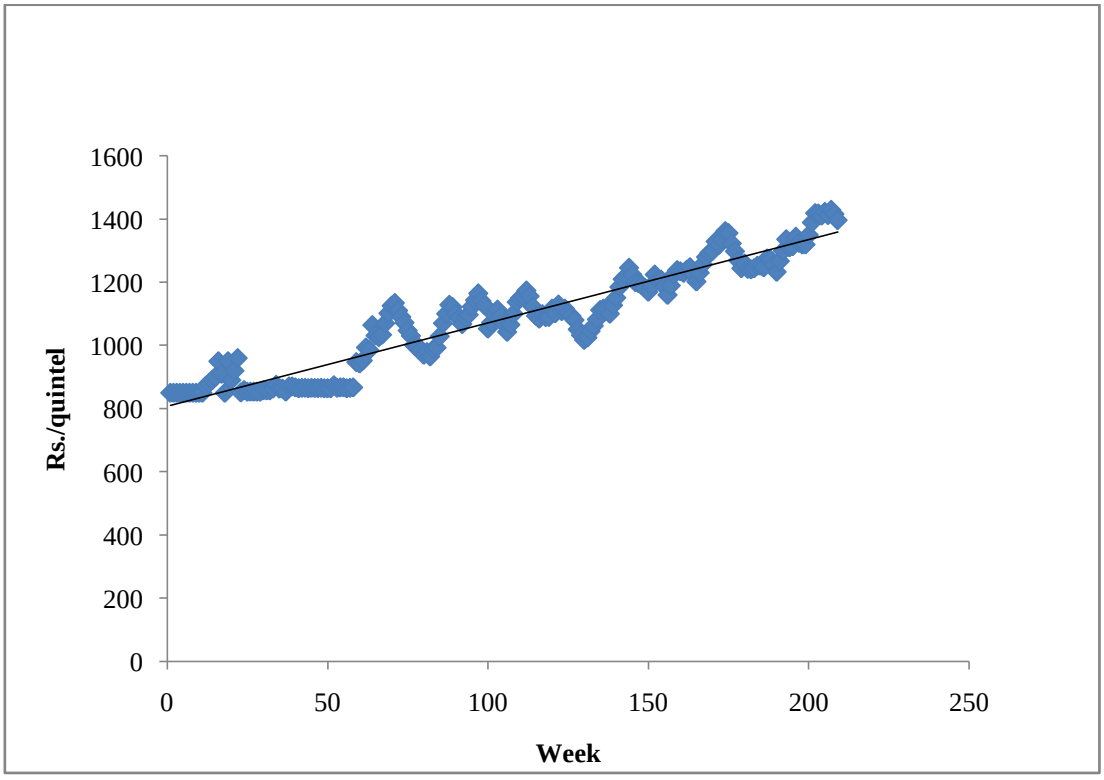

Fig 4.3.10: Trend in prices of maize in Vijayanagaram market

4.3.9 Integration among Maize markets

ADF test was cnducted for Hoshiarpur market (Punjab**),** Nawanshahar market (Punjab)**,** Bangalore market (Karnataka), Vijayanagaram market (A.P.) and Ahmednagar market**s (**Maharastra**).** It is clear from the Table 4.3.9 that in the case of maize prices in levels, the ADF test does not reject the unit root hypothesis at 5 percent level during the periods. In case of the first difference of the series, the hypothesis was, however, rejected in the periods mostly at the one percent level. Thus,all the five price series of crop were stationary of the first difference level.

Table 4.3.9: ADF test results of maize prices in different markets

Markets	**At Level**	**Stationarity**	**At First difference**	**Stationarity**	**Critical values (at 1% level)**
Hoshiarpur	-2.978605	Non-stationary	-16.26267	Stationary	-4.003005*
Nawanshahar	-3.153475	-do-	-18.89196	-do-	
Banglore	-2.585512	-do-	-16.42697	-do-	
Vijayanagaram	-3.325581	-do-	-13.94975	-do-	
Ahmednagar	-3.393945	-do-	-12.94556	-do-	

* Significant at 1 per cent level

4.3.10 Co-integration among markets

Based on the Johansen multiple co-integration procedure, co-integration between the markets was analyzed using E-Views software. Both the Maximum Eigenvalue test and trace test results indicate the presence of four co-integrating vectors at the five per cent significance level. This implies that all the five markets were in fact cointegrated and had a common sharing information on price changes in the long run. The concept of co integration is developed from the notion of equilibrium relations between the pairs of series. The price of cotton were in equilibrium relations and there existed co integration among these markets. It may be due to market forces or due to producer/seller behavior because co-integration does not require that the long run equilibrium relationship has to be generated by market forces or the behavior of individuals.The results are presented in Table 4.3.8 .

Table 4.3.10: Estimation of Johansen Co-integration test in different markets of maize

Hypothesized No. of CE (S)	**Eigen value**	**Trace Statistic**	**0.05 value**	**Prob****
None *	0.184464	122.6659	88.80380	0.0000
At most 1 *	0.129937	82.29181	63.87610	0.0007
At most 2 *	0.107347	54.73237	42.91525	0.0022
At most 3 *	0.098972	32.24793	25.87211	0.0070
At most 4	0.056963	11.61260	12.51798	0.0705

Trace test indicates 4 cointegrating eqn(s) at the 5 percent level
* denotes rejection of the hypothesis at the 5 percent level

4.3.11 Results of Granger Causality Test

The causal relationship between the price series in maize markets were approached through Granger Causality technique. The results of the analysis showing the relationship between maize markets are presented in Table 4.3.11 and figure 4.3.9.1

Table 4.3.11: Results of Pair-wise Granger Causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.
NAWANSHAHAR does not Granger Cause HOSHIARPUR	207	0.00667	0.9934
HOSHIARPUR does not Granger Cause NAWANSHAHAR		14.8440	**1.E-06**
BANGLORE does not Granger Cause HOSHIARPUR	207	0.79785	0.4517
HOSHIARPUR does not Granger Cause BANGLORE		2.60225	**0.0766**
VIJAYANAGARAM does not Granger Cause HOSHIARPUR	207	1.50029	0.2255
HOSHIARPUR does not Granger Cause VIJAYANAGARAM		0.89764	0.4092
AHMEDNAGAR does not Granger Cause HOSHIARPUR	207	0.18654	0.8300
HOSHIARPUR does not Granger Cause AHMEDNAGAR		1.07235	0.3441
BANGLORE does not Granger Cause NAWANSHAHAR	207	0.58088	0.5603
NAWANSHAHAR does not Granger Cause BANGLORE		3.50622	**0.0318**
VIJAYANAGARAM does not Granger Cause NAWANSHAHAR	207	1.20202	0.3027
NAWANSHAHAR does not Granger Cause VIJAYANAGARAM		1.95027	0.1449
AHMEDNAGAR does not Granger Cause NAWANSHAHAR	207	0.24206	0.7852
NAWANSHAHAR does not Granger Cause AHMEDNAGAR		1.31655	0.2703
VIJAYANAGARAM does not Granger Cause BANGLORE	207	2.16409	0.1175
BANGLORE does not Granger Cause VIJAYANAGARAM		0.71128	0.4922
AHMEDNAGAR does not Granger Cause BANGLORE	207	11.4612	**2.E-05**
BANGLORE does not Granger Cause AHMEDNAGAR		3.31067	**0.0385**
AHMEDNAGAR does not Granger Cause VIJAYANAGARAM	207	1.93660	0.1469
VIJAYANAGARAM does not Granger Cause AHMEDNAGAR		4.12245	**0.0176**

The co-integration tests performed indicate only the existence of the long run relationship among the wholesale prices of maize crop in different markets. The direction of relationship among price series and markets is equally important for which Granger Causality test are performed.Theoretically, a variable is said to Granger-Cause another variable, inferred the flow of information related to prices among different markets.

- Hoshoshiarpur market prices influence the prices at Nawanshahar Nagar market and not vice-versa.
- Hoshiarpur market prices influence the prices at Banglore market and not vice-versa.
- Nawanshahar market prices influence the prices at Bangalore market and not vice-versa.

- Vijayanagaram market prices influence the prices at Ahmednagar market and not vice-versa.
- Ahmednagar and Bangalore market prices have a bidirectional influence.
- The unidirectional relationships where prices of one market lead to the price of other market without having a reciprocal impact on the prices would imply that such markets are not very efficient in term of influencing the price of other markets.

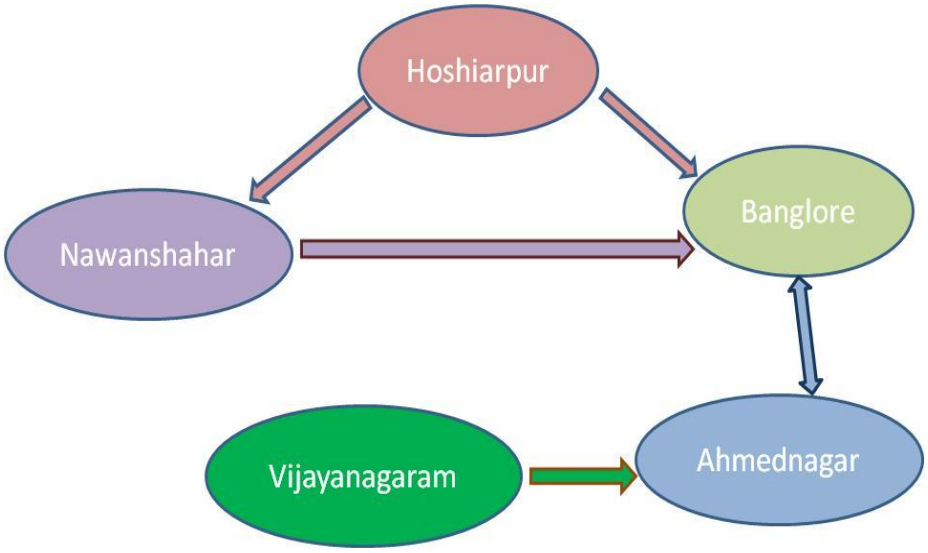

Figure 4.3.9.1 Market integration among maize markets

4.3.12 Estimation of Vector Error Correction Model

The VECM model is estimated to know how far among the prices from the equilibrium level are and to account for this kind of adjustment vector error correction model could be an approprite tool that takes into account.

Since the maize markets are integrated in the long run, it is important to study the short run and long run equilibrium among the markets. Hence Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium and results of the same presented in Table 4.3.12

The coefficient of the error correction term indicates the speed of convergence to the long run growth path as a result of a shock in their own price. The coefficients show how quickly variables return back to equilibrium. The Table 4.3.12 clearly shows that the co-integration equation of error correction mechanism is significant in all the five markets. It is the revealed from the analysis that, any disturbance in price will get corrected in about 10 hours in Banglore around 11 hours in Ahmednagar. In all the selected markets, the prices were influenced by their own weekly lags for long run equilibrium.

Table 4.3.12 : Results of vector error correction model with four lag periods in different markets

Markets	**No. of lags**	**D(HOSHIARPUR)**	**D(NA**WANSHAHAR**)**	**D(BANGLORE)**	**D(VIJAYANAGARAM)**	**D(AHMEDNAGAR)**
CointEq1		-0.012899	-0.000225	**0.055702**	0.017947	**-0.062757**
		(0.02350)	(0.02979)	**(0.01561)**	(0.00987)	**(0.01442)**
		[-0.54880]	[-0.00756]	**[3.56838]**	[1.81915]	**[-4.35314]**
D(HOSHIARPUR(-1))	1	-0.106482	0.090997	**-0.124408**	-0.039442	**0.110629**
		(0.07487)	(0.09490)	**(0.04972)**	(0.03143)	**(0.04592)**
		[-1.42231]	[0.95887]	**[-2.50213]**	[-1.25510]	**[2.40918]**
D(HOSHIARPUR(-2))	2	0.003162	0.109486	-0.041266	-0.041822	0.070707
		(0.07752)	(0.09827)	(0.05149)	(0.03254)	(0.04755)
		[0.04079]	[1.11415]	[-0.80151]	[-1.28523]	[1.48703]
D(HOSHIARPUR(-3))	3	**0.166463**	0.480121	-0.084209	0.003741	-0.040680
		(0.07556)	(0.09578)	(0.05018)	(0.03172)	(0.04634)
		[2.20315]	[5.01292]	[-1.67815]	[0.11796]	[-0.87779]
D(NAWANSHAHAR (-1))	1	-0.042194	**-0.303853**	-0.051994	-0.008721	-0.036888
		(0.05714)	**(0.07244)**	(0.03795)	(0.02399)	(0.03505)
		[-0.73839]	**[-4.19481]**	[-1.37003]	[-0.36358]	[-1.05244]
D(NAWANSHAHAR (-2))	2	-0.012046	-0.059349	-0.032887	0.013855	-0.027121
		(0.05843)	(0.07407)	(0.03881)	(0.02453)	(0.03584)
		[-0.20614]	[-0.80125]	[-0.84745]	[0.56487]	[-0.75671]
D(NAWANSHAHAR (-3))	3	-0.010028	0.007039	-0.053428	0.029725	0.003982
		(0.05524)	(0.07003)	(0.03669)	(0.02319)	(0.03389)
		[-0.18152]	[0.10052]	[-1.45619]	[1.28184]	[0.11750]
D(BANGLORE(-1))	1	0.089700	-0.176656	-0.132664	-0.028539	-0.026440
		(0.10740)	(0.13614)	(0.07133)	(0.04508)	(0.06588)
		[0.83519]	[-1.29758]	[-1.85990]	[-0.63306]	[-0.40136]

D(BANGLORE(-2))	2	0.019742	-0.127718	**-0.140906**	0.009312	0.077313
		(0.10568)	(0.13396)	**(0.07019)**	(0.04436)	(0.06482)
		[0.18681]	[-0.95341]	**[-2.00762]**	[0.20991]	[1.19273]
D(BANGLORE(-3))	3	**-0.295455**	0.016501	0.068202	-0.016756	0.039477
		(0.10273)	(0.13022)	(0.06823)	(0.04312)	(0.06301)
		[-2.87597]	[0.12672]	[0.99962]	[-0.38858]	[0.62650]
D(VIJAYANAGARAM(-1))	1	0.265506	0.028405	0.215949	0.018074	-0.051563
		(0.17395)	(0.22050)	(0.11553)	(0.07302)	(0.10670)
		[1.52630]	[0.12882]	[1.86923]	[0.24754]	[-0.48327]
D(VIJAYANAGARAM(-2))	2	-0.099402	-0.023705	0.050568	0.088272	-0.159533
		(0.17569)	(0.22271)	(0.11668)	(0.07375)	(0.10776)
		[-0.56578]	[-0.10644]	[0.43339]	[1.19697]	[-1.48042]
D(VIJAYANAGARAM(-3))	3	-0.121595	-0.054019	0.092180	0.075323	0.050360
		(0.17637)	(0.22357)	(0.11714)	(0.07403)	(0.10818)
		[-0.68942]	[-0.24162]	[0.78695]	[1.01743]	[0.46552]
D(AHMEDNAGAR(-1))	1	0.086529	-0.007201	0.034089	-0.061745	**0.227565**
		(0.12142)	(0.15391)	(0.08064)	(0.05097)	**(0.07447)**
		[0.71264]	[-0.04679]	[0.42274]	[-1.21149]	**[3.05561]**
D(AHMEDNAGAR(-2))	2	0.077113	0.004930	0.132835	0.024860	-0.001307
		(0.12142)	(0.15391)	(0.08064)	(0.05097)	(0.07447)
		[0.63510]	[0.03203]	[1.64728]	[0.48777]	[-0.01755]
D(AHMEDNAGAR(-3))	3	-0.122100	-0.126066	0.027622	-0.012433	0.075675
		(0.12192)	(0.15455)	(0.08097)	(0.05118)	(0.07478)
		[-1.00145]	[-0.81569]	[0.34112]	[-0.24294]	[1.01192]
C		2.087142	2.280837	1.419029	2.419720	2.129661
		(4.21595)	(5.34416)	(2.79995)	(1.76965)	(2.58590)
		[0.49506]	[0.42679]	[0.50680]	[1.36734]	[0.82357]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (1),(2) and (3) indicate number of lags.

In addition,in the long run the price changes in Hoshiarpur market, the prices are influenced to the extent of 29 per cent by one week lag price of Banglore. In the long run the price changes in Banglore market are influenced to the extent of 12 per cent by one week back prices of market Hoshiarpur market . In the long run the price changes in Ahmednagar market are influenced to the extent of 11 per cent by one week back prices of market Hoshiarpur market respectivily. The kind of adjustment in the short run and long run disequilibrium of prices in the distantly located markets. The results of VECM model show that some of the estimated coefficient are positive for selected markets. The coefficient measure the ability the prices for adjustment to deviation term the long run equilibrium , which could be removed in every period of week.

4.3.13 Market Integration among Rice Markets

4.3.14 Trend in prices of rice markets:

Analysis of trend component in series of prices involves ascertaining the general direction of movement of prices over time. The general direction should be such that movement in short period among from this direction have the tendency to return in subsequent period.Market trend was work out for wholesale prices of rice for selected markets.Several studies have been done empirically using linear trend techniques which concern the market trend of agricultural commodities in India (Hosamani *et al.*,2000; Dayakar *et al.*,2003), only a little work has been carried out on the empirical evaluation of rice market trend. Trend analysis of prices of rice in Sangrur, Burdwan, Shahjahanpur and West godavari markets is presented in Table 4.3.14.

For Sangrur, Burdwan, Shahjahanpur and West godavari markets, the trend in prices was shows in Fig 4.3.11, 4.3.12, 4.3.13 and 4.3.14. Price vary in different markets with different magnitude.

Table 4.3.14: Trend in wholesale prices of rice in selected markets of India, March 2010 to April, 2014

Markets	**Intercept**	**Coefficient**	**R^2**
Sangrur	1511	5.388	0.589
Burdwan	1613	3.164	0.550
Shahjahanpur	1486	2.446	0.738
West Godavari	1996	10.830	0.838

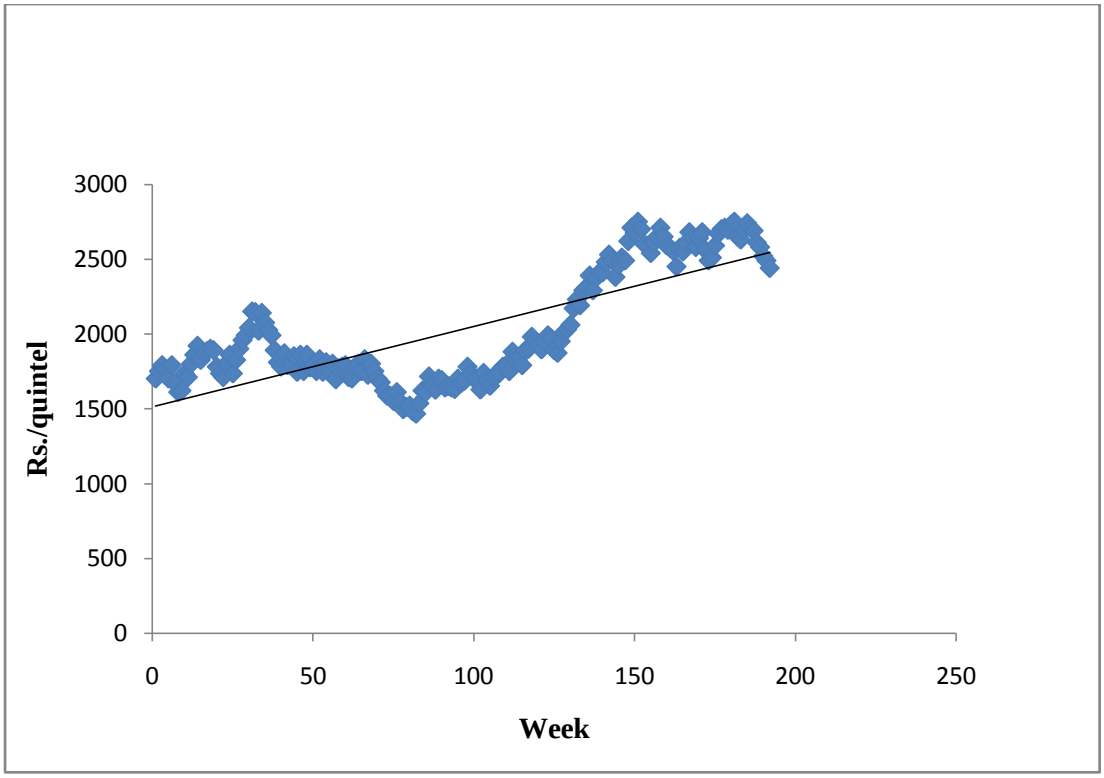

Fig 4.3.11: Trend in prices of rice in Sangrur market

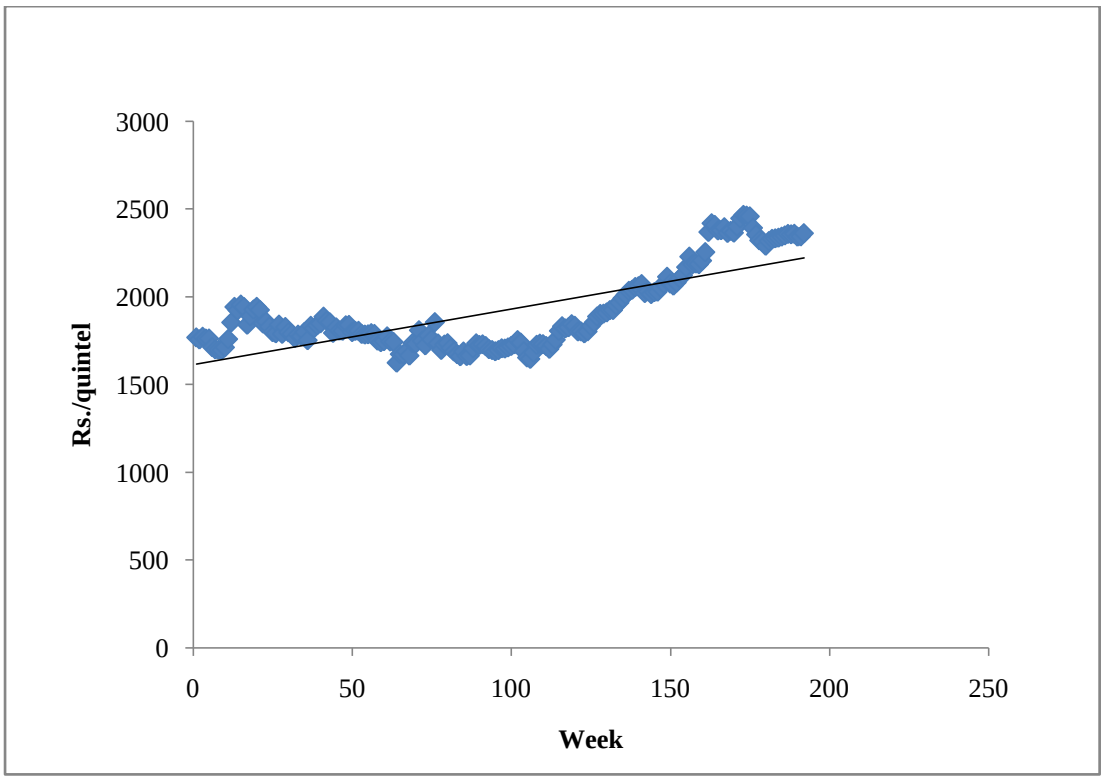

Fig 4.3.12: Trend in prices of rice in Burdwan market

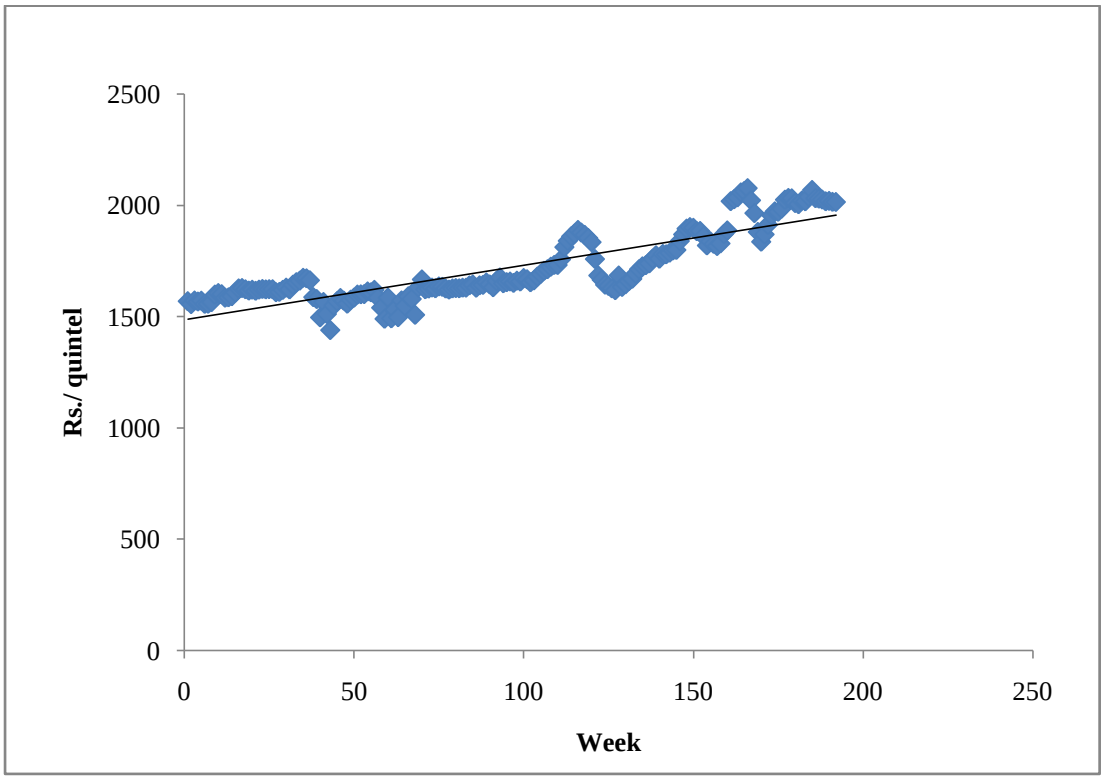

Fig. 4.3.13: Trend in prices of rice in Shahjahanpur market

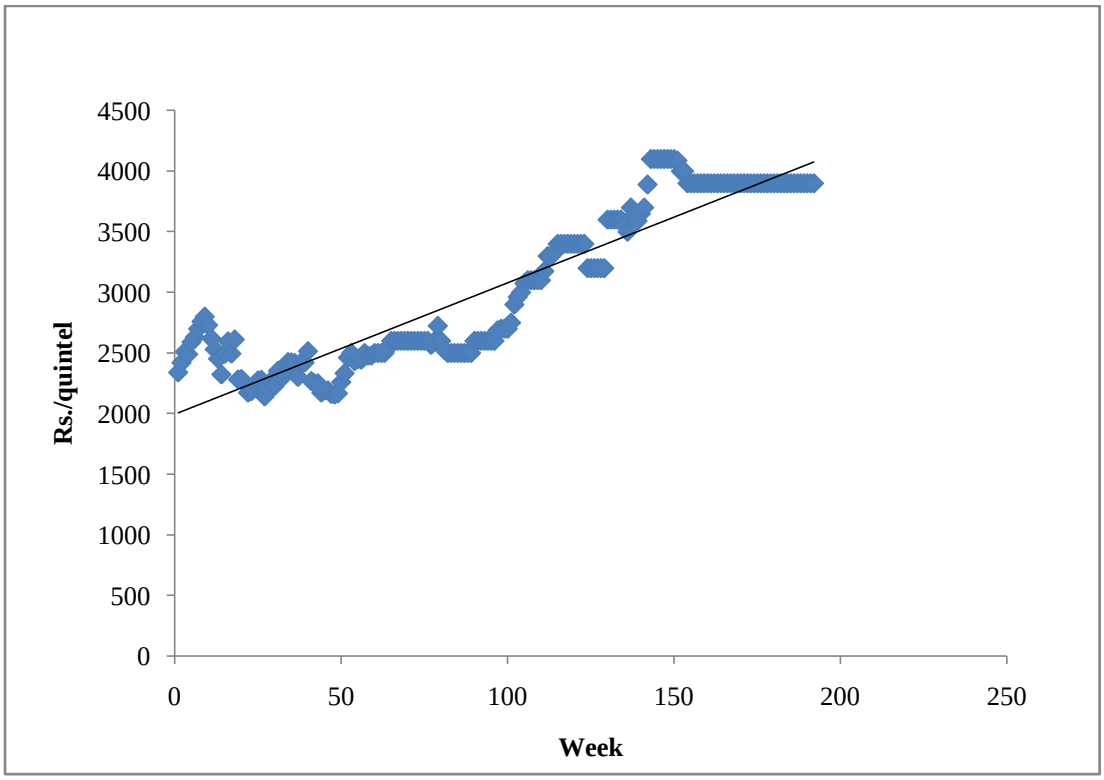

Fig 4.3.14: Trend in prices of rice in West godavari market

4.3.15 Integration among rice markets

The Augmented Dickey Fuller (ADF) based unit root test procedure was done to check whether the wholesale price series of rice among different markets such as Sangrur (Punjab), Burdwan (W.B.), Shahjahanpur (U.P.) and West Godavari (A.P.) markets are stationary.The results of unit root test are given in Table 4.3.15 ,in case of prices in levels, ADF test does not reject the unit root hypothesis at 1 percent level during the periods. In the case of first difference of the series,the hypothesis was,however was rejected at 1 per cent level.Thus all the four series were integrated of the order one.

Table: 4.3.15 ADF test results of rice **prices in different markets**

Markets	**At Level**	**Stationarity**	**At First difference**	**Stationarity**	**Critical values (at 1% level)**
Sangrur	-1.590752	Non-stationary	-16.49136	Stationary	-4.007084
Burdwan	-1.484412	-do-	-13.79628	-do-	
Shahjahanpur	-2.750782	-do-	-14.08801	-do-	
West Godavari	-2.001519	-do-	-13.60503	-do-	

4.3.16 Johansen's Multiple Co-integration test

The concept of co-integration is developed from the notion of equilibrium relations between the pairs of series. The price of cotton were in equilibrium relations and there existed co integration among these markets. It may be due to market forces or due to producer/seller behavior because co-integration does not require that the long run equilibrium relationship has to be generated by market forces or the behavior of individuals.

Johanson method of multivariate cointegration tests for the four rice price series are presented in Table 4.3.16. The trace statistic test results indicate the presence of three cointegrating vector at 5 per cent significance level for the periods.This implies that three markets were in fact cointegrated and had common sharing of information on price changed in the long run.The above empirical evidence suggests that all the four markets do exhibit a long run relationship.The farmers transfer their produce from one market to the other according to the price changes.

Table 4.3.16: Results of Johansen Co-integration Analysis

Hypothesized No. of CE(S)	**Eigen value**	**Trace Statics**	**0.05 Critical value**	**Prob****
None *	0.316702	118.2520	63.87610	0.0000
At most 1 *	0.141417	53.13108	42.91525	0.0035
At most 2 *	0.104406	27.05838	25.87211	0.0355
At most 3	0.046836	8.202554	12.51798	0.2356

Trace test indicates 3 cointegrating eqn(s) at the 5 per cent level
* denotes rejection of the hypothesis at the 5 per cent level

4.3.17 Causality in different markets

The causal relationship between the price series in rice markets were approached through Granger Causality technique. The results of the analysis showing the relationship between rice markets are presented in Table 4.3.17 and figure 4.3.15.

Table 4.3.17: Results of Pair-wise Granger Causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.
BURDWAN does not Granger Cause SANGRUR	190	0.60739	0.5459
SANGRUR does not Granger Cause BURDWAN		6.23338	0.0024
SHAHJAHANPUR does not Granger Cause SANGRUR	190	1.15463	0.3174
SANGRUR does not Granger Cause SHAHJAHANPUR		2.84731	0.0605
WEST_GODAVARI does not Granger Cause SANGRUR	190	5.72076	0.0039
SANGRUR does not Granger Cause WEST_GODAVARI		0.06348	0.9385
SHAHJAHANPUR does not Granger Cause BURDWAN	190	4.58271	0.0114
BURDWAN does not Granger Cause SHAHJAHANPUR		1.74145	0.1781
WEST_GODAVARI does not Granger Cause BURDWAN	190	6.37021	0.0021
BURDWAN does not Granger Cause WEST_GODAVARI		2.81845	0.0623
WEST_GODAVARI does not Granger Cause SHAHJAHANPUR	190	5.80152	0.0036
SHAHJAHANPUR does not Granger Cause WEST_GODAVARI		0.34638	0.7077

The co-integration tests performed indicate only the existence of the long run relationship among the wholesale prices of rice crop in different markets. The direction of relationship among price series and markets is equally important for which Granger Causality test are performed.Theoretically, a variable is said to Granger-Cause another variable, inferred the flow of information related to prices among different markets.

- Sangrur market prices influence the prices at Burdwan market and not vice-versa.
- Sangrur market prices influence the prices at Shahjahanpur market and not vice-versa.
- West Godavary market prices influence the prices at Sangrur market and not vice-versa.
- Shahjahanpur market prices influence the prices at Burdwan market and not vice-versa.
- West Godavary and Burdwan market prices have a bidirectional influence.
- West Godavary market prices influence the prices at Shahjahanpur market and not vice-versa.

The unidirectional relationships where prices of one market lead to the price of other market without having a reciprocal impact on the prices would imply that such markets are not very efficient in term of influencing the price of other markets.

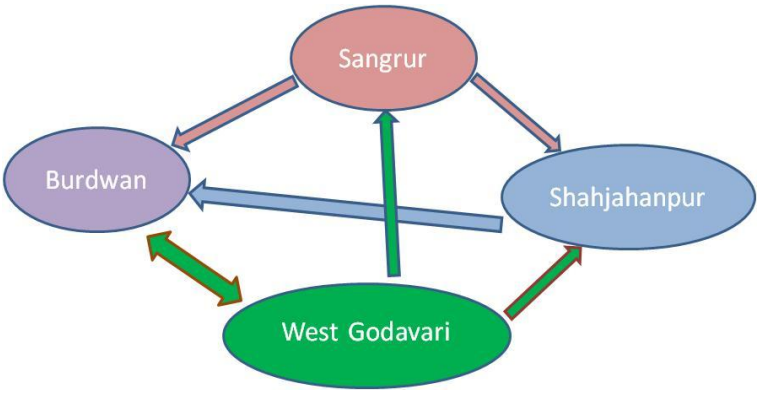

Figure 4.3.15 Market integration among rice markets

4.3.18 Estimation of Vector Error Correction model

The VECM model is estimated to know how far among the prices from the equilibrium level are and to account for this kind of adjustment vector error correction model could be an approprite tool that takes into account.

Since the rice markets are integrated in the long run, it is important to study the short run and long run equilibrium among the markets. Hence Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium and results of the same presented in Table 4.3.18. The error correction term indicates the speed of adjustment among the variable before converging to equilibrium in the dynamic model. The coefficients show how quickly variables return back to equilibrium.The Table 4.3.18 clearly shows that the co-integration equation of error correction mechanism is significant in all the four markets. It was revealed from the analysis that, any disturbance in price will get corrected in about 14 hours in Sangrur around 7 hours in Burdwan and 5 hours in Shahjahanpur. Burdwan market price model of rice, the coefficient of first week (0.17) lagged Shahajahanpur market price and third week (0.08) lagged West Godavari market price was positive and significant at 5 per cent level . It means that the price discovery occurred in the markets and was transmitted to Burdwan market.In case of Shahajahanpur market , the prices are influenced by its own second week (0.16) lag period.In West Godavari market, the prices are influenced by one week (0.39) and third week (0.42) back prices of Burdwan market. It means that the price discovery occurred in the markets and was transmitted to Shahjahanpur market. The results that even there is geographical dispersion of markets, the prices are linked together indicating, that all the market locations are in the same economic market system. More ever in the short run market prices do deviate from their equilibrium change in few weeks. The kind of adjustment in the short run and long run disequilibrium of prices in the distantly located markets. The results of VECM model show that some of the estimated coefficient are positive for selected markets. The coefficient measure the ability the prices for adjustment to deviation term the long run equilibrium , which could be removed in every period of Week.

Table 4.3.18: Results of vector error correction model with two lag periods in different markets

Markets	No. of lags	D(SANGRUR)	D(BURDWAN)	D(SHAHJAHANPUR)	D(WEST_GODAVARI)
CointEq1		**-0.082434**	**0.042510**	**-0.032701**	0.022937
		(0.02979)	**(0.01554)**	**(0.01500)**	(0.03309)
		[-2.76755]	**[2.73471]**	**[-2.18013]**	[0.69325]
D(SANGRUR(-1))	1	-0.110532	-0.052904	0.066179	-0.014240
		(0.07743)	(0.04041)	(0.03899)	(0.08600)
		[-1.42760]	[-1.30931]	[1.69733]	[-0.16557]
D(SANGRUR(-2))	2	0.060359	-0.066086	0.002035	0.102475
		(0.07795)	(0.04068)	(0.03926)	(0.08659)
		[0.77429]	[-1.62443]	[0.05185]	[1.18343]
D(SANGRUR(-3))	3	0.052022	0.029739	0.009205	0.079615
		(0.07909)	(0.04128)	(0.03983)	(0.08785)
		[0.65774]	[0.72050]	[0.23111]	[0.90621]
D(SANGRUR(-4))	4	0.098482	-0.043202	0.044092	0.096818
		(0.07581)	(0.03956)	(0.03817)	(0.08420)
		[1.29914]	[-1.09203]	[1.15500]	[1.14980]
D(BURDWAN(-1))	1	-0.002988	0.050477	0.011672	**-0.395481**
		(0.14742)	(0.07694)	(0.07424)	**(0.16376)**
		[-0.02027]	[0.65607]	[0.15722]	**[-2.41503]**
D(BURDWAN(-2))	2	-0.167281	0.107115	-0.082717	0.067618
		(0.14377)	(0.07503)	(0.07240)	(0.15970)
		[-1.16350]	[1.42758]	[-1.14247]	[0.42340]
D(BURDWAN(-3))	3	0.124921	-0.093664	0.024348	**0.419099**
		(0.14415)	(0.07523)	(0.07259)	**(0.16012)**
		[0.86661]	[-1.24506]	[0.33541]	**[2.61741]**
D(BURDWAN(-4))	4	0.008106	0.012650	0.118367	-0.036785
		(0.14369)	(0.07499)	(0.07236)	(0.15961)
		[0.05641]	[0.16870]	[1.63585]	[-0.23048]

D(SHAHJAHANPUR(-1))	1	-0.107036	**0.166618**	-0.004600	0.135464
		(0.15225)	**(0.07946)**	(0.07667)	(0.16912)
		[-0.70303]	**[2.09699]**	[-0.06000]	[0.80101]
D(SHAHJAHANPUR(-2))	2	0.225780	-0.057434	**0.157661**	0.290553
		(0.15427)	(0.08051)	**(0.07769)**	(0.17136)
		[1.46355]	[-0.71338]	**[2.02943]**	[1.69556]
D(SHAHJAHANPUR(-3))	3	0.254727	-0.069200	0.051570	0.026086
		(0.15711)	(0.08199)	(0.07912)	(0.17452)
		[1.62132]	[-0.84398]	[0.65180]	[0.14948]
D(SHAHJAHANPUR(-4))	4	0.252984	-0.062568	-0.029681	-0.143724
		(0.15589)	(0.08136)	(0.07850)	(0.17316)
		[1.62284]	[-0.76907]	[-0.37809]	[-0.83000]
D(WEST_GODAVARI(-1))	1	0.110693	-0.036751	0.043261	-0.023198
		(0.06927)	(0.03615)	(0.03488)	(0.07694)
		[1.59808]	[-1.01667]	[1.24023]	[-0.30151]
D(WEST_GODAVARI(-2))	2	-0.019431	-0.065004	0.017011	0.072320
		(0.06933)	(0.03618)	(0.03491)	(0.07701)
		[-0.28026]	[-1.79654]	[0.48721]	[0.93906]
D(WEST_GODAVARI(-3))	3	0.020602	**0.085392**	0.013400	-0.016494
		(0.06905)	**(0.03604)**	(0.03477)	(0.07670)
		[0.29836]	**[2.36957]**	[0.38535]	[-0.21504]
D(WEST_GODAVARI(-4))	4	-0.045374	-0.009717	-0.001270	-0.068767
		(0.06895)	(0.03598)	(0.03472)	(0.07658)
		[-0.65811]	[-0.27004]	[-0.03657]	[-0.89792]
C		1.528261	3.756346	0.648497	5.233629
		(4.84799)	(2.53006)	(2.44137)	(5.38512)
		[0.31524]	[1.48469]	[0.26563]	[0.97187]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (1),(2),(3) and (4) indicate number of lags.

Section IV: Suggestions to improve market efficiency in cotton, Maize and Paddy

Price variability is the major component of market risk for both producers and consumers. The high volatility of these agricultural commodities is a matter of concern for farmers, consumers and policy makers. The high prices of rice and maize can be blamed for food price implation.

- The market infrastructure is an established concept on itself, which to a large extent is of proficient nature, still the improvements like grading and fast moving transportation means needs focus.
- Almost all the farmers have the demand for proper storage facilities, so that they can store their produce in peak season and sell it at higher price in the lean season. Marketing of crops has to be improved by Government agency, which must procure the produce from the farmers as in case of cotton, maize and basmati paddy.
- To provide scientific storage facilities at village level to improve their holding capacity.
- Improve marketing infrastructure (covered area in market-yard) for better storage of produce in the market so that the damage from rainfall, animals, birds etc must be minimized.
- High capacity dryers are installed in maize markets in Punjab state which are only beneficial for medium and large farmers. But marginal, small and some extent semi-medium farmers can't use these dryers due to low farm produce. The Punjab government should provide low capacity maize dryers because dryers help farmers get better remuneration as high moisture content depletes the shelf life of maize and fetches less price in the market.
- Farmers need to be equipped with the communication system regarding the issues like the price of crops.
- Due to difference in bargaining power of small, medium and large farmers because of the factors like education, power and link ups, the prices of crops vary a lot. Thus, there is need to reduce the price variation
- The government should ensure a minimum assured procurement price for basmati paddy, American cotton and maize.
- Direct payment scheme should be encouraged to improve the farmers bargaining power.
- The government should promote value addition by setting up agro-based industries at village or block level for these crops like cotton, maize and basmati rice so that economic welfare of the farmers can be improved and they are not subjected to price fluctuations in the market.

- Cumbersome procedure of the loans by the bank is the major problem faced by the farmers. Hence, steps needs to be taken to give adequate amount of credit for the production and marketing.
- In the foregoing analysis, the timing of sale emerged as the most significant factor determining the price of the crop. Therefore, the farmers should not sell immediately after the harvest. They should desist from depressed sales and keep their produce in warehouse and avail of warehouse receipt loans. The banks provide loans up to 75 per cent of the value of produce on production of warehouse receipts. They should sell at a time when prices are favourable in the market.
- There is a need to establish sound marketing intelligence system to generate and provide up to date price information along with changing demand and supply perspectives of these crops. This will help farmers in making adequate decisions regarding choice of time and market to sell their produce.
- Framers should be educated regarding the management of diseases and insect-pests and agricultural extension services regarding identification.

CHAPTER V

SUMMARY

Punjab is a dominating state in the agriculture sector. Punjab state comprising only 1.54 per cent of the total geographical area of country now contributes 13-14 per cent towards the total food grain production of the country. State has earned a name of granary of India. Due to the extreme climatic and weather variations, very apt for a variety of crops like wheat, rice, cotton and maize along with the availability of abundant water resources, the state is very aptly known as the food bowl of India. Agriculture continues to be an important sector of the State's economy in terms of employment and contributes about 20.83 per cent of the Gross State Domestic Product (2013-14). At present, 82 per cent of the total geographical area of the State is under cultivation and the cropping intensity is around 191 per cent (Statistical Abstract of Punjab 2013).In this study, focus has been on the crops namely cotton, maize and rice, which also account for the credit of being the important and mostly grown up crops in Punjab. Bathinda, Hoshiarpur and Sangrur districts were selected for the study. The present study was undertaken with the following specific objectives:

i. To analyze the determinants of pricing efficiency for important crops.
ii. To examine the market integration among different pairs of markets for important crops.
iii. To suggest measures to improve market efficiency.

The study was based on secondary as well as primary data. The primary data was conducted in state of Punjab. There are three zones in Punjab i.e. sub mountainous, central zone and south western zone with cropping pattern maize-wheat, paddy-wheat and cotton-wheat, respectively. The south western zone was selected for the study as the cotton wheat cropping pattern prevailed in this zone. Bathinda district of south western zone was selected purposively as it ranked first in area under cotton. The sub mountainous zone was selected for the study as the maize wheat cropping pattern prevailed in this zone. Hoshiarpur district of sub mountainous zone was selected purposively as it ranked first in area under maize. Maize is the third most important kharif season crop after paddy and cotton in Punjab. The central zone was selected for the study as the paddy wheat cropping pattern prevailed in this zone. Sangrur district of central zone was selected purposively as it ranked first in area under paddy. To achieve the objectives of the study, the primary data of 180 growers from selected districts of Punjab was collected. Cotton, Maize and Paddy are important kharif crops of the Punjab state. A multistage sampling technique was employed to draw a representative sample. At the first stage, one district having maximum area under selected crop (American cotton, Kharif maize, Basmati paddy) in Punjab were selected. At the next stage, one block having maximum concentration of area under selected crop from each selected district were selected. At the

third stage, a cluster of two villages were randomly selected from namely blocks Bathinda, Hoshiarpur and dhuri representing different farm size categories were taken following the probability proportional to size, the farmers were categorized into three groups on the basis of their operational holdings i.e. Small farmers (up to 2 hectare), Medium farmers (2 to 10 hectare) and large farmers (> 10 hectare) of operational holdings. Thus a total sample of 180 farmers covering six villages, three blocks and three districts of Punjab was finally chosen for the ultimate analysis. The primary data so collected was through a specially structured interview schedule.

To accomplish the objective of the study, the secondary data regarding to area, production and productivity of selected crops in Punjab were collected from various published sources such as *Statistical Abstracts of Punjab* for the period 1960-61 to 2012-13. The annual compound growth rates (ACGRs) were computed by using power function. From each state, one market was selected on the basis of availability of prices data. Secondary data of cotton was collected from different states i.e. Bathinda (Punjab), Mansa (Punjab) , Akola (Maharastra), Rajkot (Gujrat) and Surendranagar (Gujrat) markets of India. Maize wholesale price data were collected from Hoshiarpur (Punjab), Nawanshahar (Punjab), Banglore (Karnataka), Vijayanagaram (A.P.) and Ahmednagar (Maharastra) market. Rice wholesale price data were collected from Sangrur (Punjab), Burwan (West Bengol), Shahjahanpur (U.P.) and West godavari (A.P.).

The overall scenario of American cotton in Punjab using the analysis of year-wise area under American cotton was highest in 1988-89. The table further reveals that the production of American cotton in Punjab varied between 339 thousand hectare in 1962-63 to 2572 thousand hectare in 2006-07. The productivity of American cotton in Punjab varied between 269 kg per hectare (1960-61) to 763 kg per hectare (2006-07).Trend shows that the area has maximum value in the year of 1970-71 to 1979-80 at the value of 9.7552 while it fluctuates in the other considered years. The maximum downfall is during the year 1990-91 to 1999-2000 at the value -3.6589. The maximum production occurs in the year 1980-81 to 1989-90 having the value of 11.2793 while the valley value is -13.2342. The peak value of yield occurs in the year 1980-81 to 1989-90 having value of 8.6129 while the crest value is -9.9278 in the year 1990-91 to 1999-2000.

The present scenario of maize production in the Punjab state shows that the areas under maize in Punjab have been consistently decreasing over the period of time. The area under maize decreased from 577 thousand hectares in 1975-76 to 131 thousand hectares during 2012-13. With the continuous increase in productivity of rice from 850 Kg per hectare in 1962-63 to 3981 Kg per hectare in 2011-12 along with increase in production during the period of 1962-63 to 1972-73, the production of maize jumped from 308 thousand mt tonnes to 906 thousand mt tones. The above analysis clearly presents that the area has maximum

value in the year of 1960-61 to 1969-70 at the C.G.R. of 5.8703 per cent per annum,while it deviates in the other presented years. The maximum downfall is in the year 1980-81 to 1989-1990 at the value -5.6449 per cent per annum. The maximum production occurs in the year 1960-61 to 1969-70 having the value of 9.8714 per cent per annum while the valley value is -6.8324 per cent per annum in the year 1980-81 to 1989-90. The peak value of yield occurs in the year 2000-2001 to 2012-13 having value of 3.9162 per cent while the crest value is -1.2646 per cent per annum.

Rice is the most important crop in India as it is the staple food for two-third of the population. The trends rice crops with respect to area, production and productivity has been examined in the Punjab stste. Over the last few years, the Punjab state has undergone numerous changes in agriculture sector paddy cultivation in particular. Therefore, the results corresponding to the growth pattern of area, production and productivity of rice in the Punjab state shows that the the area has maximum value in the year of 1970-71 to 1979-80 at the C.G.R.s of 9.7552 per cent per annum while it fluctuates in the other considered years. The maximum downfall is in the year 1990-91 to 1999-2000 at the value -3.6589 per cent per annum . The maximum production occurs in the year 1980-81 to 1989-90 having the value of 11.2793 per cent annum while the valley value was -13.2342 per cent per annum. The peak value of yield occurs in the year 1980-81 to 1989-90 having value of 8.6129 per cent per annum while the crest value is -9.9278 per cent per annum in the year 1990-91 to 1999-2000.

Socio economic status of sample farmers. All categories of farmers take loan from both institutional and non-institutional sources. The small farmers prefer to take loan from non-institutional sources due to easy access ability. Education level among the respondent was examined. As per results illiteracy was observed in small farm size in all selected crops. Mostly farmers sell the crops immediately after harvest but some farmers store the crops for few months.

The results of primary data of American cotton, Kharif maize and Basmati paddy growers showed that the average farm size was 6.66, 6.71 and 6.24 hectare of sample farmers in Punjab.In case of American cotton grower, all classes of farmers leased in land except large farmers and only medium farm leased out land.In case of kharif maize grower, all classes of farmers leased in and leased out land except small farmer. In case of basmati paddy grower, all classes of farmers leased in except large farrmer and leased out land except small farm. The overall results of cropping pattern of entire sample revealed that american cotton stood at first place in kharif season with 23 per cent of GCA followed by basmati paddy with (13.00 per cent) and overall percentage of cropping intensity is 199.25 in Bathinda district. In Hoshiarpur district ,on an average farm, during kharif season the highest area of the order of 2.66 hectare i.e. 19.32 per cent of gross cropped area was under maize followed by basmati paddy (7.91 per cent). And overall percentage of cropping intensity is 205.22. In Sangrur

district, on an average farm, during kharif season the highest area of the order of 3.73 hectare i.e. 29.98 percent of gross cropped area was under Basmati paddy followed by paddy (12.46 per cent) and overall percentage of cropping intensity is 199.36.

The per hectare costs and returns of selected crops cultivation are calculated at current prices. The average per hectare total variable cost on American cotton cultivation on farms was Rs. 42457.47. Overall the per hectare gross return from American cotton have been recorded at Rs. 99866.42**.** On an average, the total cost per hectare of kharif maize cultivation was Rs. 33239.40 on different sized farms. Overall the per hectare gross return from crop has been recorded at Rs. 54029.54. The overall situation of basmati paddy, variable cost of the sample respondents was Rs. 29142.92 per hectare. Overall per hectare gross return from crop has been recorded at Rs. 104527.73. Among small and medium farmers, manure and fertilizer,plant protection chemical and hired tractor charges constituted the major item of production cost.For large farmers, paid out labour, fertilizers and tractor charges constituted the major cost of production for all selected crops.Institutional loans were accessible to large as well as small farmers.However, due to higher requirement, all classes of farmers took a very high amount of non institutional loans as well.As a result, the ratio of institutional loans to total loans turned out to be higher for larger farmers compared to medium and large farmers. From the discussion of marketed surplus, it was observed that farmers of all sizes of holdings fully participated in the market and could be termed as commercial farmers. The dominant share of large farmers in the total marketed surplus.The marketable surplus showed a tendency to increase with increase in farm size.

To achieve the objectives of the study, the multiple regression analysis was carried out to ascertain the volume and direction of factors entering into price formation in American cotton, kharif Maize and basmati paddy.In case of American cotton, the regression coefficients of marketable surplus, operational area and time of sale were significantly positive.For kharif maize, the regression coefficients of operational area, use of dryers and time of sale were significantly positive at 1 per cent level of significance. The regression analysis further displayed significant coefficient of marketable surplus with a positive sign. In case of basmati paddy, the value of coefficients of marketable surplus was non-significant. Time of sale and operational area were significantly positive at 1 and 5 per cent level of significance.

The existing market structure in the state was studied.The farmers surveyed were sold their entire produce in the regulated market.All the villages surveyed were found to be well connected with mandis by approachable pucca roads.Moreover, adequate transport facilities for instance tractor trolley, were available to the farmers.However, the farmers had no scientific storage facilities on account of which they sold their produce immediately after the harvest even if yielded them lower prices.There was no provision for proper grading facilities

in the market. It was observed that the institutional credit provided to the farmers was far lesser than their requirement and they were compelled to take loans from commission agent or arhatias.

To achieve the second objective of the study, the market performance of selected crops in different state has been studied on the basis of monthly wholesale prices. It is concluded from the analysis that there exists high degree of co-integration between different markets. Though a long run equilibrium relationship existed between all the studied markets in term of weekly prices, yet some market pairs have shown Bidirectional causality and others have depicted unidirectional. Since the markets are integrated in the long run, it is important to study the short run and long run equilibrium among the markets. Hence Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium. In case of cotton prices in levels,the ADF test does not reject the unit root hypothesis at the 5 percent level during the period. In case of the first difference of the series, the hypothesis was however rejected in the period mostly at one percent level of significance, suggesting that the price series were free from the consequences of unit root. This implied that the price series were stationary at the first difference level. For maize prices in levels, the ADF test does not reject the unit root hypothesis at 5 percent level during the periods. In case of the first difference of the series, the hypothesis was, however, rejected in the periods mostly at one percent level. Thus,all the five price series of crop were stationary of the first difference level. In case of rice ,ADF test does not reject the unit root hypothesis at one percent level during the periods and first difference of the series, the hypothesis was, however rejected at one per cent level. Thus all the four series were integrated of the order one.

Johansen's multiple co-integration tests was employed to determine the long run relationship between two price series. Out of five markets, four markets were co-integrated at 0.05% level of significance, implying that the selected cotton markets had long run equilibrium relationship and there existed co integration among these markets. For maize prices, both the Maximum Eigenvalue test and trace test results indicate the presence of four co-integrating vectors at five per cent significance level.In case of rice prices, the trace statistic test results indicate the presence of three cointegrating vector at 5 per cent significance level for the periods. This implies that three markets were in fact cointegrated and had common sharing of information on price changed in the long run. The above empirical evidence suggests that all the four markets do exhibit a long run relationship

Then Granger causality test was used to analyze the direction among different cotton markets. The Akola market price had a bidirectional influence on the price of Rajkot. The Rajkot market price had a bidirectional influence on the price of Akola, Surendranagar and Mansa, except no causality between Rajkot and Bathinda market. The Surendranagar market

price had a bidirectional influence on the price of Rajkot, Bathinda and Mansa, except no causality between Surendranagar and Akola market. The Bathinda market price had a bidirectional influence on the price of Surendranagar and Mansa. The Mansa market price had a bidirectional influence on the price of Rajkot ,Surendranagar and Bathinda, except no causality between Mansa and Akola market. In case of maize prices, Granger-causality results indicated that there was unidirectional causality originating from Hoshiarpur to Nawanshahar, Hoshiarpur to Bangalore, Nawanshahar to Bangalore and Vijayanagaram to Ahmednagar. There was also bi-directional causality between Bangalore to Ahmednagar and Ahmednagar to Bangalore.In case of rice, the Pairwise Granger Causality Test showed that the Sangrur market price has shown a unidirectional influence on the the price of Burdwan and Shahjahanpur market, except no causality between Sangrur and West Godavari.Burdwan market price has depicted a bidirectional causality on the prices of West Godavari, except no causality between Burdwan and Sangrur, Burdwan and Shahjahanpur. Shahjahanpur market price has shown a unidirectional influence on the price of Burdwan, except no causality between Shahjahanpur and Sangrur, Shahjahanpur and West Godavari.West Godavari market price has shown a bidirectional influence on the price of Burdwan. West Godavari market price has shown a unidirectional influence on the price of Sangrurs and Shahjahanpur.

Then Vector Error Correction Model was employed to know the speed of adjustments among different cotton markets for long run equilibrium. The results revealed that in short run Akola market converges to its original equilibrium price level within 19 hours. Rajkot market converges to its original equilibrium price level within 11 hours and Mansa market converges to its original equilibrium price level within 15 hours. In case of the Akola market price model of cotton, the coefficient of two week (0.21) lagged and four week (0.24) lagged own price was positive and significant. Akola market price model, the coefficient of one week (-0.47) and three week (0.49) lagged Bathinda market price was negative and significant at five per cent level. The coefficient of one week (0.40) and three week (0.35) lagged Mansa market price was positive and significant. In case of long run Akola market, price was influenced by the Bathinda market and Mansa market with one and three lag period. Akola market was influenced by its own price too. It means that the price discovery occurred in the markets and was transmitted to Akola market. Rajkot market price model of cotton, the coefficient of one week (0.41) lagged Mansa market price was positive and significant at 5 per cent level. In case of Rajkot market, price was influenced by Mansa market with with 1 week lag period. It means that the price discovery occurred in the markets and was transmitted to Rajkot market. Surendranagar market price model, the coefficient of two week (0.28) lagged Akola market price was positive and significant and the coefficient of two week (0.20) lagged own price was negative and significant. The Surendranagar market price was influenced by its own price and Akola market price with two week lag period. It means that

the price discovery occurred in the markets and was transmitted to Surendranagar market. For Bathinda market price model, the coefficient of 1 week (0.44) lagged Mansa market price was positive and significant at 5 percent level. Bathinda market price was influence by Mansa market with one week lag period. It means that the price discovery occurred in the markets and was transmitted to Bathinda market. Mansa market price model, the coefficient of one week (0.15) lagged Akola market price and one week (0.38) lagged own price was positive and significant. The Mansa market was influenced by Akola market price and its own price too with one week lag period. It means that the price discovery occurred in the markets and was transmitted to Mansa market.The co-integration equation of error correction mechanism is significant in all the five maize markets. It is revealed from the analysis that, any disturbance in price will get corrected in about 10 hours in Bangalore and around 11 hours in Ahmednagar. In all the selected markets, the prices were influenced by their own weekly lags for long run equilibrium. In the long run the price changes in Hoshiarpur market, the prices are influenced to the extent of 29 per cent by one week lag price of Banglore. In the long run the price changes in Banglore market are influenced to the extent of 12 per cent by one week back prices of Hoshiarpur market . In the long run the price changes in Ahmednagar market are influenced to the extent of 11 per cent by one week lag prices of Hoshiarpur market respectivily. The co-integration equation of error correction mechanism is significant in all the four rice markets. It is thus revealed from the analysis that, any disturbance in price will get corrected in about 14 hours in Sangrur, around 7 hours in Burdwan and 5 hours in Shahjahanpur. Burdwan market price model of rice, the coefficient of first week (0.17) lagged Shahajahanpur market price and third week (0.08) lagged West Godavari market price was positive and significant at 5 per cent level . It means that the price discovery occurred in the markets and was transmitted to Burdwan market. In case of Shahajahanpur market, the prices are influenced by its own second week (0.16) lag period. In West Godavari market, the prices are influenced by one week (0.39) and third week (0.42) lag prices of Burdwan market. It means that the price discovery occurred in the markets and was transmitted to Shahjahanpur market.

The following major conclusions emerged from this study

- Cost of cultivation of American cotton, Kharif maize and basmati paddy showed tendency to increase with decrease in the size of holding. However per hectare yield was higher on large farms as compared to medium and small. Therefore gross returns per hectare of selected crops cultivation were higher on large farms.
- Marketable and marketed surplus showed a tendency to increase with increase in farm size.
- Pricing efficiency was determined by marketable surplus, operational area and storage pattern in the three crops. While these factors explained 67 percent pricing

efficiency in American cotton, it was found to be explaining as high as 95 per cent in maize and as low as 21 per cent in paddy.

- It was observed the data used for the analysis were weekly wholsale prices in five regional markets namely Bathinda (Punjab), Mansa (Punjab), Akola (Maharashtra), Rajkot (Gujrat) and Surendranagar (Gujrat) indicated market integration among the cotton market in India.
- In terms of weekly wholesale price in five regional markets namely Hoshiarpur (Punjab), Nawanshahar (Punjab), Bangalore (Karnataka), Vijayanagaram (A.P.) and Ahmednagar (Maharastra) markets indicated market integration among the maize market in India.
- Sangrur (Punjab), Burdwan (W.P.), Shahjahanpur (U.P.) and West Godavari (A.P.) markets also indicated market integration among the rice market in India.

Suggestions

- The farmers can avoid distress sales by availing warehouse receipt loans
- Almost all the farmers have the demand for storage facilities so that they can store their produce in peak season and to sell it at higher price in the lean season.
- Improved extension activities and certification facilities with subsidized inputs could be provided to cotton, maize and paddy farmers to sustain their income level.
- Improve marketing infrastructure for better storage of produce in the market.
- To increase the production of crops in the state, there is a need to have proper price policy
- High capacity dryer is almost installed in maize markets in Punjab state which is only beneficial for medium and large farmers. But marginal, small and some extent semi-medium farmers cannot uses these dryer due to low farm produce so low capacity dryer should be implanted in maize agricultural markets for eliminates this problem.
- The government should promote value addition by setting up agro-based industries at village or block level for these crops like cotton seed oil crushers, pop corn making and rice shellers so that economic welfare of the farmers can be improved and they are not subjected to price fluctuations in the market.
- Markets were co-integrated in terms of weekly wholesale price which indicated that the price movements of cotton, maize and rice leads to the stability over space.
- Greater integration in these markets may help the farmers as well as consumers of selected crops through better price signals to increase their surpluses.

REFERENCES

Acharya S S (2003) Price integration of wholesale markets for food grains and oilseeds in India. *Indian J Agril Mktg* ,**2**:385.

Ajjan N, Shajeena M H and Raveendaran N (2013) A study on integration of chicken pea (CICER ARIETINUM) markets in India. *Indian J Agril Mktg* **27**: 132-41

Alam S and Alam M J (2001) Price behaviour of rice in Bangladesh. *Indian J Agril Mktg* **15**: 20-29

Anonymous (1961-2014) *Statistical Abstract of Punjab*. Economic and Statistical Organisation, Government of Punjab.

Anonymous (2011) Ministry of Agriculture Govt. of India. Online source culled from (www.indiastate.com).

Anonymous (2010 2014) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Asche F, Bremnes H and Wessells C (1999) Product aggregation, market integration and relationships between prices: An application to World salmon markets. *Am J Agri Econ* **81**: 568-81

Baharumshah A and Habibullah M (1994) Price efficiency in pepper markets in malaysia: cointegration Analysis. *Ind J Agri Econ* **49**: 205-15

Behura D and Durga C (1998) Cointegration and market integration: An application to the marine fish markets in Orissa. *Ind J Agri Econ* **53**: 344-50.

Bharadwaj S P (2011) Significance of market information system in agricultural devolpment. *Indian J Agri Mktg* **25**: 83-94.

Burarak S S, Sharma H and Meena G L (2013) Market integration and price volatility in domestic markets of coriander in Rajasthan. *Indian J Agril Mktg* **27**: 121-31.

Dayakar R K A, Kumar B and Mathew B (2003) Trends in Production, Prices and Market Arrivals of Sorghum vs Completing Crops-A Critical Analysis. *Indian J Agric Mktg* **17**: 185-92.

Ghosh M (2000) Cointegration tests and spatial integration of rice markets in India. *Ind J Agri Econ* **55**: 616-26.

Goodwin K B and Piggott N E (2001) Spatial market integration in the presence of threshold effects. *Amer J Agril Econ* **83**: 302-17.

Hosamani S B, Gumagolmeth K C and Savadathi P M (2000) Trends in arrivals and price of groundnut and cotton in Dharwad market. *International Convention of Agricultural Marketing Management-Challenges in the Millennium, August, MANAGE*, Hydrabad. **21**: 315-17.

Kar A, Atteri R B and Kumar P (2004) Market infrastructure in Himachal Pradesh and integration of the Indian apple markets. *Indian J Agril Mktg* **18**: 243-52.

Khunt K A, Gajipara H M and Vekariya (2006) Price behaviour of major vegetables in Gujarat state. *Indian J Agril Mktg* **20**: 28-37.

Kumar P and Sharma R (2003) Spatial price integration and pricing efficiency at farm level. *Indian J Agril Econ* **58**: 201-17.

Lele, Uma J (1967) *Food grain Market in India, Private performance and public policy*.Cornel University Press Ithaca New York: 89.

Mahalle S L, Shastri S and Kumar S (2015) Integration of wheat markets in Maharashtra. *Agril Econ Res Rev* **28**: 179-87.

Manohar N S, Dixit A K and Reddy B S (2012) Market integration and price behavior in maize markets: A case study of Rajasthan. *Ind J Agril Mktg* **26**: 123-30.

Mavi H K, Sidhu R S and Sidhu J S (2012) Investigating the efficiency of various marketing models and problems of kinnow growers of Punjab. *Agril Econ Res Rev* **25**: 87-97.

Mehta P (1970) Movement of American cotton price in Punjab with special reference to Bathinda. *Agric Situation India* **24**: 899-906.

Monke E and Petzel T (1984) Market integration: An application to International trade in cotton. *American J Agril Econ* **66**: 401-87**.**

Mundinamani S M, Sastry K N and Basavaraja H (1999) Trend and seasonality in market arrivals and prices of groundnut in Karnataka. *Indian J Agril Mktg* **13**: 53-59.

Nasurudeen P and Subramanian (1995) Price integration of oils and oilseeds. *Indian J Agril Econ* **50**: 624-33.

Pandit A, Samal P and Mishra J R (2012) An analysis of price behavior of rice in Eastern Indian markets. *Indian J Agri Mktg* **26**: 102-14.

Rangasamy N and Elumalai K (2010) Futures and spot price relations : a case of pepper in India. *Indian J Agril Mktg* **24**: 104-10.

Rivera G G and Helfand S M (2001) The extent, pattern, and degree of market integration: A multivariate approach for the Brazilian rice market. *Amer J Agril Econ* **83**: 576-92.

Sahni M L (1979) *Functioning of cotton market in Punjab*. Thesis of M.Sc Student, Punjab Agriculture University Ludhiana.

Salam S, Alam S and Moniruzzaman M D (2012) Price Behavior of Major Cereal Crops in Bangladesh. *Food Sci Quality Mgt* **3**: 23-34.

Sangeet, Kaur A and Bhogal S (2014) Performance of regulated agricultural market in Punjab**,** *Ind J Econ Dev* **10**: 52-59.

Sekhon M K, Sidhu M S, Mahal A K and Dhaliwal T K (2013) A study on market margins and spatial integration among different cabbage markets. *Indian J Agril Mktg* **27**: 172-79.

Shruthi M, Krishnamurthy K N (2013) Statistical study of trends in arrivals and prices of maize in selected markets of Karnataka. *Mysore J Agric Sci* **47**: 791-96.

Sreeja M (2004) *Land use dynamics in Kerala- An economic analysis* M.Sc Thesis, Department of Agricultural Economics, University of Agricultural Sciences, Dharwad**.**

Sendhil R, Kar A, Mathur V C and Jha G K (2013) Price discovery, transmission and volatility : Evidence from agricultural commodity futures. *Agril Econ Res Rev* **26**: 41-54.

Sidhu J S, Singh J, Kumar R, Pal G, Singh L, Ajjan N, Raveendaran N (2012) *Commodity report: Wheat*. Research Report: 63-78. Department of Economics & Sociology, PAU, Ludhiana, India.

Singh G, Chahal S S and Kataria P (2010) A study on behaviour of arrivals and prices of green chillies in Punjab. *Indian J Agril Mktg* **24**: 26-37.

Singh J (2011) Impact assessment study of IPM basmati project for boosting diversification process in Punjab, *Sir Rattan Tata Trust, Mumbai*,1-58.

Singh N and Agarwal N L (2000) Market integration for cumin seed in Rajasthan.*Indian J of Agril Mktg* **14**: 25-31.

Singh P, K S Suhay and Jain R (2000) Analysis of prices and arrivals of represented and mustered in Haryana. *Indian J Agril Mktg* **14**: 59-65.

Sivagami R, Alagumani T and Samsai T (2010) Integration of production and marketing of maize through contract farming. *Indian J Agril Mktg* **24**: 145-51.

Sumalatha B S (2012) Price volatility and integration of spot and futures markets of agricultural commodities in India. *Indian J Agril Mktg* **26**: 25-35.

Tahir Z (1997) Integration of agricultural commodity markets in the South Punjab, Pakistan. *The Pakistan Develop Rev* **36**: 24.

Vani and Krishnaiah J.(1998) Price Integration in marketing of chillies; A study of Guntur market in Andhra Pradesh. *Indian J Agril Mktg (*conf. Spl.) **12**: 48.

Wani M H, Paul R K, Bazaz N H and Manzoor M (2015) Market integration and price forecasting of apple in India. *Ind J Agri Econ* **70**: 169-81.

Yogisha G M, Karnool N N, Kumar V H S and Basavaraja H (2007) Trends and seasonal variations in arrivals and prices of potato in Kolar District. *Agric Mrktg* **69**: 26-28.

Zakari S and Ying L (2014) Measuring spatial integration Niger grain market. *J Agril Sci* **6**: 15-23.

ANNEXURE I

Area under important crops in Punjab, 1960-61 to 2012-13 (000 ha)

Year	Paddy	Maize	American Cotton
1960-61	228	326	245
1961-62	228	323	212
1962-63	249	362	211
1963-64	257	354	258
1964-65	287	383	254
1965-66	293	385	222
1966-67	285	444	222
1967-68	314	476	227
1968-69	345	490	229
1969-70	359	534	221
1970-71	390	555	212
1971-72	450	548	246
1972-73	476	562	235
1973-74	499	567	301
1974-75	569	522	342
1975-76	567	577	363
1976-77	680	536	375
1977-78	858	444	440
1978-79	1052	424	470
1979-80	1172	393	460
1980-81	1183	382	502
1981-82	1269	340	546
1982-83	1322	307	582
1983-84	1481	294	556
1984-85	1644	304	409

1985-86	1714	260	471
1986-87	1786	261	496
1987-88	1720	233	565
1988-89	1778	249	701
1989-90	1908	207	669
1990-91	2015	188	637
1991-92	2069	176	615
1992-93	2072	190	636
1993-94	2179	194	536
1994-95	2265	173	538
1995-96	2185	171	649
1996-97	2159	166	625
1997-98	2281	165	626
1998-99	2519	154	456
1999-00	2604	163	381
2000-01	2612	164	358
2001-02	2487	165	506
2002-03	2530	153	374
2003-04	2614	155	387
2004-05	2646	155	454
2005-06	2647	149	512
2006-07	2621	154	573
2007-08	2609	154	581
2008-09	2735	151	511
2009-10	2802	139	497
2010-11	2826	133	470
2011-12	2818	126	506
2012-13	2849	131	472

ANNEXURE II

Production of Important Crops in Punjab, 1960-61 to 2012-13

(000Mt tones), (Production of cotton 000bales)

Year	Rice	Maize	American Cotton
1960-61	236	370	388
1961-62	236	446	353
1962-63	268	308	339
1963-64	282	490	469
1964-65	351	488	455
1965-66	293	643	406
1966-67	338	614	371
1967-68	415	774	468
1968-69	470	706	467
1969-70	535	784	495
1970-71	688	861	471
1971-72	920	857	589
1972-73	955	906	563
1973-74	1140	764	762
1974-75	1179	898	837
1975-76	1447	846	863
1976-77	1776	619	837
1977-78	2497	678	967
1978-79	3090	689	1070
1979-80	3052	677	966
1980-81	3233	612	969
1981-82	3750	625	1073
1982-83	4156	546	1070
1983-84	4536	539	632
1984-85	5052	576	1136

1985-86	5485	412	1253
1986-87	5949	528	1555
1987-88	5422	365	1765
1988-89	4925	293	2029
1989-90	6697	394	2324
1990-91	6506	333	1802
1991-92	6739	345	2301
1992-93	7026	436	2211
1993-94	7645	360	1451
1994-95	7662	322	1648
1995-96	6843	307	1768
1996-97	7334	352	1716
1997-98	7904	345	784
1998-99	7940	352	480
1999-00	8716	420	754
2000-01	9157	458	921
2001-02	8816	449	1137
2002-03	8880	312	955
2003-04	9656	462	1309
2004-05	10433	424	1916
2005-06	10207	407	2253
2006-07	10138	481	2572
2007-08	10486	525	2283
2008-09	11000	514	2235
2009-10	11236	475	1968
2010-11	10819	491	1786
2011-12	10542	502	1597
2012-13	11390	482	1620

ANNEXURE III

Yield of important crops in Punjab, 1960-61 to 2012-13 **(Kg/ha)**

Year	Rice	Maize	American Cotton
1960-61	1035	1135	269
1961-62	1035	1381	300
1962-63	1076	850	289
1963-64	1097	1384	327
1964-65	1223	1274	322
1965-66	1000	1670	311
1966-67	1185	1383	335
1967-68	1322	1627	371
1968-69	1364	1440	369
1969-70	1490	1469	380
1970-71	1765	1555	399
1971-72	2045	1564	407
1972-73	2007	1616	407
1973-74	2287	1348	430
1974-75	2071	1720	416
1975-76	2553	1467	404
1976-77	2611	1157	379
1977-78	2910	1527	374
1978-79	2937	1625	387
1979-80	2604	1723	357
1980-81	2733	1602	329
1981-82	2955	1838	334
1982-83	3144	1780	313
1983-84	3062	1835	193
1984-85	3073	1895	471
1985-86	3200	1585	452

1986-87	3331	2022	533
1987-88	3164	1567	531
1988-89	2770	1177	492
1989-90	3510	1902	591
1990-91	3229	1786	481
1991-92	3257	1962	636
1992-93	3391	2297	591
1993-94	3507	1856	460
1994-95	3381	1861	521
1995-96	3132	1793	463
1996-97	3397	2118	467
1997-98	3465	2091	213
1998-99	3152	2286	179
1999-00	3347	2577	337
2000-01	3506	2793	437
2001-02	3545	2722	382
2002-03	3510	2040	434
2003-04	3694	2982	575
2004-05	3943	2738	716
2005-06	3856	2734	748
2006-07	3868	3127	763
2007-08	4019	3409	668
2008-09	4022	3404	743
2009-10	4010	3414	673
2010-11	3828	3693	646
2011-12	3741	3981	537
2012-13	3998	3680	577

ANNEXURE IV

Weekly wholesale prices of cotton in different markets in India, 2010-2014

Week	Rajkot	Surendranagar	Akola	Bathinda	Mansa
1-8 April , 2010	3449.81	3495.39	3393.12	3379.68	3363.47
9-15 April	3399.99	3412.03	3295.34	3100.00	3257.60
16-23 April	3387.80	3327.36	3242.92	3287.80	3200.00
24-30 April	3325.75	3260.97	3030.97	3375.75	3390.00
1-8 May	3359.12	3178.00	2562.91	3459.12	3510.12
9-15 May	3404.87	3219.01	2672.10	3400.87	3480.13
16-23 May	3394.57	3285.68	2795.60	3390.57	3370.34
24-31 May	3434.47	3341.05	2833.04	3434.47	3440.45
1-8 June	3393.35	3369.55	2988.48	3393.35	3510.00
9-15 June	3378.18	3121.18	3070.94	3378.18	3620.23
16-23 June	3449.92	3304.97	3100.06	3449.92	3580.12
24-30 June	3482.96	3482.96	3230.12	3482.96	3410.12
1-8 July	3459.16	3459.16	3331.82	3459.16	3380.56
9-15 July	3528.97	3400.00	3356.41	3528.97	3440.34
16-23 July	3532.14	3532.14	3393.29	3532.14	3490.12
24-31 July	3583.91	3583.91	3377.01	3583.91	3590.45
1-8 August	3612.51	3612.51	3175.66	3612.51	3640.20
9-15 August	3629.52	3629.52	3242.08	3629.52	3610.23
16-23 August	3720.43	3720.43	3308.04	3720.43	3580.45
24-31 August	3759.84	3759.84	3266.20	3759.84	3540.14
1-8 September	3830.82	3555.00	3390.40	3830.82	3500.06
9-15 September	4206.50	3376.45	3519.20	3669.07	3760.50
16-23 September	4161.46	3661.42	3603.28	3851.00	3723.55
24-30 September	3750.00	3724.47	3750.12	3779.95	3651.05
1-8 October	3899.77	3994.53	3990.34	3907.77	3849.29
9-15 October	4311.32	4419.01	4162.12	4205.28	3902.34

16-23 October	4307.55	4332.65	4361.27	4133.82	4115.99
24-30 October	4436.02	4449.68	4398.90	4310.07	4171.48
1-8 November	4347.29	4370.15	4321.92	4482.58	4391.42
9-15 November	4564.22	4478.89	4446.65	4737.99	4716.09
16-23 November	4498.63	4138.52	4295.38	4748.23	4678.27
24-30 November	4335.88	4177.09	4274.90	4708.64	4676.75
1-8 December	4429.06	4212.39	4296.83	4743.90	4637.62
9-15 December	4412.16	4143.42	4123.64	4679.30	4671.12
16-23 December	4455.63	4377.06	4363.92	4819.28	4854.18
24-30 December	4446.33	4415.40	4531.74	4833.84	4853.27
1-8 January ,2011	4484.34	4440.97	4637.96	4919.06	4870.13
9-15 January	4625.80	4589.04	4969.57	4932.51	4925.69
16-23 January	4972.29	4912.92	5300.73	5103.26	5037.85
24-30 January	5464.80	5331.32	5695.60	5298.05	5250.01
1-8 February	5818.13	5735.71	6185.49	5891.32	5933.13
9-15 February	6777.11	6635.55	6262.50	6671.54	6712.73
16-23 February	6405.47	6415.62	6024.03	6741.88	6584.88
24-30 February	6150.08	6179.96	5595.24	6477.00	6436.90
1-8 March	6464.39	6549.17	6167.69	6514.44	6723.42
9-15 March	6354.06	6218.96	5758.26	6454.91	6649.00
16-23 March	6477.44	6430.60	5984.80	6339.00	6660.26
24-30 March	6717.12	6378.40	6231.43	6235.35	6911.42
1-8 April	6727.75	6159.11	6370.03	6167.60	6679.27
9-15 April	6133.91	6020.69	5895.44	6063.51	6263.51
16-23 April	5642.50	5798.59	5638.26	5442.50	5842.50
24-30 April	5400.10	5681.97	5464.09	5100.10	5600.10
1-8 May	4734.96	5529.66	5058.38	4940.96	5240.96
9-15 May	4075.42	5370.18	4930.12	4875.42	4975.42

16-23 May	3835.06	5241.86	4870.00	4735.06	4835.06
24-30 May	4453.39	5066.60	4780.45	4653.39	4753.39
1-8 June	4066.46	4906.38	4600.00	4566.46	4666.46
9-15 June	3901.31	4786.31	4580.56	4490.31	4590.31
16-23 June	3823.03	4564.74	4300.00	4323.03	4423.03
24-30 June	3952.01	4328.26	4100.00	4252.01	4352.01
1-8 July	3859.21	4084.14	3891.97	4159.21	4120.21
9-15 July	3419.02	3910.12	3873.81	4019.02	4040.02
16-23 July	3358.81	3870.00	3904.20	3958.81	3940.81
24-30 July	3320.82	3680.50	3850.00	3820.82	3800.82
1-8 August	3633.08	3490.67	3725.00	3733.08	3713.08
9-15 August	4027.65	3480.60	3647.45	3670.00	3640.00
16-23 August	4063.91	3500.00	3407.59	3570.25	3570.25
24-31 August	3991.07	3340.78	3548.00	3510.33	3483.33
1-8 September	3951.64	3293.02	3722.82	3660.74	3568.45
9-15 September	4149.38	3392.07	3890.60	3742.39	3575.83
16-23 September	4162.09	3497.93	3956.43	3827.05	3852.34
24-30 September	3979.37	3659.61	4056.44	3884.54	3974.44
1-8 October	4385.22	3855.45	4139.56	4184.58	4075.63
9-15 October	4072.60	4087.28	4214.43	4424.37	4325.01
16-23 October	4091.64	4111.82	4260.55	4346.93	4285.53
24-30 October	4130.90	4274.88	4596.00	4280.32	4300.01
1-8 November	4520.10	4327.98	4533.50	4137.37	4129.90
9-15 November	4413.63	4456.78	4309.08	4053.11	4024.58
16-23 November	4341.59	4382.73	4261.00	4099.20	4103.44
24-30 November	4165.92	4156.64	3991.49	4063.33	4065.44
1-8 December	4255.57	4195.20	4080.97	4018.55	3763.88
9-15 December	4241.39	4193.15	4078.55	3930.93	3881.33

16-23 December	4220.63	4165.38	3883.65	3972.27	3926.81
24-30 December	4230.45	4144.00	3950.44	4089.29	4130.00
1-8 January ,2012	4334.38	4258.45	4098.56	4256.35	4339.92
9-15 January	4415.19	4390.94	4180.48	4572.67	4566.96
16-23 January	4409.92	4404.32	4257.78	4606.94	4575.63
24-30 January	4390.84	4301.91	4140.90	4459.84	4456.00
1-8 February	4351.82	4431.26	4217.87	4413.79	4366.86
9-15 February	4284.52	4359.69	4145.83	4344.15	4384.18
16-23 February	4252.71	4334.49	4083.34	4223.46	4198.77
24-30 February	4167.23	4210.43	3894.75	4044.97	4071.66
1-8 March	4100.62	4090.42	3812.55	4211.45	4229.86
9-15 March	3854.41	3772.53	3559.28	4269.88	4198.82
16-23 March	4024.65	3834.11	3836.57	4161.41	4148.40
24-30 March	4153.66	3767.40	3761.43	4166.79	4163.03
1-8 April	4118.88	4030.91	3875.01	4125.86	4039.46
9-15 April	4077.29	3887.33	3835.11	3920.31	3998.67
16-23 April	3956.06	3935.21	3698.46	3826.70	4061.73
24-30 April	3908.06	3568.70	3445.56	3890.22	4213.89
1-8 May	4102.84	3850.96	4036.21	4100.24	4390.44
9-15 May	3974.14	3809.26	3946.91	4276.56	4290.30
16-23 May	3872.54	3690.91	3856.45	4165.12	4180.39
24-30 May	3760.86	3628.26	3335.00	4090.12	4083.62
1-8 June	3737.59	3776.23	3505.31	3937.59	3987.59
9-15 June	3732.98	3869.33	3600.00	3832.98	3882.98
16-23 June	3824.96	3964.75	3610.58	3814.96	3854.96
24-30 June	3997.77	4107.63	3642.86	3967.77	3980.77
1-8 July	4059.96	4372.38	3959.46	4020.96	4080.96
9-15 July	4331.44	4525.00	4000.00	4231.44	4190.44

16-23 July	4668.36	4651.85	3900.00	4368.36	4168.36
24-30 July	4628.44	4520.88	4128.44	4228.44	4078.44
1-8 August	4586.63	4500.00	4386.63	4186.63	4086.63
9-15 August	4072.22	4470.66	4272.22	4072.22	3972.22
16-23 August	4645.53	4638.36	4445.53	3945.53	3875.53
24-31 August	4415.02	4253.46	4515.02	3855.02	3955.02
1-8 September	4030.17	3703.71	4430.17	3775.00	3953.08
9-15 September	3390.08	3527.61	4390.08	3663.39	3848.81
16-23 September	3648.41	3680.48	4248.41	3640.61	3451.53
24-30 September	3499.19	3778.05	4340.19	3679.68	3639.53
1-8 October	3754.62	3851.13	4154.62	3890.40	3790.12
9-15 October	4037.31	4155.31	4237.31	4093.02	3904.40
16-23 October	4256.58	4237.27	4156.58	4338.73	4110.94
24-30 October	4342.02	4350.47	4050.00	4035.64	4011.67
1-8 November	4342.69	4294.61	4073.16	4079.49	4047.05
9-15 November	4346.39	4342.63	4050.00	4271.39	4188.55
16-23 November	4291.55	4309.28	4023.65	4222.14	4191.75
24-30 November	4242.66	4209.38	3978.11	4161.55	4124.47
1-8 December	4238.17	4223.32	4020.17	4197.39	4141.81
9-15 December	4310.52	4273.06	4037.73	4237.93	4197.17
16-23 December	4298.94	4267.46	4076.92	4194.59	4146.12
24-30 December	4253.74	4271.72	4048.82	4177.59	4156.91
1-8 January ,2013	4237.13	4221.94	4075.55	4154.56	4050.89
9-15 January	4215.98	4209.89	4040.05	4129.60	4105.42
16-23 January	4203.54	4177.67	4185.08	4117.99	4049.08
24-30 January	4206.73	4186.25	4152.08	4134.05	4086.70
1-8 February	4183.26	4163.58	4047.7	4185.82	4162.39
9-15 February	4238.37	4225.39	4108.76	4317.76	4265.23

16-23 February	4497.75	4460.25	4312.3	4518.01	4510.24
24-30 February	4771.27	4769.24	4728.78	4792.74	4813.53
1-8 March	4867.74	4811.51	4765.33	4830.45	4820.70
9-15 March	4918.76	4846.65	4902.61	4829.61	4829.96
16-23 March	4794.79	4786.44	4864.27	4781.63	4782.61
24-30 March	4789.14	4731.04	4910.12	4747.33	4653.46
1-8 April	4867.74	4866.39	4945.44	4707.24	4726.55
9-15 April	4918.76	4858.52	4991.00	4558.50	4684.16
16-23 April	4794.79	4790.92	4685.91	4660.36	4519.66
24-30 April	4789.14	4726.37	4543.09	4485.00	4495.00
1-8 May	4786.28	4621.53	4563.14	4486.67	4426.67
9-15 May	4780.46	4562.84	4072.96	4410.00	4400.00
16-23 May	4704.00	4456.53	4175.00	4350.00	4380.00
24-30 May	4717.50	4583.14	4153.29	4417.50	4487.50
1-8 June	4775.59	4761.55	4100.00	4575.59	4585.59
9-15 June	5018.98	4750.00	4100.00	4618.98	4620.98
16-23 June	5080.69	4676.73	4100.00	4580.69	4510.69
24-30 June	5289.40	4437.00	4100.00	4489.40	4470.40
1-8 July	5302.00	4650.00	4280.12	4382.00	4375.00
9-15 July	5470.85	4630.12	4470.34	4470.85	4470.85
16-23 July	5219.61	4890.50	4620.34	4519.61	4580.61
24-30 July	5078.91	5500.00	4740.45	4578.91	4598.91
1-8 August	5195.03	5370.88	4880.34	4665.03	4675.03
9-15 August	5561.80	4870.50	4990.56	4781.80	4761.80
16-23 August	5684.05	4552.00	5056.67	4695.05	4784.05
24-31 August	5815.00	5120.44	5160.67	4786.00	4896.12
1-8 September	5801.64	5411.10	5300.00	4851.00	4981.77
9-15 September	5757.78	5669.78	5210.12	4813.78	4896.39

16-23 September	5764.70	5407.85	5080.34	5030.64	4993.53
24-30 September	5711.23	5307.66	4930.00	5117.91	5088.29
1-8 October	5371.01	5399.23	4870.34	5095.62	5126.61
9-15 October	4938.16	4672.26	4760.00	5147.56	5173.73
16-23 October	4877.74	4715.73	4656.78	5206.29	5227.18
24-30 October	4891.51	4845.13	4550.00	5227.80	5268.79
1-8 November	4900.87	4860.61	4370.12	5161.35	5237.84
9-15 November	4922.39	4722.78	4280.12	5097.68	5273.94
16-23 November	4744.33	4703.36	4075.00	5142.40	5119.12
24-30 November	4757.99	4691.58	4422.50	5045.15	5042.02
1-8 December	4732.07	4640.79	4530.00	5005.43	5010.46
9-15 December	4773.86	4637.49	4350.00	4980.43	4442.92
16-23 December	4827.31	4653.52	4607.91	4990.54	5074.36
24-30 December	4883.04	4820.88	4619.82	5062.73	5025.86
1-8 January ,2014	4972.36	4780.05	4761.29	5314.67	5097.47
9-15 January	5198.23	4967.79	4707.53	5445.09	5100.12
16-23 January	5420.24	5281.96	4894.88	5428.06	5391.19
24-30 January	5419.20	5305.66	4655.16	5356.06	5303.08
1-8 February	5380.59	5345.47	5001.60	5408.35	5293.97
9-15 February	5364.48	5291.17	4965.90	5423.79	5518.73
16-23 February	5285.79	5301.51	5000.00	5365.03	5468.36
24-30 February	5141.44	5216.83	4482.36	5283.94	5364.28
1-8 March	5090.13	5167.84	4919.30	5312.79	5338.50
9-15 March	5092.45	5186.88	4933.33	5302.95	5315.52
16-23 March	5068.13	5063.67	4982.46	5267.48	5296.43
24-30 March	4924.78	4890.47	5000.00	5290.16	5289.41

ANNEXURE V

Weekly wholesale prices of maize in different markets in India, 2010-2014

Week	Hoshiarpur	Banglore	Vijayanagaram	Nawanshahar	Ahmednagar
02.04.2010	990.50	915.00	850.00	970.50	864.22
09.04.2010	960.00	915.00	850.00	940.00	852.19
16.04.2010	940.12	915.00	850.00	910.12	850.00
23.04.2010	930.00	915.00	850.00	940.00	846.00
30.04.2010	920.00	915.00	850.00	950.00	851.70
07.05.2010	935.50	915.00	850.00	935.50	857.40
14.05.2010	940.56	915.00	850.00	945.56	859.96
21.05.2010	940.50	915.00	850.00	948.50	879.46
28.05.2010	985.00	915.00	850.00	975.00	898.97
04.06.2010	980.67	915.00	850.00	980.67	1016.16
11.06.2010	980.20	920.57	850.00	970.20	1091.42
18.06.2010	920.50	950.00	871.43	950.50	1014.32
25.06.2010	940.56	950.00	880.00	960.56	1010.04
02.07.2010	920.00	950.00	890.00	940.00	951.31
09.07.2010	935.50	997.79	900.00	955.50	951.07
16.07.2010	940.56	1000.00	950.00	960.56	970.63
23.07.2010	940.50	1000.00	910.00	970.50	1047.99
30.07.2010	985.00	1004.38	850.00	985.00	1056.18
06.08.2010	832.50	1008.76	950.00	862.50	1064.37
13.08.2010	837.55	1075.00	890.00	877.55	1100.95
20.08.2010	850.01	978.49	920.00	850.01	1037.51
27.08.2010	841.05	1017.18	960.00	871.05	1028.89
03.09.2010	830.00	1048.43	851.00	850.00	1019.36
10.09.2010	844.43	1050.00	858.63	844.43	1025.00
17.09.2010	855.21	1067.55	853.33	865.21	1056.21
24.09.2010	861.24	1057.57	853.64	881.24	1037.16
01.10.2010	840.00	1054.44	853.48	890.00	1037.58
08.10.2010	881.05	1050.00	853.50	891.05	994.78
15.10.2010	890.68	1024.56	853.33	890.68	938.49

22.10.2010	875.21	999.13	857.72	895.21	901.53
29.10.2010	891.24	981.89	857.57	891.24	938.99
05.11.2010	900.00	964.66	857.43	930.00	976.46
12.11.2010	950.00	950.00	863.39	950.00	972.32
19.11.2010	930.12	930.57	875.42	940.12	923.75
26.11.2010	980.12	920.28	863.00	926.88	887.81
03.12.2010	1050.00	910.00	863.33	924.28	917.90
10.12.2010	1030.00	906.86	853.76	989.03	899.17
17.12.2010	1070.00	941.60	870.00	1076.68	891.01
24.12.2010	1040.00	930.91	870.00	1044.84	906.29
31.12.2010	1100.00	931.24	867.22	1062.60	912.29
07.01.2011	1215.00	931.57	864.44	1079.32	918.29
14.01.2011	1230.25	950.00	865.60	1065.81	925.53
21.01.2011	1245.56	950.60	865.71	1127.73	945.99
28.01.2011	1200.50	950.00	864.44	1232.80	923.69
04.02.2011	1305.00	972.99	865.61	1213.57	918.11
11.02.2011	1330.67	918.24	865.28	1291.50	979.35
18.02.2011	1317.17	949.34	864.88	1249.00	976.48
25.02.2011	1322.60	964.08	865.71	1343.58	977.77
04.03.2011	1175.00	1017.75	864.38	1366.97	984.37
11.03.2011	1130.16	1015.65	864.52	1377.79	1016.06
18.03.2011	1170.70	1075.98	864.00	1334.58	1044.77
25.03.2011	1180.70	1088.70	873.92	1136.68	1048.39
01.04.2011	1300.00	1112.50	865.71	1173.11	1117.28
08.04.2011	1280.50	1107.85	867.18	1103.37	1125.47
15.04.2011	1305.45	1250.53	867.27	1164.76	1144.41
22.04.2011	1290.25	1164.84	864.44	1304.17	1145.32
29.04.2011	1310.50	1166.47	865.79	1221.20	1117.18
06.05.2011	1235.00	1168.10	867.14	1311.70	1089.05
13.05.2011	1205.00	1160.00	947.22	1209.58	1064.05
20.05.2011	1150.90	1164.25	942.76	1311.16	1066.33

27.05.2011	1030.25	1156.09	952.39	1210.50	1087.92
03.06.2011	992.50	1116.99	993.72	1295.16	1101.50
10.06.2011	910.15	1120.00	985.66	1136.40	1084.90
17.06.2011	950.45	1162.94	1064.64	1016.08	1132.95
24.06.2011	960.25	1175.00	1031.58	1029.12	1124.51
01.07.2011	812.50	1157.15	1026.60	964.48	1178.48
08.07.2011	830.50	1180.00	1034.04	904.20	1129.47
15.07.2011	820.25	1157.92	1070.34	976.65	1075.26
22.07.2011	860.50	1205.42	1102.20	821.03	1071.90
29.07.2011	815.27	1202.64	1125.92	837.47	1135.53
05.08.2011	895.00	1199.87	1134.64	882.55	1150.83
12.08.2011	870.25	1195.79	1110.71	801.67	1154.89
19.08.2011	860.50	1165.15	1090.80	864.21	1170.56
26.08.2011	880.25	1190.80	1072.47	860.21	1109.78
02.09.2011	887.50	1179.13	1047.40	831.45	1049.00
09.09.2011	890.75	1150.39	1030.68	842.50	1109.29
16.09.2011	870.50	1094.05	1000.76	803.43	1148.25
23.09.2011	860.50	1099.44	998.89	822.55	1048.53
30.09.2011	875.27	1078.05	984.68	857.88	1015.59
07.10.2011	1000.00	1056.67	970.48	841.90	982.65
14.10.2011	1025.00	1060.00	979.09	888.92	985.21
21.10.2011	920.90	1042.60	965.15	840.77	983.92
28.10.2011	980.75	1034.44	988.46	1007.15	944.33
04.11.2011	927.50	1066.10	993.13	1094.70	1002.77
11.11.2011	905.00	1083.44	1029.11	994.25	993.82
18.11.2011	975.00	1082.96	1070.43	933.90	962.31
25.11.2011	976.54	1080.00	1100.55	939.91	949.11
02.12.2011	1162.50	1071.22	1128.86	917.34	959.69
09.12.2011	1200.16	1068.36	1121.75	907.17	994.63
16.12.2011	1170.70	1088.18	1100.38	926.67	1053.32
23.12.2011	1180.70	1105.07	1086.41	1196.00	1105.06

30.12.2011	1230.78	1109.76	1067.72	1282.04	1116.30
06.01.2012	1250.00	1114.46	1089.04	1162.70	1127.54
13.01.2012	1230.16	1134.52	1097.67	1155.10	1129.85
20.01.2012	1230.78	1133.71	1122.97	1175.28	1135.56
27.01.2012	1304.00	1160.43	1143.56	1233.40	1140.96
03.02.2012	1300.00	1136.78	1165.12	1177.16	1107.29
10.02.2012	1315.45	1133.96	1140.89	1273.95	1132.60
17.02.2012	1290.25	1111.97	1126.67	1363.83	1137.02
24.02.2012	1310.60	1120.00	1053.33	1346.77	1131.87
02.03.2012	1170.00	1110.00	1072.43	1306.53	1118.44
09.03.2012	1180.50	1100.00	1097.11	1242.72	1113.21
16.03.2012	1245.45	1100.00	1113.65	1348.07	1124.88
23.03.2012	1250.25	1080.38	1093.37	1148.88	1135.56
30.03.2012	1210.50	1101.80	1068.23	1147.00	1126.92
06.04.2012	1375.00	1200.00	1043.10	1299.12	1118.29
13.04.2012	1374.33	1150.00	1065.92	1293.63	1177.70
20.04.2012	1354.42	1125.00	1100.42	1234.99	1176.95
27.04.2012	1356.83	1108.33	1137.71	1391.83	1129.82
04.05.2012	1250.00	1125.00	1150.06	1328.00	1105.25
11.05.2012	1240.00	1153.33	1156.45	1297.80	1076.07
18.05.2012	1220.40	1145.67	1174.23	1281.32	1093.98
25.05.2012	1090.50	1131.38	1156.21	1266.83	1061.69
01.06.2012	1025.00	1115.50	1122.69	1236.83	1016.47
08.06.2012	1025.08	1110.00	1093.82	1194.33	1090.32
15.06.2012	1058.67	1147.00	1084.77	1196.76	1117.30
22.06.2012	1059.20	1120.17	1099.15	1057.00	1124.71
29.06.2012	1030.12	1123.33	1089.96	1056.00	1135.88
06.07.2012	900.00	1228.83	1090.17	1043.83	1147.06
13.07.2012	925.83	1265.00	1116.67	1023.00	1147.56
20.07.2012	942.33	1280.00	1102.25	925.83	1183.64
27.07.2012	910.15	1250.00	1129.75	942.33	1236.67

03.08.2012	900.00	1280.00	1108.77	1172.33	1342.17
10.08.2012	973.01	1300.00	1116.67	1183.83	1392.00
17.08.2012	976.76	1300.00	1102.73	1235.33	1386.28
24.08.2012	956.29	1300.00	1094.01	1135.00	1354.52
31.08.2012	980.32	1337.17	1080.56	1198.18	1334.76
07.09.2012	1025.00	1300.00	1051.12	1172.80	1315.00
14.09.2012	1013.67	1340.00	1032.77	1184.82	1428.71
21.09.2012	1037.50	1500.00	1017.53	1127.45	1434.52
28.09.2012	1030.32	1500.00	1024.74	1013.67	1357.41
05.10.2012	1050.00	1500.00	1045.45	937.50	1384.90
12.10.2012	1023.67	1480.00	1062.29	1030.32	1322.16
19.10.2012	1027.50	1466.40	1082.72	833.66	1310.50
26.10.2012	1035.32	1401.00	1112.40	767.36	1301.70
02.11.2012	1025.00	1442.17	1116.52	908.04	1283.23
09.11.2012	1034.05	1473.67	1120.12	839.98	1251.19
16.11.2012	1049.44	1273.67	1100.52	784.98	1298.40
23.11.2012	1038.05	1307.50	1127.46	1023.50	1324.97
30.11.2012	1026.67	1356.00	1151.38	844.17	1316.62
07.12.2012	1212.50	1400.00	1185.30	1076.32	1308.27
14.12.2012	1226.83	1366.67	1210.01	1112.33	1329.99
21.12.2012	1248.30	1366.67	1219.31	1085.58	1336.29
28.12.2012	1240.68	1420.00	1246.27	1309.06	1324.72
04.01.2013	1220.94	1425.00	1224.77	1221.67	1320.78
11.01.2013	1239.10	1425.00	1200.30	1280.90	1329.01
18.01.2013	1240.50	1425.00	1196.56	1150.00	1353.96
25.01.2013	1257.33	1425.00	1191.04	1246.75	1331.07
01.02.2013	1275.00	1425.00	1182.07	1266.83	1292.83
08.02.2013	1228.83	1425.00	1170.14	1258.30	1293.27
15.02.2013	1265.00	1415.00	1189.80	1140.68	1289.39
22.02.2013	1280.00	1400.00	1224.78	1220.94	1280.69
01.03.2013	1100.00	1390.00	1206.82	1177.33	1272.00

08.03.2013	1110.00	1460.00	1208.45	1203.58	1294.64
15.03.2013	1147.00	1404.00	1186.71	1216.30	1295.56
22.03.2013	1120.17	1437.50	1160.17	1160.62	1306.18
29.03.2013	1150.00	1398.33	1190.00	1421.98	1360.37
05.04.2013	1275.00	1190.00	1225.00	1208.68	1414.57
12.04.2013	1258.83	1390.00	1238.83	1263.12	1382.01
19.04.2013	1265.00	1414.00	1235.00	1282.67	1331.10
26.04.2013	1280.00	1390.00	1230.00	1259.06	1277.61
03.05.2013	1200.00	1402.00	1240.00	1263.00	1269.42
10.05.2013	1247.92	1380.00	1247.92	1305.70	1239.04
17.05.2013	1205.42	1400.00	1225.42	1386.25	1243.73
24.05.2013	1202.64	1346.67	1202.64	1319.33	1319.61
31.05.2013	1240.50	1305.00	1230.50	1348.58	1367.28
07.06.2013	1150.00	1403.33	1257.00	1380.92	1414.95
14.06.2013	1287.38	1420.00	1280.43	1392.80	1343.71
21.06.2013	1146.47	1420.00	1293.16	1326.00	1423.46
28.06.2013	1079.70	1420.00	1299.48	1135.83	1495.86
05.07.2013	1175.00	1478.33	1329.83	1124.00	1416.30
12.07.2013	1267.38	1500.00	1318.52	1101.00	1482.33
19.07.2013	1056.47	1500.00	1336.28	1133.45	1399.79
26.07.2013	1170.70	1500.00	1362.40	1191.40	1342.41
02.08.2013	1105.00	1508.33	1356.08	1134.25	1358.75
09.08.2013	1023.66	1525.00	1323.31	1165.00	1375.00
16.08.2013	1107.36	1487.50	1298.38	1177.67	1430.57
23.08.2013	1108.04	1450.00	1269.64	1167.30	1407.69
30.08.2013	1010.00	1450.00	1244.65	1164.83	1452.71
06.09.2013	1075.00	1450.00	1259.66	1156.30	1497.74
13.09.2013	1016.65	1487.40	1242.57	1073.25	1476.89
20.09.2013	1017.87	1524.80	1240.98	1071.20	1498.32
27.09.2013	1040.79	1550.00	1244.81	957.00	1445.72
04.10.2013	1040.00	1550.00	1252.50	1139.83	1452.78

11.10.2013	1054.583	1550.00	1252.50	1152.92	1418.44
18.10.2013	1053.50	1550.00	1247.34	1107.92	1343.87
25.10.2013	1042.25	1420.00	1275.57	1111.40	1325.30
01.11.2013	1050.00	1420.00	1273.23	1283.00	1357.17
08.11.2013	1066.65	1419.00	1255.57	1319.00	1341.51
15.11.2013	1087.87	1309.50	1233.16	1349.40	1321.30
22.11.2013	1040.79	1254.75	1267.51	1319.70	1322.20
29.11.2013	1060.79	1227.38	1300.04	1340.00	1321.89
06.12.2013	1225.00	1213.69	1336.58	1341.02	1321.58
13.12.2013	1235.70	1206.84	1310.81	1353.20	1312.82
20.12.2013	1256.50	1203.42	1314.52	1273.12	1311.24
03.01.2014	1242.62	1201.71	1344.55	1257.17	1318.77
10.01.2014	1307.50	1200.00	1325.16	1285.83	1350.00
17.01.2014	1304.40	1175.00	1319.62	1290.00	1377.06
24.01.2014	1327.50	1150.00	1320.00	1324.50	1323.32
31.01.2014	1315.40	1150.00	1350.21	1298.80	1310.00
07.02.2014	1347.50	1160.00	1389.75	1294.50	1329.26
14.02.2014	1445.00	1180.00	1419.29	1288.17	1348.53
21.02.2014	1462.50	1180.00	1418.10	1322.33	1315.62
28.02.2014	1470.83	1162.50	1411.27	1317.60	1310.00
07.03.2014	1476.42	1168.00	1423.12	1267.50	1310.00
14.03.2014	1350.00	1160.00	1413.09	1302.47	1313.68
21.03.2014	1322.33	1200.00	1429.80	1259.80	1310.00
28.03.2014	1317.60	1300.00	1416.56	1296.48	1310.00
04.04.2014	1367.50	1283.33	1397.06	1334.00	1380.00

ANNEXURE VI

Weekly wholesale prices of rice in different markets in India, 2010-2014

Week	Burdwan	Sangrur	Shahjahanpur	West Godavari
1-8 April , 2010	1768.01	1700.00	1569.43	2340.00
9-15 April	1756.23	1750.00	1556.08	2420.00
16-23 April	1771.80	1790.00	1572.45	2510.00
24-30 April	1761.29	1760.00	1567.60	2490.00
1-8 May	1761.87	1700.00	1571.56	2590.00
9-15 May	1712.67	1790.00	1557.16	2630.00
16-23 May	1699.22	1670.00	1557.53	2700.00
24-31 May	1697.71	1610.00	1564.90	2760.00
1-8 June	1695.65	1620.00	1599.07	2800.00
9-15 June	1711.57	1735.00	1605.95	2730.00
16-23 June	1758.76	1710.00	1600.71	2620.00
24-30 June	1853.61	1800.00	1584.76	2530.00
1-8 July	1942.04	1860.00	1586.54	2452.71
9-15 July	1922.49	1920.00	1591.60	2323.08
16-23 July	1955.29	1825.00	1608.36	2492.86
24-31 July	1941.45	1870.00	1626.84	2596.22
1-8 August	1840.12	1885.00	1628.52	2494.79
9-15 August	1888.88	1900.00	1622.73	2611.54
16-23 August	1926.81	1890.00	1616.86	2281.58
24-31 August	1942.22	1780.00	1620.75	2285.71
1-8 September	1924.60	1735.00	1615.88	2250.00
9-15 September	1846.73	1710.00	1621.20	2172.97
16-23 September	1857.17	1800.00	1624.27	2184.72
24-30 September	1829.38	1860.00	1622.19	2242.86
1-8 October	1797.82	1735.00	1623.34	2274.19
9-15 October	1791.15	1825.00	1623.11	2279.17
16-23 October	1841.05	1900.00	1609.59	2141.67
24-30 October	1788.08	1957.50	1610.91	2202.27
1-8 November	1827.53	1990.00	1620.03	2273.90
9-15 November	1796.69	2040.00	1630.32	2229.05
16-23 November	1787.71	2150.00	1622.02	2353.33
24-30 November	1764.51	2145.00	1643.44	2307.14

1-8 December	1783.86	2020.00	1654.80	2316.67
9-15 December	1775.63	2140.00	1661.36	2425.00
16-23 December	1798.81	2075.00	1674.40	2423.33
24-30 December	1752.00	2025.00	1672.20	2418.18
1-8 January ,2011	1834.11	1990.00	1663.36	2302.50
9-15 January	1820.00	1890.00	1587.71	2425.00
16-23 January	1837.71	1810.00	1578.98	2421.43
24-30 January	1847.52	1780.00	1496.48	2515.38
1-8 February	1886.46	1870.00	1565.74	2268.75
9-15 February	1862.62	1790.00	1511.70	2250.00
16-23 February	1853.68	1800.00	1439.41	2250.00
24-30 February	1793.53	1850.00	1549.80	2173.08
1-8 March	1824.99	1745.00	1569.25	2190.00
9-15 March	1806.24	1860.00	1583.76	2192.31
16-23 March	1805.25	1750.00	1571.76	2161.76
24-30 March	1837.09	1860.00	1557.81	2157.00
1-8 April	1839.36	1775.00	1576.08	2166.67
9-15 April	1798.26	1790.00	1584.96	2260.00
16-23 April	1804.88	1750.00	1599.19	2333.33
24-30 April	1805.61	1830.00	1600.21	2462.50
1-8 May	1787.65	1745.00	1601.17	2500.00
9-15 May	1784.00	1810.00	1613.28	2433.33
16-23 May	1785.46	1750.00	1609.14	2450.00
24-30 May	1792.28	1800.00	1620.32	2444.44
1-8 June	1787.74	1695.00	1585.58	2500.00
9-15 June	1748.99	1770.00	1540.12	2477.78
16-23 June	1741.01	1780.00	1490.12	2477.78
24-30 June	1746.72	1790.00	1585.55	2500.00
1-8 July	1774.09	1710.00	1491.95	2500.00
9-15 July	1743.97	1700.00	1532.12	2500.00
16-23 July	1742.30	1780.00	1497.28	2500.00
24-30 July	1623.97	1800.00	1572.87	2542.86
1-8 August	1673.06	1750.00	1547.66	2600.00
9-15 August	1670.73	1830.00	1591.40	2600.00

16-23 August	1687.21	1725.00	1579.50	2600.00
24-31 August	1664.23	1800.00	1507.93	2600.00
1-8 September	1736.30	1750.00	1631.81	2600.00
9-15 September	1732.90	1700.00	1667.18	2600.00
16-23 September	1808.86	1675.00	1622.77	2600.00
24-30 September	1747.95	1620.00	1625.67	2600.00
1-8 October	1722.83	1585.00	1630.36	2600.00
9-15 October	1777.94	1585.00	1627.01	2600.00
16-23 October	1756.08	1550.00	1635.53	2600.00
24-30 October	1854.92	1610.00	1633.71	2600.00
1-8 November	1733.42	1545.00	1625.96	2566.67
9-15 November	1696.44	1495.00	1621.22	2600.00
16-23 November	1727.11	1510.00	1626.55	2724.15
24-30 November	1734.99	1520.00	1628.18	2600.00
1-8 December	1706.83	1480.00	1627.19	2525.00
9-15 December	1687.55	1465.00	1629.92	2500.00
16-23 December	1672.62	1535.00	1629.81	2500.00
24-30 December	1660.50	1620.00	1640.28	2500.00
1-8 January ,2012	1687.85	1610.00	1644.47	2500.00
9-15 January	1661.96	1715.00	1629.63	2500.00
16-23 January	1664.65	1660.00	1640.61	2500.00
24-30 January	1706.39	1625.00	1642.45	2500.00
1-8 February	1734.42	1700.00	1653.55	2500.00
9-15 February	1724.71	1690.00	1644.61	2600.00
16-23 February	1728.58	1640.00	1631.82	2600.00
24-30 February	1718.64	1650.00	1660.32	2600.00
1-8 March	1701.34	1640.00	1676.12	2600.00
9-15 March	1696.04	1630.00	1649.76	2600.00
16-23 March	1688.95	1700.00	1654.86	2600.00
24-30 March	1695.53	1670.00	1657.61	2600.00
1-8 April	1705.99	1685.00	1651.33	2687.50
9-15 April	1704.32	1780.00	1661.53	2700.00
16-23 April	1710.87	1734.23	1657.50	2700.00
24-30 April	1719.20	1700.00	1673.56	2700.00

1-8 May	1728.24	1700.00	1667.94	2750.00
9-15 May	1752.65	1626.69	1654.17	2900.00
16-23 May	1738.52	1738.38	1662.38	2962.50
24-30 May	1688.82	1687.20	1679.59	3000.00
1-8 June	1653.29	1651.90	1692.31	3075.00
9-15 June	1645.50	1713.25	1705.85	3100.00
16-23 June	1682.08	1720.00	1712.97	3100.00
24-30 June	1725.85	1740.00	1724.31	3100.00
1-8 July	1732.68	1780.00	1732.42	3100.00
9-15 July	1729.46	1790.00	1732.04	3100.00
16-23 July	1718.92	1750.00	1757.32	3175.00
24-30 July	1702.71	1880.00	1812.52	3300.00
1-8 August	1727.82	1820.00	1840.87	3300.00
9-15 August	1754.97	1840.00	1860.83	3328.57
16-23 August	1805.57	1790.00	1873.40	3400.00
24-31 August	1831.67	1890.00	1889.77	3400.00
1-8 September	1819.12	1900.00	1877.74	3400.00
9-15 September	1825.43	1980.00	1867.60	3400.00
16-23 September	1843.41	1950.00	1853.75	3400.00
24-30 September	1834.09	1930.00	1835.00	3400.00
1-8 October	1801.70	1895.00	1758.97	3400.00
9-15 October	1801.47	1950.00	1685.00	3400.00
16-23 October	1790.83	1990.00	1665.78	3400.00
24-30 October	1802.08	1970.00	1643.19	3200.00
1-8 November	1833.20	1890.00	1637.81	3200.00
9-15 November	1853.68	1872.00	1626.79	3200.00
16-23 November	1887.18	1950.00	1618.72	3200.00
24-30 November	1901.91	2010.00	1685.01	3200.00
1-8 December	1903.19	2030.00	1633.32	3200.00
9-15 December	1910.01	2060.00	1644.89	3600.00
16-23 December	1923.30	2170.00	1659.64	3600.00
24-30 December	1924.02	2230.00	1669.90	3600.00
1-8 January ,2013	1952.08	2190.00	1693.72	3600.00
9-15 January	1966.12	2290.00	1713.00	3600.00

16-23 January	1991.46	2310.00	1726.04	3557.14
24-30 January	2011.67	2390.00	1731.49	3500.00
1-8 February	2033.43	2290.00	1738.86	3700.00
9-15 February	2039.24	2375.00	1760.47	3640.00
16-23 February	2055.30	2410.00	1775.82	3590.00
24-30 February	2059.46	2410.00	1760.00	3650.00
1-8 March	2072.01	2480.00	1781.92	3700.00
9-15 March	2020.71	2530.00	1780.00	3890.00
16-23 March	2030.18	2490.00	1787.09	4100.00
24-30 March	2014.84	2380.00	1797.22	4100.00
1-8 April	2026.14	2460.00	1799.81	4100.00
9-15 April	2028.04	2510.00	1840.00	4100.00
16-23 April	2052.42	2490.00	1869.69	4100.00
24-30 April	2074.97	2620.00	1895.67	4100.00
1-8 May	2113.70	2710.00	1902.58	4100.00
9-15 May	2074.37	2675.00	1899.32	4100.00
16-23 May	2062.89	2750.00	1884.18	4087.50
24-30 May	2080.99	2700.00	1885.15	4000.00
1-8 June	2104.47	2600.00	1861.56	4000.00
9-15 June	2122.95	2590.00	1820.03	3900.00
16-23 June	2168.53	2540.00	1838.94	3900.00
24-30 June	2228.32	2610.00	1826.98	3900.00
1-8 July	2184.94	2650.00	1817.35	3900.00
9-15 July	2188.43	2710.00	1829.02	3900.00
16-23 July	2184.89	2650.00	1871.87	3900.00
24-30 July	2205.63	2590.00	1887.64	3900.00
1-8 August	2254.04	2575.00	2019.09	3900.00
9-15 August	2368.70	2555.00	2027.35	3900.00
16-23 August	2418.44	2450.00	2035.71	3900.00
24-31 August	2408.74	2575.00	2058.50	3900.00
1-8 September	2377.22	2550.00	2064.76	3900.00
9-15 September	2378.94	2610.00	2077.74	3900.00
16-23 September	2395.88	2680.00	2023.06	3900.00
24-30 September	2362.99	2640.00	1965.46	3900.00

1-8 October	2374.91	2580.00	1880.75	3900.00
9-15 October	2364.52	2640.00	1836.69	3900.00
16-23 October	2399.79	2680.00	1869.91	3900.00
24-30 October	2446.45	2560.00	1913.17	3900.00
1-8 November	2465.93	2490.00	1954.87	3900.00
9-15 November	2461.67	2510.00	1973.35	3900.00
16-23 November	2457.67	2590.00	1971.29	3900.00
24-30 November	2392.25	2670.00	1985.36	3900.00
1-8 December	2354.90	2700.00	2025.85	3900.00
9-15 December	2321.09	2710.00	2033.60	3900.00
16-23 December	2313.87	2695.00	2031.87	3900.00
24-30 December	2290.04	2730.00	2010.69	3900.00
1-8 January ,2014	2316.90	2750.00	2005.30	3900.00
9-15 January	2329.38	2650.00	2022.01	3900.00
16-23 January	2332.46	2630.00	2018.28	3900.00
24-30 January	2335.97	2700.00	2039.70	3900.00
1-8 February	2341.96	2740.00	2069.53	3900.00
9-15 February	2348.88	2710.00	2032.44	3900.00
16-23 February	2357.60	2690.00	2030.26	3900.00
24-30 February	2355.23	2610.00	2026.13	3900.00
1-8 March	2358.43	2580.00	2018.43	3900.00
9-15 March	2342.13	2520.00	2020.24	3900.00
16-23 March	2342.92	2490.00	2015.95	3900.00
24-30 March	2361.75	2440.00	2015.49	3900.00

LIST OF PUBLISHED/ACCEPTED/SUBMITTED RESEARCH ARCTICLES

S.No	Title	Journal	NAAS Rating	Status
1.	Market Integration of Food grain in India: The case of the Rice Market	Indian Journal of Economics and Development	4.01	Submitted
2.	An analysis of price behaviour of cotton in Indian Markets	Indian Journal of Agricultural Marketing	2.89	Submitted
3.	Integration of Maize Markets in India	Journal of Agricultural Development and Policy	3.27	Submitted

Market Integration of Food grain in India: The case of the Rice Market

Parvinder Jeet Kaur* and M.K.Sekhon**

ABSTRACT

*This paper tests the extent of co-integration of wholesale prices of rice among markets of different states i.e. Punjab (*Sangrur)*, West Bengal (*Burdwan), Uttar Pradesh (Shahjahanpur) and Andhra Pradesh (*West Godavari) of India by using Johansen test, examined the causality tests and also captures the speed of adjustment to deviations in long run equilibrium by using Vector Error Correction Model. Weekly wholesale price data from April, 2010 to march, 2014 were used for the study. The number of observation became 190 which the data was collected. Out of four markets only three markets were co-integrated. Some market pairs have shown bidirectional causality, while others have depicted unidirectional causality. The long-term equilibrium relationship exists between all the studied markets in term of weekly price of the rice, there also exists a short-run disequilibrium between some of the market pairs. Greater integration in these markets may help the farmers as well as consumers of the rice through better price signals.*

Key word: Rice, market integration, co-integration, India

JEL Classification: C22, C32, O53, Q11

INTRODUCTION

Rice is the most important and extensively grown food crop in the World. It is the staple food of more than 60 percent of the world population. Rice is mainly produced and consumed in the Asian region. India has the largest area under rice in the world and ranks second in the production after China. Country has also emerged as a major rice consumer. The major rice growing states in India are West Bengal, Uttar Pradesh, Andhra Pradesh and Punjab etc. More than 50 percent of country's population depends fully or partially on rice as it constitutes the main cereal food. Rice is the most dominating crop enterprise in Punjab accounting for about 62 percent of the total cropped area in kharif season. It was cultivated on 2851 thousand ha with production of 11267 thousand tonnes respectively (Anonymous 2014). Rice crop was an important component of an exemplary growth of Punjab agriculture during past four decades. The area under this crop increased from just 3.90 lakh ha in 1970-71 to 28.51 lakh ha in 2013-14 (Anonymous 2014). During the same year total production of rice in Punjab was the highest in our country. The state has been contributing 29.3 per cent of rice towards central pool since last four decades (Anonymous, 2014).

*Ph.D. Scholar and **Senior Economist (Marketing), Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141004 (India)
Mail: parvinderbrr@gmail.com

Efficient functioning of markets is an essential pre-requisite of a sound marketing system to provide remunerative prices of the produce to the farmer-sellers as well as for providing of goods at reasonable prices to the innumerable consumers. One of the common indicators of the efficient functioning of the markets is the existence of high degree of integration of markets and prices. Integrated market is defined as market in which prices of differentiated products do not behave independently. Markets which are independent must be modeled in a disaggregate manner, while markets which are integrated may be amenable to aggregate analysis. According to Lele (1967), market integration is measured as an interrelationship between price movements for commodity in two or more selected markets of the area. The existence of integration in the markets influences the conduct of the firms of the markets and consequently the marketing efficiency. The behavior of a highly integrated market is different from that of a lesser integrated or dis-integrated market. Markets located in different areas differ in the extent of integration and therefore, variation exists in their degree of efficiency. The spatial price behavior in regional markets is an important indicator of the overall market performance. Markets which are not integrated may convey inaccurate price signals that might distort producer's marketing decisions and contribute to inefficient product movement. Integrated markets are defined as markets in which prices of product in differentiated do not behave independently (Monke and petzel, 1984).

There are several studies that have dealt with the measurement of market co-integration, especially in food markets in many countries (Baulch, 1997; Engle and Granger 1987; Johansen, 1988; Johansen and Juselius,1990). However, work in this field in India has been very limited (Jha *et al*., 1997; Blyn, 1973; Ghosh, 2000; Deb, 2004; Reddy and Reddy, 2011). Jha *et al.,* (1997) investigated rice and wheat market integration in India, carrying out binary and multivariate co-integration tests. Applying these methods to the monthly wholesale prices of rice and wheat for the period from 1980 to 1990, they observed that all pairs of prices of rice as well as of wheat are cointegrated. Moreover, for both the crops, all the prices taken together are linked in a co-integrating relationship and concluded that food markets all over India are highly integrated.

A study by Ghosh (2000) using the Johansen method of co-integration, evaluated the inter-state and intra-state regional integration of rice markets by testing the long run linear relationship between the prices. One price was set by law in the regional

markets within the state of Uttar Pradesh, whereas in Bihar, Orissa and West Bengal a single price was not maintained by law, even though the rice markets were integrated. At an inter-state level, prices are integrated, but a law stipulating one price has not been implemented. On the whole, the regional rice markets within and across the states are spatially linked in the long run, suggesting that prices provided relevant signals to the regional markets within and across the states. In line with Ghosh (2000), the present study evaluates the market integration of rice markets in India by using the methods of Engle and Granger (1987) and Johansen and Juselius (1990). Present study also examines the long-term causality effect by applying granger causality tests and short-term price adjustment to the long-run equilibrium price by using the error correction model.

METHODOLOGY

Data for the study were obtained from secondary sources. Time series data on the weekly wholesale prices of rice required for the study was collected from the market committees and AGMARKNET of selected markets. The number of observation became 190 which the data was collected.

Augemented Dickey-Fuller (ADF) Test:

The Augemented Dickey-Fuller (ADF) unit-root was performed in this study to verify stationarity in the series. The autoregressive formulation of the ADF test with a drift term is given by equation (1).

$$\Delta p_{it} = a_0 + \gamma P_{it-1} + \sum_{i=2}^{n} \beta_i \Delta p_{it-j+1} + \varepsilon_t \quad \text{..... (1)}$$

where p_{it} is the price in market i at the time t, $\Delta p_{it} = (p_{it} - p_{it-1})$ and a_0 is the intercept or drift term.The joint hypothesis to check the presence of unit root is: $H_0 : \gamma = a_0 = 0$ using ϕ_1 statistics. Failure of the rejection of null hypothesis means that the series is non-stationary.

Johanson Cointegration Test

For co integration analysis, the Johansen (1988) maximum likelihood estimator was chosen over the Engle and Granger (1987) two step procedure.The Johansen procedure is a multivariate generalization of the Dickey Fuller test and formulation is as follows:

$$p_{it} = A_1 p_{it-1} + \varepsilon_t \quad \text{..... (2)}$$

So that

$$\Delta p_{it} = A_1 p_{it-1} - p_{it-1} + \varepsilon_t \quad \text{.....(3)}$$

$$\Delta p_{it} = (A_1 - I) p_{it-1} + \varepsilon_t \quad \text{.....(4)}$$

$$\Delta p_{it} = \pi p_{it-1} + \varepsilon_t \quad \text{.....(5)}$$

where, p_{it} and ε_t are (n×1) vectors; A_1 is an (n×n) matrix of parameters;I is an (n×n) identity matrix and π is the $(A_1 - 1)$ matrix.

Trace test was used to determine the presence of co-integrating relationship between the price series.Using the estimates of the characterstic roots,the test for the number of characteristic roots that are insignificantly diifferent from unity was conducted using the following statistics:

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{n} \ln\left(1 - \hat{\lambda}_j\right) \quad \text{.....(6)}$$

where, λ_j denotes the estimated values of the characteristic roots (eigen value) obtained from the estimated π matrix; and T is the number of usable observations.The Eigen values representing the strength of the correlation between the first difference and error-correction.

Granger causality Test:

When a co-integration relationship is present for variables, Granger causality test (Granger,1969) can be used to analyze the direction of this co movement relationship. Whether market p_1 Granger causes market p_2 or vice versa was checked using equation (7):

$$p_{it} = c + \sum_{j}^{n} \left(\phi p_{1t-j} + \delta_j p_{2t-j}\right) + \varepsilon_t \quad \text{.....(7)}$$

A simple test of the joint significance of δ_j was used to check the Granger causality, i.e.

$H_0 : \delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$

Vector Error Correction Model :

Vector Error Correction Model (VECM) to find the short-term disturbance and the adjustment mechanism to estimate the speed of adjustment.The ECM explains the difference in y_t and y_{t-1} (i.e.Δy_i) by equation (9):

$$\Delta y_t = a + \mu\left(y_{t-1} - \beta x_{t-1}\right) + \sum_{i=0}^{i=1} \delta_i \Delta x_{t-i} + \sum_{i=1}^{i=t} \gamma_i \Delta y_{t-i} \quad \text{.....(8)}$$

It includes the lagged differences in both x and y, which have a more immediate impact on the value of Δy_t. In explaining changes in a variable,the ECM accounts for its long run relationship with other variable. The coefficient of error-correction term indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long-run equilibrium and if it is positive and zero, the series diverges from equilibrium.

The advantage of the error-correction model is that it allows for short run dynamics as well as an assessment of the degree of convergence towards the long run relation as shown by the cointegration.

RESULTS AND DISCUSSION

Market Integration among rice Markets

The integration tests elaborated above were carried out on log weekly prices of wholesale markets in India.These tests have been used to study the integration of markets. To avoid spurious results, there is a need to check whether the variables are stationary or not. Therefore, it is necessary to examine time-series properties of the variables. Further, to establish the long-run equilibrium relation among the price series, it is necessary to co-integrate them. Co-integration among the variables, in turn, requires checking the order of integration among variables and variables cannot be integrated in the presence of unit root, the same can be examined through conducting a stationarity test. The price movement, volatility within the market and integration between market were studied.Augmented Dickey-Fuller test (ADF) was applied to check whether the price series of cotton crop are stationary in their level, followed by their first difference.

Augmented Dickey Fuller test

Augmented Dickey-Fuller (ADF) test is employed to test the validity of market integration hypothesis. A unit root test is a statistical test for the proposition that in an autoregressive statistical model of a time series, the autoregressive parameter is one. It is a test for detecting the presence of stationarity in the series. The early and pioneering work on testing for a unit root in time series was done by Dickey and Fuller (Dickey and Fuller 1979 and 1981). Stationarity time series is one whose mean, variance and covariance are unchanged by time shift. Non-stationary time series have time varying mean or variance or both. If a time series is non-stationary, we can study its behaviour only for a time period under consideration. It is not

possible to generalize it to other time periods. It is, therefore, not useful for forecasting purpose. The presence of unit root in a time series is tested with the help of Augmented Dickey-Fuller Test.

The Augmented Dickey Fuller (ADF) based unit root test procedure was condcted to check whether the wholesale price series of rice among different markets such as Sangrur (Punjab), Burdwan (W.B.), Shahjahanpur (U.P.) and West Godavari (A.P.) markets are stationary.The results of unit root test are given in Table 1 ,in case of prices in levels, ADF test does not reject the unit root hypothesis at 1 percent level during the periods. In the case of first difference of the series,the hypothesis was,however was rejected at 1 per cent level.Thus all the four series were integrated of the order one.

Table: 1 **ADF test results of rice prices in different markets**

Markets	**At Level**	**Stationarity**	**At First difference**	**Stationarity**	**Critical values (at 1% level)**
Sangrur	-1.590752	Non-stationary	-16.49136	Stationary	4.007084
Burdwan	-1.484412	-do-	-13.79628	-do-	
Shahjahanpur	-2.750782	-do-	-14.08801	-do-	
West Godavari	-2.001519	-do-	-13.60503	-do-	

Johansen's Multiple Co-integration test

Based on the Johansen multiple co-integration procedure, co-integration between the markets was analyzed using E-Views software. Both the Maximum Eigenvalue test and trace test results indicate the presence of four co-integrating vectors at the five per cent significance level. This implies that all the five markets were in fact cointegrated and had a common sharing information on price changes in the long run.

Johanson method of multivariate cointegration tests for the four rice price series are presented in Table 2. The trace statistic test results indicate the presence of three cointegrating vector at 5 per cent significance level for the periods.This implies that three markets were in fact cointegrated and had common sharing of information on price changed in the long run.The above empirical evidence suggests that all the four markets do exhibit a long run relationship.The farmers transfer their produce from one market to the other according to the price changes.

Table 2 : Results of Johansen Co-integration Analysis

Hypothesized No. of CE(S)	Eigen value	Trace Statistic	0.05 Critical value	Prob**
None *	0.316702	118.2520	63.87610	0.0000
At most 1 *	0.141417	53.13108	42.91525	0.0035
At most 2 *	0.104406	27.05838	25.87211	0.0355
At most 3	0.046836	8.202554	12.51798	0.2356

Trace test indicates 3 cointegrating eqn(s) at the 5 per cent level

* denotes rejection of the hypothesis at the 5 per cent level

Results of Granger Causality Test

Evidence of causality can be inferred from the F (causality) statistics from the Granger causality tests presented in Table 3, which indicate the strength of causality in each market with reference to every other market, based on the significance level of F (causality) statistics.

The causal relationship between the price series in rice markets were approached through Granger Causality technique. The results of the analysis showing the relationship between rice markets are presented in Table 3 and figure 1.The study finds no co-integration within five pairs of markets (Burdwan-Sangrur, Shahjahanpur - Sagrur, Sangrur-West Godavary, Burdwan- Shahjahanpur, Shahjahanpu-West Godavary).

Table 3: Results of Pair-wise Granger Causality test results

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
BURDWAN does not Granger Cause SANGRUR		0.60739	0.5459
SANGRUR does not Granger Cause BURDWAN	190	6.23338	0.0024
SHAHJAHANPUR does not Granger Cause SANGRUR		1.15463	0.3174
SANGRUR does not Granger Cause SHAHJAHANPUR	190	2.84731	0.0605
WEST_GODAVARI does not Granger Cause SANGRUR		5.72076	0.0039
SANGRUR does not Granger Cause WEST_GODAVARI	190	0.06348	0.9385
SHAHJAHANPUR does not Granger Cause BURDWAN		4.58271	0.0114
BURDWAN does not Granger Cause SHAHJAHANPUR	190	1.74145	0.1781
WEST_GODAVARI does not Granger Cause BURDWAN		6.37021	0.0021
BURDWAN does not Granger Cause WEST_GODAVARI	190	2.81845	0.0623
WEST_GODAVARI does not Granger Cause SHAHJAHANPUR		5.80152	0.0036
SHAHJAHANPUR does not Granger Cause WEST_GODAVARI	190	0.34638	0.7077

Theoretically, a variable is said to Granger-Cause another variable, the Table 3 it is inferred that:

- Sangrur market prices influence the prices at Burdwan market and not vice-versa.
- Sangrur market prices influence the prices at Shahjahanpur market and not vice-

versa.

- West Godavary market prices influence the prices at Sangrur market and not vice-versa.
- Shahjahanpur market prices influence the prices at Burdwan market and not vice-versa.
- West Godavary and Burdwan market prices have a bidirectional influence.
- West Godavary market prices influence the prices at Shahjahanpur market and not vice-versa.

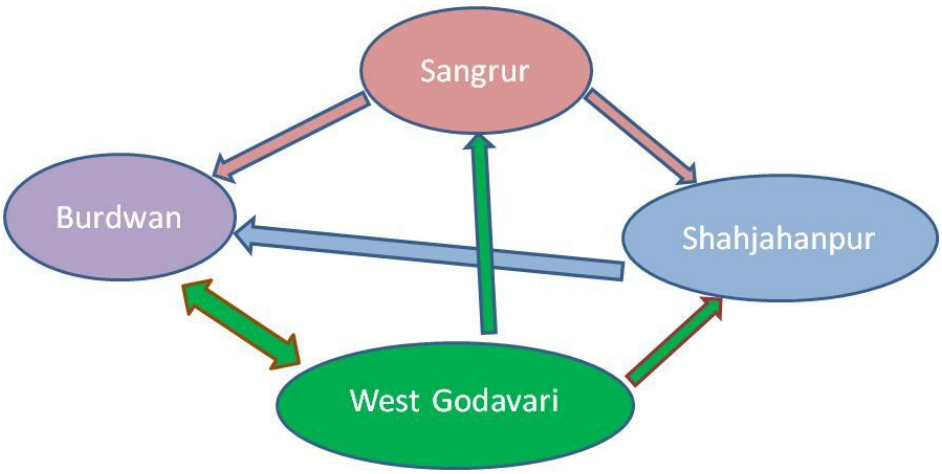

Figure 1 Market integration among rice markets

Vector Error Correction model

Since the rice markets are integrated in the long run, it is important to study the short run and long run equilibrium among the markets. Hence Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium and results of the same presented in Table 4. The error correction term indicates the speed of adjustment among the variable before converging to equilibrium in the dynamic model. The coefficients show how quickly variables return back to equilibrium.The Table 4 clearly shows that the co-integration equation of error correction mechanism is significant in all the four markets. It was revealed from the analysis that, any disturbance in price will get corrected in about 14 hours in Sangrur around 7 hours in Burdwan and 5 hours in Shahjahanpur. Burdwan market price model of rice, the coefficient of first week (0.17) lagged Shahajahanpur market price and third week (0.08) lagged West Godavari market price was positive and significant at 5 per cent level . It means that the price discovery occurred in the

markets and was transmitted to Burdwan market.In case of Shahajahanpur market , the prices are influenced by its own second week (0.16) lag period.In West Godavari market, the prices are influenced by one week (0.39) and third week (0.42) back prices of Burdwan market. It means that the price discovery occurred in the markets and was transmitted to Shahjahanpur market.

Table 4: Results of vector error correction model with two lag periods in different markets

Error Correction	D(SANGRUR)	D(BURDWAN)	D(SHAHJAHANPUR)	D(WEST_GODAVARI)
CointEq1	**-0.082434**	**0.042510**	**-0.032701**	0.022937
	(0.02979)	**(0.01554)**	**(0.01500)**	(0.03309)
	[-2.76755]	**[2.73471]**	**[-2.18013]**	[0.69325]
D(SANGRUR(-1))	-0.110532	-0.052904	0.066179	-0.014240
	(0.07743)	(0.04041)	(0.03899)	(0.08600)
	[-1.42760]	[-1.30931]	[1.69733]	[-0.16557]
D(SANGRUR(-2))	0.060359	-0.066086	0.002035	0.102475
	(0.07795)	(0.04068)	(0.03926)	(0.08659)
	[0.77429]	[-1.62443]	[0.05185]	[1.18343]
D(SANGRUR(-3))	0.052022	0.029739	0.009205	0.079615
	(0.07909)	(0.04128)	(0.03983)	(0.08785)
	[0.65774]	[0.72050]	[0.23111]	[0.90621]
D(SANGRUR(-4))	0.098482	-0.043202	0.044092	0.096818
	(0.07581)	(0.03956)	(0.03817)	(0.08420)
	[1.29914]	[-1.09203]	[1.15500]	[1.14980]
D(BURDWAN(-1))	-0.002988	0.050477	0.011672	**-0.395481**
	(0.14742)	(0.07694)	(0.07424)	**(0.16376)**
	[-0.02027]	[0.65607]	[0.15722]	**[-2.41503]**
D(BURDWAN(-2))	-0.167281	0.107115	-0.082717	0.067618
	(0.14377)	(0.07503)	(0.07240)	(0.15970)
	[-1.16350]	[1.42758]	[-1.14247]	[0.42340]
D(BURDWAN(-3))	0.124921	-0.093664	0.024348	**0.419099**
	(0.14415)	(0.07523)	(0.07259)	**(0.16012)**
	[0.86661]	[-1.24506]	[0.33541]	**[2.61741]**
D(BURDWAN(-4))	0.008106	0.012650	0.118367	-0.036785
	(0.14369)	(0.07499)	(0.07236)	(0.15961)
	[0.05641]	[0.16870]	[1.63585]	[-0.23048]

D(SHAHJAHANPUR(-1))	-0.107036	**0.166618**	-0.004600	0.135464
	(0.15225)	**(0.07946)**	(0.07667)	(0.16912)
	[-0.70303]	**[2.09699]**	[-0.06000]	[0.80101]
D(SHAHJAHANPUR(-2))	0.225780	-0.057434	**0.157661**	0.290553
	(0.15427)	(0.08051)	**(0.07769)**	(0.17136)
	[1.46355]	[-0.71338]	**[2.02943]**	[1.69556]
D(SHAHJAHANPUR(-3))	0.254727	-0.069200	0.051570	0.026086
	(0.15711)	(0.08199)	(0.07912)	(0.17452)
	[1.62132]	[-0.84398]	[0.65180]	[0.14948]
D(SHAHJAHANPUR(-4))	0.252984	-0.062568	-0.029681	-0.143724
	(0.15589)	(0.08136)	(0.07850)	(0.17316)
	[1.62284]	[-0.76907]	[-0.37809]	[-0.83000]
D(WEST_GODAVARI(-1))	0.110693	-0.036751	0.043261	-0.023198
	(0.06927)	(0.03615)	(0.03488)	(0.07694)
	[1.59808]	[-1.01667]	[1.24023]	[-0.30151]
D(WEST_GODAVARI(-2))	-0.019431	-0.065004	0.017011	0.072320
	(0.06933)	(0.03618)	(0.03491)	(0.07701)
	[-0.28026]	[-1.79654]	[0.48721]	[0.93906]
D(WEST_GODAVARI(-3))	0.020602	**0.085392**	0.013400	-0.016494
	(0.06905)	**(0.03604)**	(0.03477)	(0.07670)
	[0.29836]	**[2.36957]**	[0.38535]	[-0.21504]
D(WEST_GODAVARI(-4))	-0.045374	-0.009717	-0.001270	-0.068767
	(0.06895)	(0.03598)	(0.03472)	(0.07658)
	[-0.65811]	[-0.27004]	[-0.03657]	[-0.89792]
C	1.528261	3.756346	0.648497	5.233629
	(4.84799)	(2.53006)	(2.44137)	(5.38512)
	[0.31524]	[1.48469]	[0.26563]	[0.97187]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (1),(2),(3) and (4) indicate number of lags.

CONCLUSIONS

The market performance of rice in India has been studied on the basis of weekly wholesale prices data for five years The results ~~of the~~ Johansen-Juselius method of multivariate co-integration tests for four selected markets. Both the eigen value test and the trace test results indicate the presence of three co-integrating vectors at the five per cent significance level during the period. This implies that all the four markets were in fact cointegrated and had a common sharing of information on price changes in the long run. The market prices in general, attains a long-run equilibrium relationship/ converge in the long-run after restating and correcting prices ranging from -0.03 per cent to -0.08 per cent per week. There is integration even among the geographically dispersed rice markets. However, some pairs have shown bidirectional causality and others have depicted unidirectional causality.

It was observed from the study that the markets have a strong association in term of wholesale prices of rice in different markets, thereby influencing the prices from one market to other market with a one weeks lag to two weeks lag. This helped to transfer the price signals from one market to another and thereby helps in stabilizing the prices over space and create a healthy competitive environment.

REFERENCES

Anonymous (2010) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2011) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2012) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2013) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) *Statistical Abstract of Punjab.* Economic and Statistical Organisation, Government of Punjab.

Baulch, B. 1997. Transfer Costs, Spatial Arbitrage and Testing for Food Market Integration. *American Journal of Agricultural Economic*, **79**, 477-487.

Dickey and Fuller (1979), "Distribution of Estimates for Autoregressive Time Series with a unit root", Journal of American Statistical Association, Vol. **74**, 427-31.

Dickey and Fuller (1981), "Liklihood Ratio Statisitcs for Autoregressive Time Series with a unit root", Econometrica, Vol. **49**, 1057-72.

Engle, R. F. & Granger, C. W. J. 1987. Cointegration and Error Correction: Representation, Estimation and Testing, *Econometrica*, **55**, 251-276.

Ghosh, M. 2000. Cointegration Tests and Spatial Integration of Rice Markets in India, *Ind J Agri Econ* , **55**, 616-626.

Jha, R., Murthy, M.V.B., Nagarajan, H. K., & Seth, A. K. 1997. Market Integration in Indian Agriculture, *Economic Systems*, **21**, 217-234.

Johansen,S. & Juselius. 1990. Maximum Likelihood Estimation and Inference on Cointegration with Application to Demand for Money, *Oxford Bulletin of Economics and Statistics*, **52**, 169-210.

Lele, Uma J (1967) *Food grain Market in India, Private performance and public policy*.Cornel University Press Ithaca New York: **89**.

Monke E and Petzel T (1984) Market integration: An application to International trade in cotton. *American J Agril Econ* **66**(4): 401-87**.**

An analysis of price behaviour of cotton in Indian Markets

Parvinder Jeet Kaur* and M.K.Sekhon**
Department of Economics and Sociology, Punjab Agricultural University, Ludhiana

ABSTRACT

The current study seeks to explore the degree of market integration through co-integration analysis on the wholesale weekly prices of cotton. Five markets were selected from different states i.e. Maharastra *(Akola), Gujrat (Rajkot and Surendranagar) and Punjab (Bathinda and Mansa) of India during april,2010 to march, 2014. The number of observation became 188 which the data was collected. By using Johansen test, examined the causality tests, using Vector Error Correction Model and captures the speed of adjustment to long run equilibrium. The results reveal that out of five markets only four markets were co-integrated and the Rajkot market was the dominant one. However, the study finds no co-integration within four pairs of markets (Surendranagar- Akola, Bathinda – Akola, Mansa – Akola and Rajkot – Bathinda). The Granger Causality Test reveals six and four bi-directional and uni-directional causations respectively under different market situations. Further, Vector Error Correction Model (VECM) results reveal a combination of positive and negative coefficients, though positive coefficients exceed the negative coefficients.Greater integration in these markets may help the farmers as well as consumers of selected crops through better price signals.*

Keywords: Cotton, Cointegration, market integration, India

JEL Classification: C22, C32, O53, Q11

INTRODUCTION

Cotton is an immensely important crop for the economy of India and livelihood of the Indian farming community. It is cultivated on about 11.61 million hectares area in the country which

accounts for about 30 per cent of the global cotton area and it also contributes to 22 per cent of global cotton produce, currently ranking second after China (Sabesh *et al* 2014). About 70 per cent of global production comes from just four countries, China holds highest share in global production (27 percent), followed by India (22 per cent), USA (13 per cent) and Pakistan (8 per cent) (NBHC Global cotton conference, 2013). Cotton plays a vital role in the country's economic growth by providing substantial employment and making significant contribution to export earnings. It accounts for 59 per cent of the fibre used in textile industry.

The cotton cultivation in India not only engaged around 6 million farmers but also involved another 40-50 million people relating to cotton cultivation, cotton trade and its processing. The annual production of cotton in India during 2012-13 was 33.40 million bales (Anonymous, 2013). During 2012-13, it was cultivated on 472 thousand hectares with total production of 1620 thousand metric tonnes in Punjab (Anonymous 2013).

Essentially, an efficient marketing system is one where there is a perfect market integration and full price transmission, with instantaneous price adjustment to changes from within or outside the system. Such a system would enable the producers, middlemen and consumers in the marketing chain to derive maximum gains. It would also help in elimination of unprofitable arbitrage and isolation of spatially differentiated markets and would that efficient allocation of resources across space and time is achieved (Nkang *et al*, 2007). Spatial market integration is the smooth transmission of price signals and information across spatially separated markets (Golleti *et al* ,1995) or is the measure of the extent to which demand and supply in one location are transmitted to another (Negassa *et al*, 2003). If two markets are integrated, they will experience identical price shocks/ changes (Barrett, 1996). While the poor performance of econometric models for forecasting has been reported by clements *et al* (1995, 1998, 1999), other (Granger 1981, 1986, Granger *et al* 1983 , Engle and

Granger 1987, Johansen 1988, 1995 and 1996, Banerjee *et al* 1993, Harris, 1995) formulated the basis for coitegration analysis followed by equilibrium-correction model which were used by large number of researchers in agricultural economics (Kulendran 1996, Singh *et al* 2000, Rapsomanikis *et al*, 2003, Sendhil *et al* 2013) in one or the other frame to reduce forecast failures.Alternatively, market integration is a function of how fast and how much information is reflected in prices. The rate at which prices exhibit market information is the speed at which this information is disseminated to the market participants (Zapata *et al* 2005).It also allows us to find out what are the variables which are endogenous and the ones which are exogenous in the system through the 'error-correction' procedure (Kumar *et al* 2003) . The studies on integration helps in planning and developing the system for efficient marketing. In this paper an attempt has been made to examine the trends in wholesale prices and the existence of integration among different markets of cotton in India.

METHODOLOGY

The data used in the co-integration analysis of weekly wholesale prices of five cotton markets i.e. Akola (Maharastra),Rajkot (Gujrat),Surendranagar (Gujrat),Bathinda (Punjab) and Mansa (Punjab) of India.

Analysis of market Integration

Augemented Dickey-Fuller test involved testing for stationary of the vriables. The Augemented Dickey-Fuller (ADF) test considers the null hypothesis that given series has a unit-root, i.e. it is non-stationary.The autoregressive formulation of the ADF test with a drift term is given by equation (1).

$$\Delta p_{it} = a_0 + \gamma P_{it-1} + \sum_{i=2}^{n} \beta_i \Delta p_{it-j+1} + \varepsilon_t \quad \text{..... (1)}$$

where p_{it} is the price in market i at the time t, $\Delta p_{it} = (p_{it} - p_{it-1})$ and a_0 is the intercept or drift term.The joint hypothesis to check the presence of unit root is: $H_0 : \gamma = a_0 = 0$ using ϕ_1 statistics. Failure of the rejection of null hypothesis means that the series is non stationary.

Johansen's Multiple Cointegration Analysis

For co integration analysis, the Johansen (1988) maximum likelihood estimator was chosen over the Engle and Granger (1987) two step procedure.The Johansen procedure is a multivariate generalization of the Dickey Fuller test and formulation is as follows:

$$p_{it} = A_1 p_{it-1} + \varepsilon_t \quad \text{..... (2)}$$

So that

$$\Delta p_{it} = A_1 p_{it-1} - p_{it-1} + \varepsilon_t \quad \text{.....(3)}$$

$$\Delta p_{it} = (A_1 - I) p_{it-1} + \varepsilon_t \quad \text{.....(4)}$$

$$\Delta p_{it} = \pi p_{it-1} + \varepsilon_t \quad \text{.....(5)}$$

where, p_{it} and ε_t are (n×1) vectors; A_1 is an (n×n) matrix of parameters;I is an (n×n) identity matrix and π is the $(A_1 - 1)$ matrix.

Trace test was used to determine the presence of co integrating relationship between the price series.Using the estimates of the characterstic roots,the test for the number of characteristic roots that are insignificantly diifferent from unity was conducted using the following statistics:

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{n} \ln\left(1 - \hat{\lambda}_j\right) \quad \text{.....(6)}$$

where, λ_j denotes the estimated values of the characteristic roots (eigen value) obtained from the estimated π matrix; and T is the number of usable observations.The Eigen values representing the strength of the correlation between the first difference and error-correction.

Granger causality Test

When a co-integration relationship is present for variables, Granger causality test (Granger,1969) can be used to analyze the direction of this co movement relationship. Whether market p_1 Granger causes market p_2 or vice versa was checked using equation (7):

$$p_{it} = c + \sum_{j}^{n} \left(\phi p_{1t-j} + \delta_j p_{2t-j} \right) + \varepsilon_t \quad \text{.....(7)}$$

A simple test of the joint significance of δ_j was used to check the Granger causality, i.e.

$H_0 : \delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$

Vector Error Correction Model

Vector Error Correction Model (VECM) to find the short-term disturbance and the adjustment mechanism to estimate the speed of adjustment.The ECM explains the difference in y_t and y_{t-1} (i.e.Δy_i) by equation (8):

$$\Delta y_t = a + \mu \left(y_{t-1} - \beta x_{t-1} \right) + \sum_{i=0}^{i=1} \delta_i \Delta x_{t-i} + \sum_{i=1}^{i=t} \gamma_i \Delta y_{t-i} \quad \text{.....(8)}$$

It includes the lagged differences in both x and y, which have a more immediate impact on the value of Δy_t. In explaining changes in a variable,the ECM accounts for its long run relationship with other variable. The coefficient of error-correction term indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long-run equilibrium and if it is positive and zero, the series diverges from equilibrium.

The advantage of the error-correction model is that it allows for short run dynamics as well as an assessment of the degree of convergence towards the long run relation as shown by the cointegration.

Results and Discussion

The integration tests elaborated above were carried out on log weekly wholesale prices of selected markets in India. The evaluation of market efficiency by co-integration analysis

recognizes that the time series of price for various markets are usually non-stationary.Therefore, it is necessary to examine time-series properties of the variables. Further, to establish the long-run equilibrium relation among the price series, it is necessary to co-integrate them. Co-integration among the variables, in turn, requires checking the order of integration among variables and variables cannot be integrated in the presence of unit root, the same can be examined through conducting a stationarity test. The price movement, volatility within the market and integration between market were studied with time series data collected from market committee and AGMARKNET .Augmented Dickey-Fuller test (ADF) was applied to check whether the price series of selected crops are stationary in their level, followed by their first difference.

Integration among Cotton Markets

In economic analysis, it is often assumed that the economic time series are stationary and the relations between stationary series are in the state of equilibrium.For that purpose it is required to identify whether it is stationary series or not.

The Augmented Dickey Fuller (ADF) based unit root test procedure was conducted to check whether the wholesale price series of cotton among different markets such as Akola (Maharastra),Rajkot (Gujrat),Surendranagar (Gujrat),Bathinda (Punjab) and Mansa (Punjab) markets of India are stationary.

It is evidently clear from the results of Table 1 that in the case of cotton prices in levels,the ADF test does not reject the unit root hypothesis at the 5 percent level during the period.In case of the first difference of the series, the hypothesis was however rejected in the period mostly at the one percent level of significance,suggesting that the price series were free from the consequences of unit root.This implied that the price series were stationary at the first difference level.

Table 1: ADF test results of cotton prices in different markets

Markets	At Level	Stationarity	At First difference	Stationarity	Critical values (at 1% level)
Akola	-1.984697	Non-stationary	-7.726356	Stationary	-4.007084
Rajkot	-2.735968	-do-	-11.29436	-do-	
Surendranagar	-2.527728	-do-	-11.07229	-do-	
Bathinda	-2.614903	-do-	-8.895403	-do-	
Mansa	-2.202827	-do-	-10.44084	-do-	

Co-integration among markets

To determine the long run relationship between the price series from a range of five price series, Johansen's Multiple Co-integration test was employed and the results presented in Table 2, reveal that out of five markets, four were cointegrated at 5 per cent level of significance,implying that the selected cotton markets had long-run equilibrium relationship and there existed co integration among these markets. It may be due to market forces or due to producer/seller behavior because co-integration does not require that the long run equilibrium relationship has to be generated by market forces or the behavior of individuals.

Table 2 : Results of Johansen's Co-integration Analysis

Hypothesized No. of CE(S)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob**
None *	0.248631	140.8104	88.80380	0.0000
At most 1 *	0.175814	87.92656	63.87610	0.0001
At most 2 *	0.118620	52.15509	42.91525	0.0047
At most 3 *	0.098059	28.79584	25.87211	0.0210
At most 4	0.051096	9.702749	12.51798	0.1413

Trace test indicates 4 cointegrating eqn(s) at 5 per cent levels,

*denotes rejection of the null hypothesis at 5 per cent levels

Causality in different markets

The causal relationship between the prices series in cotton markets were approached through Granger Causality technique. The results of the analysis showing the relationship between cotton markets are presented in Table **3** and figure 1. The study finds no co-

integration within four pairs of markets (Surendranagar-Akola, Bathinda-Akola, Mansa-Akola , Rajkot-Bathinda,).

Table 3: Results of Pair-wise Granger Causality test results

Null Hypothesis	**Obs**	**F-Statistic**	**Prob**
RAJKOT does not Granger Cause AKOLA		2.52851	**0.0424**
AKOLA does not Granger Cause RAJKOT	188	3.03874	**0.0188**
SURENDRANAGAR does not Granger Cause AKOLA		0.99616	0.4111
AKOLA does not Granger Cause SURENDRANAGAR	188	5.26050	**0.0005**
BATHINDA does not Granger Cause AKOLA		1.87175	0.1175
AKOLA does not Granger Cause BATHINDA	188	4.33177	**0.0023**
MANSA does not Granger Cause AKOLA		1.67935	0.1569
AKOLA does not Granger Cause MANSA	188	2.27534	**0.0631**
SURENDRANAGAR does not Granger Cause RAJKOT		3.26575	**0.0130**
RAJKOT does not Granger Cause SURENDRANAGAR	188	4.15556	**0.0030**
BATHINDA does not Granger Cause RAJKOT		3.98124	**0.0040**
RAJKOT does not Granger Cause BATHINDA	188	1.18522	0.3189
MANSA does not Granger Cause RAJKOT		4.08769	**0.0034**
RAJKOT does not Granger Cause MANSA	188	3.34546	**0.0114**
BATHINDA does not Granger Cause SURENDRANAGAR		4.87080	**0.0009**
SURENDRANAGAR does not Granger Cause BATHINDA	188	2.64465	**0.0352**
MANSA does not Granger Cause SURENDRANAGAR		5.04891	**0.0007**
SURENDRANAGAR does not Granger Cause MANSA	188	3.30387	**0.0122**
MANSA does not Granger Cause BATHINDA		7.52972	**1.E-05**
BATHINDA does not Granger Cause MANSA	188	10.5592	**1.E-07**

The co-integration tests performed indicate only the existence of the long run relationship among the wholesale prices of cotton crop in different markets. The direction of relationship among price series and markets is equally important for which Granger Causality test are performed.Theoretically, a variable is said to Granger-Cause another variable, inferred the flow of information related to prices among different markets.

- Rajkot and Akola market prices have a bidirectional influence.
- Akola market prices influence the prices at Surendranagar market and not vice-versa.
- Akola market prices influence the prices at Bathinda market and not vice-versa.
- Akola market prices influence the prices at Mansa market and not vice-versa.
- Surendranagar and Rajkot market prices have a bidirectional influence.
- Bathinda market prices influence the prices at Rajkot market and not vice-versa.
- Mansa and Rajkot market prices have a bidirectional influence.
- Bathinda and Surendranagar market prices have a bidirectional influence.
- Mansa and Surendranagar market prices have a bidirectional influence.
- Mansa and Bathinda market prices have a bidirectional influence.

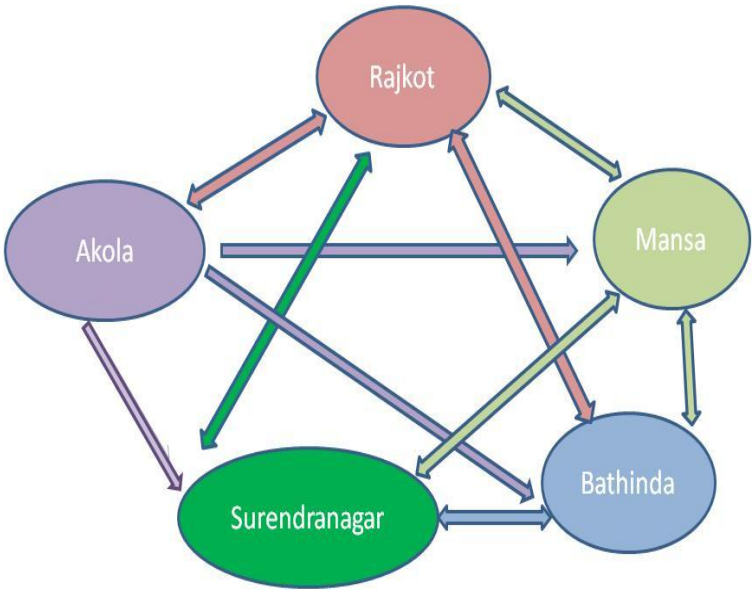

Figure 1 Market integration among cotton markets

Estimation of Vector error correction model

The VECM model is estimated to know how far among the prices from the equilibrium level are and to account for this kind of adjustment vector error correction model could be an approprite tool that takes into account. Different cotton markets are integrated in the long run, it is important to

study the short and long run association for equilibrium among the markets.Hence Vector Error Correction model (VECM) was employed to know the speed of adjustments among markets for long run equilibrium.The Results are shown in Table 4.

The results revealed that in short run Akola market converges to its original equilibrium price level within 19 hours. Rajkot market converges to its original equilibrium price level within 11 hours and Mansa market converges to its original equilibrium price level within 15 hours.In case of the Akola market price model of cotton, the coefficient of 2 week (0.21) lagged and 4 week (0.24) lagged own price was positive and significant.Akola market price model, the coefficient of 1 week (0.47) and 3 week (0.49) lagged Bathinda market price was negative and significant at 5 per cent level.The coefficient of 1 week (0.40) and 3 week (0.35) lagged Mansa market price was positive and significant.In case of long run Akola market price was influenced by the Bathinda market and Mansa market with one and three lag period. Akola market was influenced by its own price too. It means that the price discovery occurred in the markets and was transmitted to Akola market. Rajkot market price model of cotton, the coefficient of 1 week (0.41) lagged Mansa market price was positive and significant at 5 per cent level. In case of Rajkot market, price was influence by Mansa market with with 1 week lag period. It means that the price discovery occurred in the markets and was transmitted to Rajkot market.Surendranagar market price model, the coefficient of 2 week (0.28) lagged Akola market price was positive and significant and the coefficient of 2 week (0.20) lagged own price was negative and significant. The Surendranagar market price was influenced by its own price and Akola market price with 2 week lag period. It means that the price discovery occurred in the markets and was transmitted to Surendranagar market.Bathinda market price model, the coefficient of 1 week (0.44) lagged Mansa market price was positive and significant at 5 percent level.Bathinda market, price was influence by Mansa market with 1 week lag period. It means that the price discovery occurred in the

markets and was transmitted to Bathinda market.Mansa market price model, the coefficient of 1 week (0.15) lagged Akola market price and 1week (0.38) lagged own price was positive and significant. The Mansa market was influenced by Akola market price and its own price too with 1 week lag period. It means that the price discovery occurred in the markets and was transmitted to Mansa market. The kind of adjustment in the short run and long run disequilibrium of prices in the distantly located markets. The results of VECM model show that some of the estimated coefficient are positive for selected markets. The coefficient measure the ability the prices for adjustment to deviation term the long run equilibrium , which could be removed in every period of week.

Table 4: Results of vector error correction model with four lag periods in different markets

Error Correction	**D(AKOLA)**	**D(RAJKOT)**	**D(SURENDRANAGAR)**	**D(BATHINDA)**	**D(MANSA)**
CointEq1	**-0.115234**	**-0.064925**	-0.041265	0.004851	**-0.088247**
	(0.02718)	**(0.03191)**	(0.02908)	(0.01838)	**(0.01987)**
	[-4.24014]	**[-2.03454]**	[-1.41918]	[0.26386]	**[-4.44189]**
D(AKOLA(-1))	0.079954	0.194172	0.122298	0.117821	**0.153690**
	(0.08960)	(0.10521)	(0.09587)	(0.06061)	**(0.06550)**
	[0.89232]	[1.84554]	[1.27573]	[1.94383]	**[2.34634]**
D(AKOLA(-2))	**0.206089**	0.154184	**0.280168**	0.026962	0.043886
	(0.08790)	(0.10321)	**(0.09404)**	(0.05946)	(0.06426)
	[2.34458]	[1.49385]	**[2.97912]**	[0.45344]	[0.68296]
D(AKOLA(-3))	-0.045747	0.008511	0.025541	-0.024850	0.110074
	(0.09041)	(0.10616)	(0.09673)	(0.06116)	(0.06610)
	[-0.50597]	[0.08017]	[0.26403]	[-0.40629]	[1.66537]

D(AKOLA(-4))	**0.242870**	0.049955	0.167613	0.030738	0.112428
	(0.09545)	(0.11207)	(0.10212)	(0.06457)	(0.06977)
	[2.54461]	[0.44574]	[1.64139]	[0.47608]	[1.61133]
D(RAJKOT(-1))	-0.031867	-0.027798	-0.046396	0.009360	0.010792
	(0.08102)	(0.09514)	(0.08668)	(0.05481)	(0.05923)
	[-0.39331]	[-0.29219]	[-0.53523]	[0.17077]	[0.18221]
D(RAJKOT(-2))	-0.135274	-0.147016	-0.040250	-0.054007	-0.082967
	(0.07917)	(0.09296)	(0.08470)	(0.05355)	(0.05787)
	[-1.70872]	[-1.58154]	[-0.47521]	[-1.00847]	[-1.43359]
D(RAJKOT(-3))	0.085943	-0.139409	0.144780	0.012578	0.014047
	(0.07815)	(0.09177)	(0.08361)	(0.05287)	(0.05713)
	[1.09969]	[-1.51917]	[1.73151]	[0.23791]	[0.24587]
D(RAJKOT(-4))	-0.124168	0.087137	-0.039358	0.001842	-0.085710
	(0.07912)	(0.09290)	(0.08465)	(0.05352)	(0.05784)
	[-1.56939]	[0.93795]	[-0.46496]	[0.03441]	[-1.48190]

D(SURENDRANAGAR(-1))	0.093638	0.044098	0.056564	0.041871	0.035569
	(0.08957)	(0.10518)	(0.09583)	(0.06059)	(0.06548)
	[1.04538]	[0.41927]	[0.59023]	[0.69102]	[0.54320]
D(SURENDRANAGAR(-2))	-0.059924	0.048840	**-0.201809**	0.047080	0.071276
	(0.08741)	(0.10263)	**(0.09352)**	(0.05913)	(0.06390)
	[-0.68557]	[0.47587]	**[-2.15799]**	[0.79624]	[1.11546]
D(SURENDRANAGAR(-3))	0.063706	0.102158	-0.103761	0.088398	0.061466
	(0.08642)	(0.10148)	(0.09246)	(0.05846)	(0.06318)
	[0.73713]	[1.00669]	[-1.12217]	[1.51204]	[0.97289]
D(SURENDRANAGAR(-4))	0.001447	-0.081060	-0.151161	-0.084609	-0.052365
	(0.08892)	(0.10441)	(0.09513)	(0.06015)	(0.06500)
	[0.01627]	[-0.77639]	[-1.58895]	[-1.40664]	[-0.80560]
D(BATHINDA(-1))	**-0.466884**	-0.191905	-0.043545	0.057446	-0.049178
	(0.20057)	(0.23551)	(0.21459)	(0.13568)	(0.14663)
	[-2.32773]	[-0.81483]	[-0.20292]	[0.42339]	[-0.33540]

D(BATHINDA(-2))	-0.200493	0.231722	0.072218	-0.129185	-0.177970
	(0.18978)	(0.22284)	(0.20305)	(0.12838)	(0.13874)
	[-1.05643]	[1.03984]	[0.35567]	[-1.00625]	[-1.28278]
D(BATHINDA(-3))	**-0.486965**	0.083188	-0.045338	-0.017947	-0.115813
	(0.16889)	(0.19831)	(0.18070)	(0.11425)	(0.12347)
	[-2.88330]	[0.41948]	[-0.25091]	[-0.15709]	[-0.93803]
D(BATHINDA(-4))	-0.017937	-0.086221	0.197602	0.073148	0.014252
	(0.15304)	(0.17969)	(0.16373)	(0.10352)	(0.11187)
	[-0.11721]	[-0.47982]	[1.20687]	[0.70659]	[0.12740]
D(MANSA(-1))	**0.396087**	**0.410260**	0.312184	**0.438392**	**0.385109**
	(0.16911)	**(0.19857)**	(0.18093)	**(0.11440)**	**(0.12363)**
	[2.34215]	**[2.06604]**	[1.72541]	**[3.83212]**	**[3.11509]**
D(MANSA(-2))	0.125247	-0.286845	-0.122842	0.003438	-0.121147
	(0.16564)	(0.19450)	(0.17722)	(0.11205)	(0.12109)
	[0.75612]	[-1.47478]	[-0.69315]	[0.03068]	[-1.00047]

D(MANSA(-3))	**0.349177**	0.063042	0.065808	0.102184	0.128381
	(0.15746)	(0.18489)	(0.16846)	(0.10652)	(0.11511)
	[2.21757]	[0.34097]	[0.39063]	[0.95933]	[1.11532]
D(MANSA(-4))	-0.156330	-0.129983	-0.179646	-0.176838	-0.161050
	(0.13687)	(0.16072)	(0.14644)	(0.09259)	(0.10006)
	[-1.14215]	[-0.80877]	[-1.22676]	[-1.90991]	[-1.60956]
C	14.96025	4.037354	5.631471	3.304055	8.993037
	(13.3256)	(15.6469)	(14.2570)	(9.01431)	(9.74140)
	[1.12267]	[0.25803]	[0.39500]	[0.36653]	[0.92318]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (-1),(2),(3) and (4) indicate number of lags.

CONCLUSION

This paper conducts robust tests for market integration in wholesale cotton markets in India using co-integration and error correction models on the weekly wholesale prices data collected from April 2010 to march 2014. The cotton is a very important cash crop in India. The study tested, market integration between cotton producer in India, including Gujarat, Maharastra, and Punjab in three market locations. Among the five markets only four markets were cointegrated at 5% level of significant as indicated by λ -max statistic and four markets were cointegrated as per λ-trace-statistic. Given the reliability of λ-max, the conclusion is that only four cointegrated markets were present among five selected cotton markets in India. Based on these results, one can conclude that, even though the cotton markets in India were cointegrated i.e., prices move together, either in an upward or downward direction, but the law of one price does not hold. The results have revealed that the selected markets are cointegrated and converge on the long run equilibrium. The results further suggest that even if there is geographical dispersion of markets, the prices are linked together indicating that all the market locations are in the same economic market system. However, the short run, market prices do deviate from their equilibrium but converge in few days. The Granger Causality Test reveals 6 and 4 bi-directional and uni-directional causations respectively under different market situations.However, no causation is revealed in four markets (Surendranagar- Akola, Bathinda- Akola, Mansa- Akola, Rajkot- Bathinda). Greater integration in these markets may help the farmers through better price signals to increase their production.

REFERENCES

Anonymous (2010) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2011) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2012) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2013) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) *Statistical Abstract of Punjab.* Economic and Statistical Organisation, Government of Punjab.

Banerjee, Anindya, Juan Dolado, John Galbraith and David Hendry (1993) Cointegration, Error correction and the Econometric analysis of non-stationary data, Advanced texts in Econometrics, Oxford University Press, New York,U.S.A.

Barret C.B. (1996), Markets analysis methods: Are our enriched tool kits well suited to Enlivened markets, American Journal of Agricultural Economics,**78** pp825-829.

Clements, Michael and David Hendry (1995), Forecasting in cointegrated system, Journal of applied econometrics **10** pp127-146.

Clements, Michael and David Hendry (1998) Forecasting Economic Processes, International Journal of Forecasting **14** pp 111-131

Clements, Michael and David Hendry (1999) Forecasting Non-stationary economic time series, MIT press, Cambridge, Massachusetts.

Engle R.F. and C.W.J. Granger (1987) Cointegration and Error correction: Representation estimation and testing, Econometrica: Journal of the Econometic Society, **55** pp 251-276.

Granger, Clive W.J. (1981) The comparison of time series and econometric forecasting strategies in J. Kmenta and J.B.Ramsey (Eds.) Large scale macro-Econometric models, Theory and Practice, North Holland pp 123-128

Granger Clive W.J.(1986) Developments in the study of cointegrated Economic variable, Oxford Bullentin of Economics and Statistics, **48**, pp213-228.

Granger Clive W.J. and Andrew A. Weiss (1983) Time series analysis of error-correction models in Karlin, Samuel,Takeshi Amemiya and Leo A. Goodman (Eds.) (1983), Studies in Econometrics, Time series and Multivariate Statistics.Academic press New York, pp255-278.

Golettie F., Raisuddin A. and Farid N (1995) Structural determinants of market integration: The case of rice market in Bangladesh. Developing Economics, **33** pp 185-202.

Harris, R.I.D (1995), Using cointegration analysis in Econometric modeling, Prentice hall, Hemel Hampstead.

Johansen S. (1988) A Statistical Analysis of Cointegration Vectors, Journal of Economic Dynamics and control. **12** pp 231-254.

Johansen S. (1995) Identifying restrictions of linear equations with applications to simultaneous equations and cointegration,Journal of Econometics **69** pp 111-133

Johansen S. (1996) Likelihood-based inference in cointegration vector autoregressive models, second edition, Oxford University Press, Oxford.

Kulendran, N. (1996) Modelling Quarterly Tourism Flows to Australia using cointegration Analysis, Tourism Economics. **2** pp 203-222.

Kumar P and Sharma R (2003) Spatial price integration and pricing efficiency at farm level. *Indian J Agril Econ* **58**(2): 201-17.

Negassa A.,Meyers R. and Maldhin E.G. (2003) Analyzing the grain market efficiency in developing countries: Review of existing methods and extension to the parity bound model, market trade and institutions division,discussion Paper Mo. 63, International Food Policy Research Institute Washington, D.C.,U.S.A.

Nkang, M.N., Hentry M.N. and Gabriel N.O. (2007) Price transmission and integration of cocoa and palm oil markets in cross river state, Nigeria: Implications for rural development, Agricultural Journal **2**: pp 457-463.

Sendhil R, Kar A, Mathur V C and Jha G K (2013) Price discovery, transmission and volatility : Evidence from agricultural commodity futures. *Agril Econ Res Rev* **26**(1): 41-54.

Singh N and Agarwal N L (2000) Market integration for cumin seed in Rajasthan.*Indian J of Agril Mktg* **14**(2): 25-31.

Zapata H., Fortenbery T.R. and Armstrong D. (2005) Price discovery in the world sugar futures and cash markets: Implications for the Dominican republic staff paper 469, Agricultural and applied Economics, University of Wisconsin, Madison.

Integration of Maize Markets in India

Parvinder Jeet Kaur[*], M.K.Sekhon[**] and Subhita Kumawat[***]

ABSTRACT

This paper examines whether the maize markets have become spatially integrated. Wholesale weekly prices of maize collected from five markets during the period of March, 2010 to April, 2014 were used to test the degree of market integration in India. The number of observation became 207 which the data was collected. The error correction technique was employed in the determination of the degree of market integration between the selected States using a four test procedures viz: Augumented Dickey Fuller test to detect for the presence of unit root in the series, Johansen co-integration test for the long run equilibrium relationship among the variables, vector error correction model test (VECM) to capture short-run and long-run changes in the price movements and Granger casualty test to reflect the direction of influence between prices. The Johansen co-integration test indicated that there are about four co-integrating vectors implying that maize markets in India during the study period are moderately linked together and therefore the long-run equilibrium is stable. The short-run market integration as measured by the magnitude of market interdependence and the speed of price transmission between the markets has been weak. The causality test results indicated that though the selected States maize markets drifted apart in the short run, there was smooth transmission of price signals and marketing information.

Key words: Maize, Cointegration, market integration, India
JEL Classification: C22, C32, O53, Q11

INTRODUCTION

Spatial and temporal market integration is an indicator of the efficient functioning of agricultural markets. India has been implementing agricultural liberalization policies since the early 1990s. It has been argued that such market reforms are required for achieving efficient agricultural markets and hence an efficient agricultural production system. Jha and Srinivasan (2000) have argued that such liberalisation is required for achieving allocative efficiency and long-term growth in agriculture. Until agricultural markets are integrated, producers and consumers will not realize the potential gains from liberalization. The term 'spatial market integration' refers to a situation in which the prices of a commodity in spatially separated markets move together and the price signals and information are transmitted smoothly across the markets. Hence, spatial market performance may be evaluated in terms of the relationship between the prices of spatially separated markets, and spatial price behavior in regional markets may be used as a measure of overall market performance.

[*]Ph.D. Scholar and [**]Senior Economist (Marketing), Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141004 (India)
[***] Ph.D. Scholar Department of Agricultural Economics, SKRAU, Bikaner

In this paper an attempt has been made to examine the existence of integration between the markets of maize in India.The maize production during 2013-14 was 24.35 million tons. Punjab has a vast potential in most of its area, to adopt maize as an alternative of paddy crop, which requires a lot of water. It is pertinent to mention here that Punjab was traditionally a maize growing state which changed its status to paddy cultivation during the green revolution era. With changing rural-to-urban population and lifestyles in developing countries, there is a continuous shift to the consumption of wheat, which may influence maize production. Maize is the third most important Kharif season crop after paddy and cotton in Punjab. The area under maize in Punjab has declined from 1.65 lakh hectares in 2000-01 and again declined to 1.30 lakh hectares in 2013-14. With an average productivity of 36.93 quintals per hectare, the total maize production in the state was 4.91 lakh tonnes during 2010-11. Similarly, with an average productivity of 38.98 quintals per hectare, the total maize production in the state was 5.07 lakh tonnes during 2013-14 (Anonymous 2014).

There are several studies that have dealt with the measurement of market cointegration, of agricultural commodity. Silumbu (1992) used monthly wholesale prices to test for the spatial and inter-temporal market integration of maize markets in Malawi and found that the integration of urban markets had increased slightly even under partial liberalization. Goletti and Babu (1994) used different measures of integration and monthly retail maize prices for eight regional markets in Malawi. They concluded that the liberalization of the maize market had increased market integration. Goletti et al. (1995) used weekly wholesale prices of rice to test the structural determinants of market integration in the rice market in Bangladesh and concluded that the degree of rice market integration in Bangladesh is moderate. Baulch et al. (1998) studied the spatial integration and pricing efficiency of the private sector grain trade in Bangladesh and provided econometric evidence suggesting that wholesale markets for rice are in fact well integrated, except for periods of major shortages in domestic production (such as those just after the 1997/98 and 1998/99 *Aman* harvests). Finally, Getnet et al. (2005) studied the spatial equilibrium of grain markets (white teff) in Ethiopia by using the co-integration technique and provided evidence of domestic market integration. Though extensive literature on integration is available, most of it focuses on agricultural commodities. The present study has analyzed the market integration between the markets in India.

METHODOLOGY

Data for the study were obtained from secondary sources. Time series data on the weekly prices of maize required for the study were collected from the market Committees and AGMARKNET of selected markets. Five markets were selected randomly throughout India, viz., Hoshiarpur market (Punjab**),** Nawanshahar market (Punjab)**,** Bangalore market (Karnataka), Vijayanagaram market (A.P.) and Ahmednagar market**s (**Maharastra**).**

Augmented Dickey Fuller Test

The Augemented Dickey-Fuller (ADF) is the test for the unit-root in a time series sample.The autoregressive formulation of the ADF test with a drift term is given by equation (1).

$$\Delta p_{it} = a_0 + \gamma P_{it-1} + \sum_{i=2}^{n} \beta_i \Delta p_{it-j+1} + \varepsilon_t \quad \text{..... (1)}$$

where p_{it} is the price in market i at the time t, $\Delta p_{it} = (p_{it} - p_{it-1})$ and a_0 is the intercept or drift term.The joint hypothesis to check the presence of unit root is: $H_0 : \gamma = a_0 = 0$ using ϕ_1 statistics. Failure of the rejection of null hypothesis means that the series is non-stationary.

Cointegration analysis

For co integration analysis, the Johansen (1988) maximum likelihood estimator was chosen over the Engle and Granger (1987) two step procedure.The Johansen procedure is a multivariate generalization of the Dickey Fuller test and formulation is as follows:

$$p_{it} = A_1 p_{it-1} + \varepsilon_t \quad \text{..... (2)}$$

So that

$$\Delta p_{it} = A_1 p_{it-1} - p_{it-1} + \varepsilon_t \quad \text{.....(3)}$$

$$\Delta p_{it} = (A_1 - I) p_{it-1} + \varepsilon_t \quad \text{.....(4)}$$

$$\Delta p_{it} = \pi p_{it-1} + \varepsilon_t \quad \text{.....(5)}$$

where, p_{it} and ε_t are (n×1) vectors; A_1 is an (n×n) matrix of parameters;I is an (n×n) identity matrix and π is the $(A_1 - 1)$ matrix.

Trace test was used to determine the presence of co integrating relationship between the price series.Using the estimates of the characterstic roots,the test for the number of characteristic roots that are insignificantly diifferent from unity was conducted using the following statistics:

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{n} \ln\left(1 - \hat{\lambda}_j\right) \quad \text{.....(6)}$$

where, λ_j denotes the estimated values of the characteristic roots (eigen value) obtained from the estimated π matrix; and T is the number of usable observations.The Eigen values representing the strength of the correlation between the first difference and error-correction.

Granger causality Test

When a co-integration relationship is present for variables, Granger causality test (Granger,1969) can be used to analyze the direction of this co movement relationship. Whether market p_1 Granger causes market p_2 or vice versa was checked using equation (7):

$$p_{it} = c + \sum_{j}^{n} \left(\phi p_{1t-j} + \delta_j p_{2t-j}\right) + \varepsilon_t \quad \text{.....(7)}$$

A simple test of the joint significance of δ_j was used to check the Granger causality, i.e. $H_0 : \delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$

Vector Error Correction Model

Vector Error Correction Model (VECM) to find the short-term disturbance and the adjustment mechanism to estimate the speed of adjustment.The ECM explains the difference in y_t and y_{t-1} (i.e.Δy_i) by equation (8):

$$\Delta y_t = a + \mu\left(y_{t-1} - \beta x_{t-1}\right) + \sum_{i=0}^{i=1} \delta_i \Delta x_{t-i} + \sum_{i=1}^{i=t} \gamma_i \Delta y_{t-i} \quad \text{.....(8)}$$

It includes the lagged differences in both x and y, which have a more immediate impact on the value of Δy_t. In explaining changes in a variable,the ECM accounts for its long run relationship with other variable. The coefficient of error-correction term indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long-run equilibrium and if it is positive and zero, the series diverges from equilibrium.

RESULTS AND DISCUSSION

Market Integration among maize Markets

The integration tests elaborated above were carried out on log weekly prices of wholesale markets in India. These tests have been used to study the integration of markets. To avoid spurious results, there is a need to check whether the variables are stationary or not. Therefore, it is necessary to examine time-series properties of the

variables. Further, to establish the long-run equilibrium relation among the price series, it is necessary to co-integrate them. Co-integration among the variables, in turn, requires checking the order of integration among variables and variables cannot be integrated in the presence of unit root, the same can be examined through conducting a stationarity test. The price movement, volatility within the market and integration between market were studied with time series data collected from market committee and AGMARKNET .Augmented Dickey-Fuller test (ADF) was applied to check whether the price series of cotton crop are stationary in their level, followed by their first difference.

Augmented Dickey Fuller Test:

The evaluation of market efficiency by co-integration analysis recognises that the time series of prices for various markets are usually non-stationary variables (Shen and Wang, 1990; Fortenbery and Zapata 1993, Wang and Ke,2005) and if these series are found to be non-stationary then it becomes necessary to test them for co-integration, which is a pre condition for market efficiency and un-biasness (Kellard *et al,* 1999)

As a prerequisite to conducting the co-integration tests, we have evaluated the univariate time-series properties of the data to see whether all the prices are non-stationary and integrated of the same order.The Augmented Dickey Fuller based unit root test procedure is done to check whether the price series of maize are stationary or not. It is clear from the Table 1 that in the case of maize prices in levels, the ADF test does not reject the unit root hypothesis at 5 percent level during the periods. In case of the first difference of the series, the hypothesis was, however, rejected in the periods mostly at the one percent level. Thus,all the five price series of crop were stationary of the first difference level.

Table 1 : ADF test results of maize prices in different markets

Markets	**At Level**	**Stationarity**	**At First difference**	**Stationarity**	**Critical values (at 1% level)**
Hoshiarpur	-2.978605	Non-stationary	-16.26267	Stationary	-4.003005*
Nawanshahar	-3.153475	-do-	-18.89196	-do-	
Banglore	-2.585512	-do-	-16.42697	-do-	
Vijayanagaram	-3.325581	-do-	-13.94975	-do-	
Ahmednagar	-3.393945	-do-	-12.94556	-do-	

* Significant at 1 per cent level

Results of Johansen Co-integration Test

Based on the Johansen multiple co-integration procedure, co-integration between the markets was analyzed using E-Views software. Both the Maximum Eigenvalue test and trace test results indicate the presence of four co-integrating vectors at the five per cent significance level. This implies that all the five markets were in fact cointegrated and had a common sharing information on price changes in the long run. The above empirical evidence suggests that all the markets do exhibit a long run relationship .The results are presented in Table 2.

Table 2 : Results of Johansen Co-integration Analysis

Hypothesized No. of CE (S)	Eigenvalue	Trace Statistic	0.05 value	Prob**
None *	0.184464	122.6659	88.80380	0.0000
At most 1 *	0.129937	82.29181	63.87610	0.0007
At most 2 *	0.107347	54.73237	42.91525	0.0022
At most 3 *	0.098972	32.24793	25.87211	0.0070
At most 4	0.056963	11.61260	12.51798	0.0705

Trace test indicates 4 cointegrating eqn(s) at the 5 percent level

* denotes rejection of the hypothesis at the 5 percent level

Results of Granger Causality Test

The causal relationship between the prices series in major maize markets were approached through Granger Causality technique. The results of the analysis showing the relationship between major maize markets are presented in Table 3 that the Hoshiarpur market price has depicted a unidirectional causality on the prices of Nawanshahar and Banglore, except no causality between Hoshiarpur and Vijayanagaram, Hoshiarpur and Ahmednagar. Nawanshahar market price has shown a unidirectional influence on the price of Banglore,except no causality between Nawanshahar and Hoshiarpur, Nawanshahar and Vijayanagaram , Nawanshahar and Ahmednagar.Banglore market price has shown a bidirectional influence on the price of Ahmednagar,except no causality between Banglore and Hoshiarpur,Banglore and Nawanshahar, Banglore and Banglore andijayanagaram. Vijayanagaram market price has shown unidirectional influence on the price of Ahmednagar, except no causality between Vijayanagaram and Hoshiarpur, Vijayanagaram and Nawanshahar, Vijayanagaram and Banglore. Ahmednagar market price has shown a bidirectional

influence on the price of Banglore,except no causality between Ahmednagar and Hoshiarpur, Ahmednagar and Nawanshahar, Ahmednagar and Vijayanagaram.

Table 3 : Results of Pairwise Granger Causality Tests in different markets

Market	Hoshiarpur	Nawanshahar	Banglore	Vijayanagaram	Ahmednagar
Hoshiarpur	1	→	→	x	x
Nawanshahar	x	1	→	x	x
Banglore	x	x	1	x	↔
Vijayanagaram	x	x	x	1	→
Ahmednagar	x	x	↔	x	1

Note: ↔ : Bidirectional, → : Unidirectional and x: No causality

Speed of adjustments in long run equilibrium

Since the maize markets are integrated in the long run, it is important to study the short run and long run equilibrium among the markets. Hence Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium and results of the same presented in Table 5.

The coefficient of the error correction term indicates the speed of convergence to the long run growth path as a result of a shock in their own price. The coefficients show how quickly variables return back to equilibrium. The Table 5 clearly shows that the co-integration equation of error correction mechanism is significant in all the five markets. It is the revealed from the analysis that, any disturbance in price will get corrected in about 10 hours in Banglore around 11 hours in Ahmednagar. In all the selected markets, the prices were influenced by their own weekly lags for long run equilibrium. In addition,in the long run the price changes in Hoshiarpur market, the prices are influenced to the extent of 29 per cent by one week lag price of Banglore. In the long run the price changes in Banglore market are influenced to the extent of 12 per cent by one week back prices of market Hoshiarpur market . In the long run the price changes in Ahmednagar market are influenced to the extent of 11 per cent by one week back prices of market Hoshiarpur market respectivily.

Table 5 : Results of vector error correction model with four lag periods in different markets

Error Correction:	D(HOSHIARPUR)	D(NAWANSHAHAR)	D(BANGLORE)	D(VIJAYANAGARAM)	D(AHMEDNAGAR)
CointEq1	-0.012899	-0.000225	**0.055702**	0.017947	**-0.062757**
	(0.02350)	(0.02979)	**(0.01561)**	(0.00987)	**(0.01442)**
	[-0.54880]	[-0.00756]	**[3.56838]**	[1.81915]	**[-4.35314]**
D(HOSHIARPUR(-1))	-0.106482	0.090997	**-0.124408**	-0.039442	**0.110629**
	(0.07487)	(0.09490)	**(0.04972)**	(0.03143)	**(0.04592)**
	[-1.42231]	[0.95887]	**[-2.50213]**	[-1.25510]	**[2.40918]**
D(HOSHIARPUR(-2))	0.003162	0.109486	-0.041266	-0.041822	0.070707
	(0.07752)	(0.09827)	(0.05149)	(0.03254)	(0.04755)
	[0.04079]	[1.11415]	[-0.80151]	[-1.28523]	[1.48703]
D(HOSHIARPUR(-3))	**0.166463**	0.480121	-0.084209	0.003741	-0.040680
	(0.07556)	(0.09578)	(0.05018)	(0.03172)	(0.04634)
	[2.20315]	[5.01292]	[-1.67815]	[0.11796]	[-0.87779]
D(NAWANSHAHAR (-1))	-0.042194	**-0.303853**	-0.051994	-0.008721	-0.036888
	(0.05714)	**(0.07244)**	(0.03795)	(0.02399)	(0.03505)
	[-0.73839]	**[-4.19481]**	[-1.37003]	[-0.36358]	[-1.05244]
D(NAWANSHAHAR (-2))	-0.012046	-0.059349	-0.032887	0.013855	-0.027121
	(0.05843)	(0.07407)	(0.03881)	(0.02453)	(0.03584)
	[-0.20614]	[-0.80125]	[-0.84745]	[0.56487]	[-0.75671]
D(NAWANSHAHAR (-3))	-0.010028	0.007039	-0.053428	0.029725	0.003982

	(0.05524)	(0.07003)	(0.03669)	(0.02319)	(0.03389)
	[-0.18152]	[0.10052]	[-1.45619]	[1.28184]	[0.11750]
D(BANGLORE(-1))	0.089700	-0.176656	-0.132664	-0.028539	-0.026440
	(0.10740)	(0.13614)	(0.07133)	(0.04508)	(0.06588)
	[0.83519]	[-1.29758]	[-1.85990]	[-0.63306]	[-0.40136]
D(BANGLORE(-2))	0.019742	-0.127718	**-0.140906**	0.009312	0.077313
	(0.10568)	(0.13396)	**(0.07019)**	(0.04436)	(0.06482)
	[0.18681]	[-0.95341]	**[-2.00762]**	[0.20991]	[1.19273]
D(BANGLORE(-3))	**-0.295455**	0.016501	0.068202	-0.016756	0.039477
	(0.10273)	(0.13022)	(0.06823)	(0.04312)	(0.06301)
	[-2.87597]	[0.12672]	[0.99962]	[-0.38858]	[0.62650]
D(VIJAYANAGARAM(-1))	0.265506	0.028405	0.215949	0.018074	-0.051563
	(0.17395)	(0.22050)	(0.11553)	(0.07302)	(0.10670)
	[1.52630]	[0.12882]	[1.86923]	[0.24754]	[-0.48327]
D(VIJAYANAGARAM(-2))	-0.099402	-0.023705	0.050568	0.088272	-0.159533
	(0.17569)	(0.22271)	(0.11668)	(0.07375)	(0.10776)
	[-0.56578]	[-0.10644]	[0.43339]	[1.19697]	[-1.48042]
D(VIJAYANAGARAM(-3))	-0.121595	-0.054019	0.092180	0.075323	0.050360
	(0.17637)	(0.22357)	(0.11714)	(0.07403)	(0.10818)
	[-0.68942]	[-0.24162]	[0.78695]	[1.01743]	[0.46552]
D(AHMEDNAGAR(-1))	0.086529	-0.007201	0.034089	-0.061745	**0.227565**

	(0.12142)	(0.15391)	(0.08064)	(0.05097)	**(0.07447)**
	[0.71264]	[-0.04679]	[0.42274]	[-1.21149]	**[3.05561]**
D(AHMEDNAGAR(-2))	0.077113	0.004930	0.132835	0.024860	-0.001307
	(0.12142)	(0.15391)	(0.08064)	(0.05097)	(0.07447)
	[0.63510]	[0.03203]	[1.64728]	[0.48777]	[-0.01755]
D(AHMEDNAGAR(-3))	-0.122100	-0.126066	0.027622	-0.012433	0.075675
	(0.12192)	(0.15455)	(0.08097)	(0.05118)	(0.07478)
	[-1.00145]	[-0.81569]	[0.34112]	[-0.24294]	[1.01192]
C	2.087142	2.280837	1.419029	2.419720	2.129661
	(4.21595)	(5.34416)	(2.79995)	(1.76965)	(2.58590)
	[0.49506]	[0.42679]	[0.50680]	[1.36734]	[0.82357]

Note: D is the difference, 1n is the natural logarithm,C is the constant, and (1),(2) and (3) indicate number of lags.

CONCLUSION

Using weekly wholesale market price data for the period april, 2010 to march,2014 from five markets in India, this study has extent of market integration The overall results of the market integration analysis in India indicate that, although the five markets in India are co-integrated- meaning that they have a stable long run relationship—these markets are also integrated in the short run. The results from trace statistics show that there are four co-integrating vectors and four common trends, which suggest that maize markets are stationary in four directions and non-stationary in four directions. Granger-causality results indicated that Hoshiarpur market price has depicted a unidirectional causality on the prices of Nawanshaar.Nawanshahar market price has shown a unidirectional influence on the price of Banglore. Banglore market price has shown a bidirectional influence on the price of Ahmednagar. Vijayanagaram market price has shown unidirectional influence on the price of Ahmednagar. Ahmednagar market price has shown a bidirectional influence on the price of Banglore. The short-run results indicate that these maize markets are not well integrated while long-run integration is evident, suggesting that the markets do eventually move together in the long term.

The spread of adjustment appears to be the inverse of distance and directly related with ease of transport. The policy implications of these results is that structural rigidity resulting from poor infrastructure and insufficient transportation networks hampers the easy flow of information between markets and therefore the integration of markets in the short run. Thus, in order for rice surplus regional markets to be better integrated with deficit regions, the government should invest in better transportation and infrastructure facilities.

REFERENCES

Anonymous (2010) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2011) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2012) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2013) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) AGMARKNET (Agricultural Marketing Information Network). Available at: http://www.agmarknet.nic.in

Anonymous (2014) Statistical Abstract of Punjab. Economic and Statistical Organisation, Government of Punjab.

Baulch, R., Das, J., Jain, W. M. H., Farid, N. and, Zohir S. (1998). The Spatial Integration and Pricing Efficiency of the Private Sector Grain Trade in Bangladesh. Phase I and II report. Bangladesh Institute of Development Studies. Bangladesh Agricultural University and University of Sussex.

Engle, R. F. & Granger, C. W. J. 1987. Cointegration and Error Correction: Representation, Estimation and Testing, *Econometrica*, **55**, 251-276.

Fortenbery T.R. and H.O.Zapata (1993), An Examination of co-integration relations between futures and local Grain markets, The Journal of furures markets **13** pp 921-932.

Getnet, K., Verbeke, W., and Viaene, J. (2005). Modeling Spatial Price Transmission in the Grain Markets of Ethiopia with an application of ARDL approach to White Teff. *Agricultural Economics.* **33**(3), 491-502.

Goletti, F., and Babu, S. (1994). Market Liberalization and Integration of Maize Markets in Malawi. *Agricultural Economics*, **11** (2/3), 311-24.

Goletti, F., Ahmed, R., and Farid, N. (1995). Structural Determinants of Market Integration: The Case of Rice Markets in Bangladesh. *The Developing Economics*, **33**(2), 185-202.

Jha, S., and P.V. Srinivasan (2000), Liberalisation of Foodgrain Markets: Implications for Food Security and Price Stability, in N. Krishnaji and T.N. Krishnan eds., *Public Support for Food Security: The Public Distribution System in India*, New Delhi: Sage Publications, 144-179.

Johansen S. (1988) A Statistical Analysis of Cointegration Vectors, Journal of Economic Dynamics and control. **12**,pp 231-254.

Kellard N.,P. Newbold, T Rayner and C. Ennew (1999) "The Relative efficiency of commodity Futures Markets" The Journal of Future markets 4 pp 413-4 The Journal of Future markets **4** pp 413-432

Shen, C and L.Wang (1990), "Examining the validity of a test of futures Market efficiency:A comment" The Journal of Futures Markets **10**,pp 195-196

Silumbu, A. (1992). Changing Marketing Environment, Emerging Pricing Issues and

Policy in Malawi, in J.B. Wyckoff and Mandivamba Rukuni (eds.) *Food Security Research in Southern Africa: Policy Implications*. University of Zimbabwe/Michigan State University. Food Security Research in South Africa Project. Department of Agricultural Economics and Extension. Harare.

Wang and B Ke (2005) "Efficiency tests of Agricultural Commodity Futures Markets in China", The Australian Journal of Agricultural and Resource Economics **49**,pp 125-141

VITA

Name of the Student	:	Parvinder Jeet Kaur
Father's Name	:	S. Malkeet Singh
Mother's Name	:	Smt. Simarjeet Kaur
Nationality	:	Indian
Date of Birth	:	05-05-1986
Permanent home address	:	V.P.O. Bazidpur, Bhoma, Teh. Abohar, Distt. Fazilka, Punjab-152116
Email id	:	parvinderbrr@gmail.com

EDUCATIONAL QUALIFICATION

Bachelor's Degree	:	B.Sc. (Agriculture)
University and Year of Award	:	S.K. Rajasthan Agricultural University, Bikaner, Rajasthan, 2009
% Marks	:	65%
Master's Degree	:	M.Sc. (Agriculture Economics)
University and Year of Award	:	S.K. Rajasthan Agricultural University, Bikaner, Rajasthan, 2011
% Marks	:	78.02%
Ph.D. Degree	:	Ph.D. (Agriculture Economics)
OCPA	:	7.00/10
Title of Ph.D.'s Dissertation	:	"Integration and Efficiency of Markets for Important Crops in Punjab"
University and Year of Award	:	Punjab Agricultural University, 2015