PRODUCTION, PRICE AND EXPORT POLICY OF ONION IN INDIA – AN EXPLORATORY ANALYSIS

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2023

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Thesis submitted to the

University of Agricultural Sciences, Bangalore

in partial fulfillment of the requirements for the

Degree of

Master of Business Administration

in

AGRIBUSINESS MANAGEMENT

By

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UNIVERSITY OF AGRICULTURAL SCIENCES BANGALORE

2023

INSTITUTE OF AGRI-BUSINESS MANAGEMENT
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BANGALORE

CERTIFICATE

This is to certify that the thesis entitled "**PRODUCTION, PRICE AND EXPORT POLICY OF ONION IN INDIA – AN EXPLORATORY ANALYSIS**" submitted in partial fulfilment of the requirements for the degree of **Master of Business Administration** in **Agribusiness Management** to the University of Agricultural Sciences, Bangalore is a record of bona fide research work carried out by **Ms. SOUNDARYA, G., MBAM 0030** during the period of her study in this University under my guidance and supervision. The thesis work has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bengaluru
March, 2023

(M. ARUN)
Major Advisor

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Chairman: .....
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3. .....
(PRADEEPABABU, B. N.)


Affectionately Dedicated to
My Beloved Family Members
and My Guide

ACKNOWLEDGEMENT

It's my pleasure to glance back and recall the path I travelled during the days of hard work and perseverance. This is the result of two years of work, whereby I have been accomplished, supported, and guided by many people. It is my heart's turn to express deepest sense of gratitude to all of those who directly or indirectly lent a helping hand in this endeavor.

First and foremost, I would like to praise and thank God, the Almighty, who has granted me countless blessing, knowledge, opportunities, and for gracing the peaceful atmosphere during the course of my study.

I express my heartfelt gratitude to my revered teacher, guide, and Chairman of the Advisory Committee - ***Dr. M. Arun****, Assistant Professor of Agricultural Economics, College of Horticulture (UHS Campus) UHS B Campus, GKVK, Bengaluru, for his invaluable guidance, unwavering support, close counselling, and valuable suggestions throughout my study. His interest, enthusiasm, concern, perfection, and constructive comments have always aroused my spirits to do more and to achieve higher heights. It was indeed a great pleasure and privilege to be under his guidance. I am forever grateful and indebted to him.*

I am overwhelmed with sincere feeling of indebtedness to Member of my Advisory Committee - ***Dr. Mamatha Girish****, Assistant Professor (Senior Scale), Department of Agricultural Marketing, Co-operation and Business Management, UAS, GKVK, Bengaluru, for her subtle guidance, constant encouragement, support and inspiration. She contributed her vast knowledge to complete this task in a resplendent way.*

I am profoundly grateful to Member of my Advisory Committee - ***Dr. C. P. Gracy****, Professor (Retd.), Department of Agricultural Marketing, Co-operation and Business Management, UAS, GKVK, Bengaluru, for her precious guidance, creative comments, and encouragement throughout the period of study.*

I am immensely thankful to Member of my Advisory Committee - ***Dr.Pradeepababu, B. N.****, subject matter specialist-Agricultural Economics, Market Intelligence Unit, Coffee Board, Bengaluru, for his subtle guidance and prodigious help throughout my research period.*

*My deepest gratitude to **Dr. Lalith Achuth**, Professor, Department of Economics, UAS, GKVK, Bengaluru and **Dr. Hanumanth**, Department of Statistics for providing his guidance and his selfless help throughout my research period.*

I greatly acknowledge the co-operation and help extended by all the teachers of Department of Agricultural Marketing, Co-operation and Business Management, University of Agricultural Sciences, GKVK, Bengaluru, for their valuable suggestions and support during the course of investigation.

*I would like to convey my deep sense of gratitude to my beloved parents who have been a source of inspiration, **Sri. Gangadharaih, B. R.** and **Smt. Manjula, B. M.**, for their never-ending love, affection, constant support, and encouragement throughout my life. Their blessings have renewed me every day, all the way on the journey throughout my Master's degree programme. I also place my humble gratitude to my sweet sister **Aishwarya, G**. Their understanding, firm and kind-hearted personality encouraged me to work hard, to be steadfast and to never bend to difficulty.*

*I owe special thanks to my dearest friends **Sindhu Prasad, G. P., Supriya, S.** and **Sushma N. N.** for their unconditional love and support from the UG days.*

*The thesis must surely bear the imprint of love and affection showered on me by my friends. I am ever grateful to my dearest friends and classmates, **Supriya, Priyanka, Shirisha, Poojitha, Nidhi and Chandhana** for moral support in this journey and their quality time in helping me in bringing this thesis work to a definite form and being close to me, and making my life a memory to be cherished and they deserve a more personal note of gratitude.*

Any omission in this brief acknowledgment does not mean lack of gratitude.

Bengaluru
March 2023 *(Soundarya, G.)*

Analysis of Temporal and Spatial Pattern of Onion Production in India

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Introduction

Onion is commercially grown in many parts of the country, major producers being Maharashtra, Karnataka, Madhya Pradesh, Rajasthan, Bihar, Gujrat, etc. India stands first in terms of area and second in global production, next to China. Onions from India are famous for its pungency. Growing onion is done for three purposes. One is to harvest fresh onion, Onion bulb production and for onion seed production Kulakarani *et al.* (2012).

Onion is produced throughout the year in three different seasons, Kharif (planted between July-August and harvested in October-December); late Kharif (planted between October-November and harvested in January-March); and Rabi (planted between December-January and harvested in March-May). The share of these three seasons in total onion production is Rabi – 70 per cent, Kharif – 20 per cent, and late Kharif – 10 per cent. This study attempts to analyze temporal and spatial pattern of Onion production in India. This distribution across seasons is hampered majorly by the climatic distortions in terms of heavy downpour submerging the crop and thus hampering production.

Objective

To analyze temporal and spatial pattern of onion production in India.

Methodology

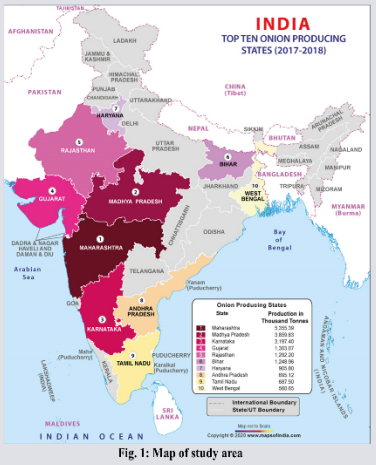

Fig. 1: Map of study area

Study area: Onion producing states

Sampling technique : Top ten onion producing states by their per cent share in total production.

Source of data:
Secondary data is collected from NHB, APEDA website.
Ministry of Agriculture and Farmers' Welfare website

Analytical tools and techniques:
Tabular Analysis, Compound Annual Growth Rate.

Results and Discussion

Table 1: Compound Annual Growth Rate of Production, Area and Productivity of Onion crop

Year	Total Area ('000 HA)	Total Production (000 MT)	Total Productivity (MT/HA)
2010	1063.8	15117.7	14.21
2011	1087.2	17511.1	16.11
2012	1051.5	16813	15.99
2013	1203.6	19401.7	16.12
2014	1173.35	18927.41	16.13
2015	1320.04	20931.21	15.86
2016	1292.61	22409.24	17.34
2017	1315.24	22071.24	16.78
2018	1219.25	22819.43	18.72
2019	-	26091.38	-
2020	-	26641.02	-
CAGR	2.74***	5.38***	2.30***
R square	0.67	0.95	0.71

Note: *** significance level 1%

Table 2: Season-wise Onion Production in India

(Production in Lakh tonnes)

Year	Kharif season	Late Kharif season	Rabi season	Total
2014	29 (15.34)	38 (20.11)	122 (64.55)	189
2015	31 (14.83)	42 (20.10)	136 (65.07)	209
2016	34 (15.18)	45 (20.09)	145 (64.73)	224
2017	35 (15.09)	46 (19.83)	151 (65.09)	232
2018	48.41 (21.21)	21.5 (9.42)	158.3 (69.36)	228.19
2019	39 (15.36)	15.74 (6.20)	199.2 (78.44)	253.94

Note: per cent share of seasons to production is denoted within parenthesis.

Table 1: Area under onion hovered around 1 to 1.3 million ha during the last decade, highest being in the years 2015 and 2017 and witnessed a considerable inter-year variation. Production of onion, in general, observed a increasing trend from 15 million tonnes in 2010 to 26.6 million tonnes in 2020.

Compound Annual Growth Rate (CAGR) for Area, Production and Productivity of onion in India during 2010-18 depicts that onion production grew at an annual rate of 5.38% with contribution from growth in area (2.74%p.a.) as well as Productivity (2.30%p.a.). All the 3 growth rates were significant at 1% level, while the growth model showed a considerable goodness of fit (R^2).

Table 2: Onion production in India being undertaken in 3 seasons viz., Kharif, Late Kharif and Rabi, it is majorly concentrated in Rabi season (65-78% during 2014 to 2019). Production of rabi onion is showing a upbeat during the last five years mainly due to the decline in production of late-kharif onion. The decline could be mainly due to the occurrence of flood, especially during the last few years.

In terms of percentage, the kharif onion production has retained a share of around 15% (except in year 2018 during which it was 21%). It should also be noted that in kharif season, onion production is majorly concentrated in the southern states of Karnataka, Andhra Pradesh and Tamil Nadu.

Graphs and Photographs

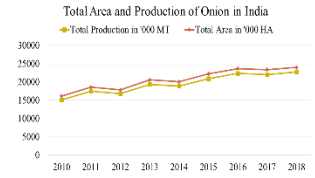

Fig. 2: Total area and production of Onion in India

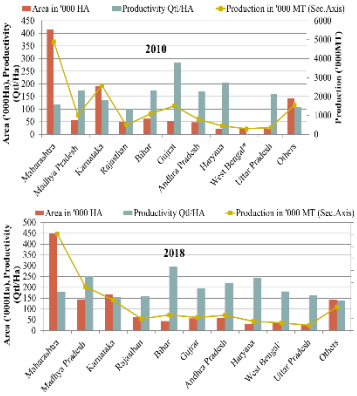

Fig. 3: Area, Production and productivity of Onion among top producing Indian states in 2010 and 2018

Note: *West Bengal data of the year 2011

Summary

Onion production in India has increased about two fold (15 to 26.6 million tonnes) during the last decade, at an annual rate of 5.38%, led by over 2% annual growth in area and productivity. This has been achieved despite adverse weather conditions especially during Kharif season. Though there is a considerable growth in production, it is majorly concentrated in the states of Maharashtra (42.73%), Madhya Pradesh (15.23%), Karnataka (8.93%), Gujrat (8.21%) and Rajasthan (4.65%). Maharashtra leads not only production but also by area. Even productivity numbers for the state is one of the highest in the country.

Across seasons, Rabi onion production recorded a gain, increasing its share from 65% to 78%, mainly due to the decline in production of onions in Late-Kharif. Kharif onion production is stable at around 15%, being predominantly produced in the southern states of Karnataka, Andhra Pradesh and Tamil Nadu, which have been traditional belts. The study finds the need for addressing flood damage of onion crop during late-kharif season, so as to sustain onion supply during off-peak seasons.

References

KULAKARANI, B. S., PATIL, S. M. AND RAMACHANDRA, V. A., 2012, Growth trends in area, production and export of onion from India – an economic analysis, *International Journal of Commerce and Business Management*, **5**(2): 159-163.

PRODUCTION, PRICE AND EXPORT POLICY OF ONION IN INDIA – AN EXPLORATORY ANALYSIS

SOUNDARYA G

ABSTRACT

Demand for onion being uniform, its production is season bound – Rabi-70%, Kharif-30%. Heavy downpour during standing crop contracts production, leading to price surge. Minimum Export Price (MEP) has been employed by government consistently for over a decade. This study analyzes effectiveness of MEP policy, explores changes in onion production pattern across Indian states and assesses impact of MEP on Export Unit Value (EUV). This study used secondary data on month-wise export, CPI, MEP, EUV and analyzed using Compound Annual Growth Rate, Linear Regression, Seasonality Index and ARIMA – Xreg function. Productivity growth of onion (2.30%) and area expansion (2.74%) led to increased production (5.36%). Onion production is concentrated in rabi (3.72%). Top ten states with more than 85% acreage, contributes 70-80% of total onion production. Maharashtra (Rabi - 33-35%) and Karnataka (Kharif 13-18%) are key contributors. Onion prices remained higher during off seasons (September to February), while slumping in peak rabi onion harvest months (April-July) with the trend getting more prominent of late. With X-reg ARIMA coefficient value close to zero (0.5), MEP indicated a positive and statistically significant influence on CPI. It was noted that India is a major rabi exporter (9.6 lakh tonnes, 27%) of onion with the small share in kharif (2.80 lakh tonnes, 7%) and late kharif (2.63 lakh tonnes, 5%) season. The regression results revealed MEP to be directly influencing the EUV, while opposite being true about export quantity. Study observes the need for season-wise compilation of onion production statistics for a meaningful policy analysis.

March 2023

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(M ARUN)
Major Advisor

ಭಾರತದಲ್ಲಿ ಈರುಳ್ಳಿ ಉತ್ಪಾದನೆ, ಬೆಲೆ ಮತ್ತು ರಫ್ತು ನೀತಿಯ ಕುರಿತು ಪರಿಶೋಧನಾತ್ಮಕ ವಿಶ್ಲೇಷಣೆ

ಸೌಂದರ್ಯ, ಜಿ

ಸಾರಾಂಶ

ಭಾರತದಲ್ಲಿ ಈರುಳ್ಳಿ ಬೇಡಿಕೆಯು ವರ್ಷವಿಡೀ ಒಂದೇ ತೆರನಾಗಿದ್ದು, ಅದರ ಬೆಳೆ ಹಂಗಾಮು ವರ್ಷದ ಎರಡು ಪ್ರಮುಖ ಬೆಳೆ ಕಾಲಮಾನಗಳಾದ ಹಿಂಗಾರು (70%) ಮತ್ತು ಮುಂಗಾರು (30%) ಮಾತ್ರವೇ ಆಗಬೇಕಾಗಿರುವುದರಿಂದ, ಹವಾಮಾನ ಅಥವಾ ಇನ್ನಾವುದೇ ವೈಪರಿತ್ಯಗಳ ಕಾರಣಕ್ಕೆ ಉತ್ಪಾದನೆ ಕುಂಠಿತವಾದಲ್ಲಿ ಬೇಡಿಕೆ ಮತ್ತು ಪೂರೈಕೆಗಳ ನಡುವೆ ವ್ಯತ್ಯಾಸ ಉಂಟಾಗುತ್ತದೆ. ವಿಶೇಷವಾಗಿ ಮುಂಗಾರಿನ ಈರುಳ್ಳಿ ಬೆಳೆಯುವ ಮತ್ತು ಕೊಯ್ಲಿನ ಸಂದರ್ಭದಲ್ಲಿ (ಸೆಪ್ಟೆಂಬರ್–ಅಕ್ಟೋಬರ್) ಸುರಿಯುವ ಧಾರಾಕಾರ ಮಳೆ ಹಾಗೂ ಪ್ರವಾಹ ಪರಿಸ್ಥಿತಿಯಿಂದ ಉತ್ಪಾದನೆಯಲ್ಲಾಗುವ ವ್ಯತ್ಯಯವು ಇತ್ತೀಚಿನ ದಶಕದಲ್ಲಿ ಸರ್ವೇಸಾಮಾನ್ಯವಾಗಿದ್ದು, ಅಂತಹ ಸಂದರ್ಭದಲ್ಲಿ ಬೆಲೆ ತೀವ್ರವಾಗಿ ಏರುತ್ತದೆ. ಭಾರತವು ಈರುಳ್ಳಿಯ ಪ್ರಮುಖ ಬಳಕೆದಾರನಷ್ಟೇ ಅಲ್ಲದೆ, ಅಧಿಕ ಉತ್ಪಾದಕ ಹಾಗೂ ರಫ್ತುದಾರನೂ ಆಗಿದ್ದು, ಸಾಮಾನ್ಯವಾಗಿ ಇದರ ರಫ್ತು ಅನಿರ್ಬಂಧಿತವಾಗಿರುತ್ತದೆ. ಮೇಲೆ ತಿಳಿಸಿರುವ ಬೆಲೆ ಏರಿಕೆಯ ಸಂದರ್ಭಗಳಲ್ಲಿ ಕೈಗೊಳ್ಳುವ ಈರುಳ್ಳಿ ರಫ್ತು, ಪೂರೈಕೆ ಕೊರತೆಯನ್ನು ಹೆಚ್ಚಿಸುವುದರಿಂದ, ಬೆಲೆ ಏರಿಕೆ ಮತ್ತೂ ತೀವ್ರಗೊಳ್ಳುತ್ತದೆ. ಇಂತಹ ಸಂದರ್ಭಗಳಲ್ಲಿ ಬೆಲೆ ಏರಿಕೆ ನಿಯಂತ್ರಿಸಲು ಭಾರತವು ಕನಿಷ್ಟ ರಫ್ತು ಬೆಲೆ (ಎಂಇಪಿ) ನೀತಿಯನ್ನು ಕಳೆದ ಒಂದೂವರೆ ದಶಕಗಳಿಂದ ಸಮಯೋಚಿತವಾಗಿ ಬಳಸುತ್ತಿದೆ. ಕಳೆದ ದಶಕದಲ್ಲಿ ಭಾರತದಲ್ಲಿ ಈರುಳ್ಳಿ ಉತ್ಪಾದನೆ (5.36%) ಏರಿಕೆಯು, ಇದರ ಬೆಳೆ ವಿಸ್ತೀರ್ಣ (2.74%) ಮತ್ತು ಉತ್ಪಾದಕತೆ (2.3%)ಗಳಲ್ಲಿನ ಏರಿಕೆಯ ಸಂಯುಕ್ತ ಫಲಿತಾಂಶವಾಗಿರುವುದನ್ನು ಮನಗಂಡಿದೆ. ಹಿಂಗಾರು ಈರುಳ್ಳಿ ಉತ್ಪಾದನೆಯು ವರ್ಷಂಪ್ರತಿ ಶೇ. 3.72 ದರದಲ್ಲಿ ಏರಿಕೆ ಕಾಣುತ್ತಿದ್ದು, ಪ್ರಮುಖ ಹತ್ತು ರಾಜ್ಯಗಳು ಶೇ.85ಕ್ಕಿಂತ ಹೆಚ್ಚು ವಿಸ್ತೀರ್ಣ ಹೊಂದಿದೆ (ಶೇ.70–80ರಷ್ಟು ಉತ್ಪಾದನೆ). ಮಹಾರಾಷ್ಟ್ರ (ಪ್ರಮುಖವಾಗಿ ಹಿಂಗಾರು;33–35%) ಮತ್ತು ಕರ್ನಾಟಕ (ಪ್ರಮುಖವಾಗಿ ಮುಂಗಾರು; 13–18%) ರಾಜ್ಯಗಳು ಪ್ರಮುಖ ಈರುಳ್ಳಿ ಉತ್ಪಾದಕರು. ಮುಂಗಾರು ಮಳೆಯ ತೀವ್ರತೆಯ ಕಾರಣದಿಂದ ಈರುಳ್ಳಿ ಉತ್ಪಾದನೆಯಲ್ಲಿ ವ್ಯತ್ಯಯದಿಂದಾಗಿ ಸೆಪ್ಟೆಂಬರ್–ಫೆಬ್ರವರಿ ತಿಂಗಳುಗಳಲ್ಲಿ ಬೆಲೆ ಸೂಚ್ಯಂಕವು ಅತ್ಯಧಿಕವಾಗಿದ್ದವು. ಪ್ರಸ್ತುತ ಅವಲೋಕನ (ARIMA X-reg)ದ ಪ್ರಕಾರ, ಈರುಳ್ಳಿಯ ಚಿಲ್ಲರೆ ಬೆಲೆಯು ಎಂಇಪಿಯ ಜೊತೆ ಸಂಬಂಧ ಹೊಂದಿರುವುದನ್ನು ಖಚಿತಪಡಿಸಿದರೂ ಸಹ, ಅದರ ಗುಣಾಂಕದ ಮೌಲ್ಯವು ಶೂನ್ಯಕ್ಕೆ ಹತ್ತಿರ (0.5) ಇರುವುದನ್ನು ಪರಿಗಣಿಸಿ, ಎಂಇಪಿಯು ಈರುಳ್ಳಿ ಚಿಲ್ಲರೆ ಬೆಲೆಯನ್ನು ಗಣನೀಯವಾಗಿ ಬದಲಿಸುವುದಿಲ್ಲ ಎಂಬುದಾಗಿ ಖಚಿತ ಪಡಿಸುತ್ತದೆ. ಭಾರತವು ಪ್ರಮುಖ ಹಿಂಗಾರು ರಫ್ತುದಾರ (9.6 ಟ್ರಿಲಿಯನ್‌ಟನ್, 27%)ನಾಗಿದ್ದು ಮುಂಗಾರು (2.80 ಲಕ್ಷ ಟನ್‌ಗಳು) ಮತ್ತು ತಡ–ಮುಂಗಾರು ಹಂಗಾಮಿನಲ್ಲಿ ಸಣ್ಣ ಪಾಲನ್ನು ಹೊಂದಿದೆ. ಭಾರತದ ಪ್ರಮುಖ ಈರುಳ್ಳಿ ಆಮದುದಾರ ರಾಷ್ಟ್ರಗಳು, ಭಾರತವು ಎಂಇಪಿ ಬಳಸಿದಾಗ (ತಿಂಗಳುಗಳಲ್ಲಿ) ಅವರ ಸರಾಸರಿ ಖರೀದಿ ಬೆಲೆಯೂ ಸಹ ಅದೇ ದಿಕ್ಕಿನಲ್ಲಿ ಬದಲಾಗುತ್ತಿದ್ದು, ಎಂಇಪಿಯು ರಫ್ತು ಬೆಲೆ ಏರಿಕೆಯನ್ನುಂಟು ಮಾಡಬಲ್ಲದು ಎಂಬ ಅಂಶವನ್ನು ಬಹಿರಂಗಪಡಿಸುತ್ತದೆ. ಆದರೆ, ಅದೇ ಸಂದರ್ಭದಲ್ಲಿ ರಫ್ತು ಪ್ರಮಾಣ ಕುಗ್ಗಿರುವುದರಿಂದ ನಮ್ಮ ಆಮದುದಾರರು ಈರುಳ್ಳಿ ಬೆಲೆ ಬದಲಾವಣೆಗೆ ಸಂವೇದನಾಶೀಲರಾಗಿರುವುದು ಕಂಡುಬಂದಿದೆ.

ಮಾರ್ಚ್, 2023

ಕೃಷಿ ವ್ಯವಹಾರ ನಿರ್ವಹಣೆ ಸಂಸ್ಥೆ
ಕೃಷಿ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ಜಿಕೆವಿಕೆ, ಬೆಂಗಳೂರು – 560 065

(ಎಂ. ಅರುಣ್)
ಪ್ರಮುಖ ಸಲಹೆಗಾರರು

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

I INTRODUCTION

Apart from paddy and wheat among cereals and sugarcane significant policy attention of the governments has been drawn by TOP (Tomato, Onion & Potato acronym TOP) vegetables of India. Usage of these three vegetables in India is such very significant that it may be considered as staple vegetables, just like staple food like cereals and pulses. Of the three, onion is a commodity of special concern to both union and state governments, as any spike in its price is capable of developing public mandate against ruling government. Onion, is a commercial spice crop in India (Ghosh *et al*., 2022) and is consumed pan India, all throughout the year. It is also relished by people across 150 countries of the world, throughout the year. Inelastic demand and lack of substitute (Kalamkar and Makwana, 2015 and Dey, 2021) coupled with demand pattern and supply sensitiveness to seasonal weather shocks, keeps the government machinery on the toes to continuously monitor the situation and device appropriate measures to address any possible shortfall in supply.

1.1 Importance of onion in Indian Economy

Onion is the second most important commercial crop (next to potato) grown in India, grown in about 1.3 million hectares, producing 20 million tonnes. Amongst vegetables, India ranks second in production of onion (11.50%) next to potato (Gondalia *et al*., 2017). Indian onions were valued at Rs. 136 billion in 2012, which gradually increased to Rs. 246 billion in 2020 contributing to about 0.76 per cent to Indian agricultural gross value added during 2019-20 (GVA agriculture 2019-20 (Rs. 32,57,443 crore) (Anonymous, 2020). With an average price of Rs. 1600/qtl, onions could generate a net income of over Rs. 1.5 lakhs to its growers per acre (Shah, 2017). Being a commercial crop, it is a major livelihood source to lakhs of growers in the major states of Maharashtra, Karnataka, Gujrat, Madhya Pradesh, Bihar, etc. The country is also the major consumer of onion with an annual demand of 16.50-18.00 million metric tonnes (Kalamkar and Makwana, 2015). Onion is an important commodity which drives food inflation and has highest instability (index - 49.30%) in price (Saxena *et al.*, 2017).

India is a net exporter of onion, imports being negligible and restricted to periods of supply short fall. The value of onion exports from India is valued at Rs. 3,432.16 crores in the year 2021 and it accounted for 51.3 per cent of total vegetable exports of the country (Gondalia *et al*., 2017). Indian onion export earning has been quite considerable despite the fact that it exports to the South-East Asian countries and the Middle East (Saxena and

Chand, 2017) that earns relatively lower prices as compared to the other country (Netherlands, Burkina Faso) exports. Processed onions account for a smaller proportion (4.69%) of production and most of it is exported. Globally, India stands second with a share of 21 per cent in terms of processed onion with the production of 19.4 million tonne. It contributes Rs. 136 crores to Indian export basket (2021). The export destinations of processed onion are Germany, USA, Brazil, Russia and The United Kingdom (Anonymous, 2020).

1.2 Onion – Seasonal Pattern of Production and its relevance to Prices

In India, onion is cultivated in Rabi and Kharif seasons. While Rabi onion produced mostly in the Central states (dominated by Maharashtra) of the country accounts for a major portion of production (because of relatively greater acreage under the crop), kharif onion is mostly restricted to a few Southern states (dominated by Karnataka and Andhra Pradesh) (Saxena & Chand, 2017, Gummagolmath *et al.*, 2020). The former being harvested amidst summer season, has superior storability, the latter since is harvested in rainy season, holds more moisture, thus prone to damage, lacking storability. Consequently, rabi onions lasts in the market for 4 to 6 months after harvest whereas kharif onion spans in the market only for 3-4 months, that too with a substantial post-harvest damage and loss (Premi and Premi, 2017). Further, untimely rainfall during kharif onion harvest season severely affects its harvest, many-a-times leaving the crop unable to be harvested. Such eventualities in Karnataka and Maharashtra are getting common in recent years. This contrast and seasonality often lead to a shortage of onion supply in kharif and late kharif season and surplus during rabi season, it has huge impact on domestic prices. The wholesale prices go as low as Rs. 6/kg in the peak rabi harvest season and as high as Rs. 80-90/kg in kharif. There have been efforts to bring acreage under the crop during kharif season in the non-traditional states such as North-Eastern states and Northern parts of the country in order to fill the supply gap (Gummagolmath *et al*., 2020).

1.3 Dynamics of onion prices vis-à-vis other agricultural commodities

Gulati, 2019 identifies that onion, unlike other agricultural commodities, exhibits typical price behavior, of not just low-price realization in peak season and high price due to less supply in lean months but a cyclical pattern in its prices. Such cycles have become more frequent since the year 2013. Every alternate year onion prices surge in response to a heavy monsoon and crop damage. In addition, its price is influenced by not only the

production factors but market forces as well. While adverse weather factors affect supply, hoarding by traders create artificial shortage situation aggravating price spike. Down the supply chain, retailers escalate their profit mark-ups. Retail prices are not monitored like wholesale prices leading to huge margins and profits for wholesalers and retailers but not farmers (Ghosh *et al.,* 2021 and Shah 2017).

Demand for onions is assumed to be uniform across India. The per capita onion consumption in India is estimated to be 14.3 kgs/annum in 2019. Due to changes in lifestyle, the consumption of onion is high in urban households than rural households (Saxena & Chand, 2017) The per capita consumption has been consistent at around 2.5-5 kgs/annum during 1960 and 2000 with moderate increases over time. The same has seen a sudden spurt to evidence manifold increase to about 15 kgs/annum during the last 2 decades.

Though onion is similar to tomato and potato among vegetables and food grains is being defined as necessary good, there is a difference in their supply patterns. While tomato production is season neutral, potato and food grains though bound by season, is grown in almost all the states. In case of onion, its production is not only seasonal, its suitability to certain states in certain season, restricts its supply.

1.4 Indian onion Export Policy

Any nation is blessed with a certain set of resources. In economic terms, the resources are broadly classified as land, labour, capital and management. These resources are judiciously employed to produce certain products. Obviously, the first right to these products will be its domestic residents. Onion being a perishable product, can withstand storability only to a moderate duration of time. Thus, excess production shall be exported beneficially to gain the valuable foreign exchange. On the contrary, at the times of supply shortage, a fall in production is inevitable. Since India is a major onion exporter, exporting mostly all throughout the year, the first right for its consumption by domestic residents is seriously hampered if free export policy is pursued. Therefore, it becomes inevitable for the government to somehow reduce exports, in order to stabilize the price. Thus, containing domestic onion prices boils down to activating restrictions on its trade. The relevant trade restricting tools available to the government are export ban, trade licensing, quantitative restrictions, quotas, Price Stabilization Fund, minimum export price etc.

In reality, use of the above tools by the government has WTO-AOA restrictions. Firstly, WTO binds the nations to employ only tariffs and convert all other non-trade barriers into tariffs. Secondly, to reduce the trade barriers to minimum levels fixed at the time of signing of agreements. The intention behind, is for effective monitoring of restrictions and its gradual withdrawal. In effect, the commodity prices in overseas markets are prevented from an undue hike (Anonymous, 2020). Thus, use of any of the above said tools would result in a price hike in the world market as a reduced export would hamper supply and hence not desirable under the WTO agreement.

Various alternative export/trade restricting tools are described for the purpose of understanding. National governments use licensing as a tool to manage international trade by taking subjective discretion of a allowing or not allowing a trade offer. Import/export ban withholds a particular commodity/ group from being traded. Quantitative restrictions allows a total export of upto certain fixed quantity. Export/import beyond such levels is not permitted. Quotas allow a certain quantity to an importer or exporter[1]. Finally, Minimum Export Price (MEP) declares a 'Floor Price' below which the commodity cannot be exported. In the recent decade, Indian government has employed the 'trade ban' and 'quantitative restrictions' very rarely. MEP has been imposed on various commodities like Edible oil, Basmati Rice and Potato but the frequency of imposition is higher on onion. The only exception to sell below MEP being a particular exporter holding a prior agreements or contracts before the date of its imposition, in which case, an export is allowed below the MEP. MEP as a policy tool is employed as and when the domestic price surge situation arises and is reduced/ withdrawn once the domestic market prices approach stability. Since 2019, MEP has not been employed, while Price Stabilization Fund seems to be pursued or experimented with.

1.5 Impact of onion trade restrictions on export market

Under the WTO agreement, policies like export ban and MEP are widely criticized, because it is considered to be distorting the market (leading to price rise) in global context. Japan and the USA had strongly objected these frequent export bans by India in the WTO forum (Anonymous, 2020). Apart from such allegations, MEP is also criticized for its *ad hoc* nature that defames its exporters of being unreliable exporter, thus may be losing

[1] Price Stabilization Fund (PSF) provisions the government to procure and maintain a buffer stock of onion to release at the time of supply shortage, if any

potential markets. Most importers prefer to hold business with consistent suppliers. India being a major exporter in the world market, its *ad hoc* policies could seriously affect long-run trade considerations.

Rose onion and Krishnapuram onion are niche varieties from India, they are famous for their pungency. Middle Eastern countries are its main importers as they are suitable for pickles but they have little or no demand in the domestic market. The MEP was imposed even on these onions till July 2013. Though an exclusive HS code (07031010) (ITC Trade Map and MEP notifications) has been created for 'Rose and Krishnapuram onions', because of carpet ban/MEP, it has turned out to be insignificant.

The all-time onion price disaster of 2019 due to floods in kharif onion producing states (South India) resulted in notifying MEP to be set as high as 850 $/ton throughout kharif and late kharif seasons failing to control the crisis, the government called for export ban. This hit the rose onion farmers very hard. They lost profitable export earning while its domestic prices remained as low as Rs. 6/kg. With continued pressure from Andhra Pradesh and Karnataka farmers, the government permitted export of Rose onion and Krishnapuram onion with quantity restriction[2].

1.6 Export situation of onion – world and India

China and India are the top 2 producers of onion in the world. Despite being largely consumed in domestic markets, these nations are major exporters too. Together, two Asian giants account for 40 per cent of world onion trade. Despite being not a consuming nation, the Netherlands has been significant exporter (Saxena & Chand, 2017), Burkina Faso has also been a significant exporter. The major onion exporting countries of the world during 2020 were Netherlands (16.96%), Mexico (12.18%), India (8.50%), China (6.88%), Egypt (6.17%) and Spain (5.88%).

Indian onions are mainly exported to the Middle East and other Asian countries. Though by volume Indian exports is sizeable, the export unit value is significantly lower (Paul *et al*., 2015 and Saxena and Chand, 2017). In 2021, top five exporters according to their yearly Export Unit Values were Finland ($/ton 38,000), Jamaica ($/ton 5,170), Congo ($/ton 4,375), Colombia ($/ton 4,161) and Switzerland ($/ton 4,143), Qualitative

[2] During 2019-20, the government allowed export of 9,000 MT of Rose onion (October, 2019), 10,000 MT of Krishnapuram Onion (February 2020) and 10,000 MT of Rose onion and Krishnapuram Onion (October 2020).

differences and protected cultivation in some of the countries could also be the contributing factors for such disparity (onion size preference of individual importing countries is in APEDA website). Since rabi onion is of relatively better quality as compared to other seasons (Ghosh *et al.*, 2021 and Shah, 2017), a comparison of unit values across seasons could be meaningful to understand if there are any significant differences in price realization.

1.7 Brief comment on Unit Price Realization

As a policy, MEP can serve dual purposes. One, it helps in reducing the surge in price in domestic markets, other, escalates export prices above normal range. India, by becoming member of WTO, has liberalized its trade, while the resultant EXIM policies impact the domestic supplies. A free export policy causes a shortage of produce in domestic market, thus resulting in price spikes, evoking hue and cry among consumers. An obvious question is, whether a spike in price is good or bad? As a spike in price support producers to realize better prices, it supports increase in their incomes, but increasing burden on consumer pockets and may be forcing them to reduce consumption. However, governments consider favoring consumers rather than the producers mainly because the former is more unified and their aggregate opinions materialize in voter turnout, while the latter group lacks unity, thus not affecting mandate. As indicated earlier, the price surge is due to the crop loss. An increased price, if MEP is not imposed, would favor growers by compensating the loss of income. The farmers who would otherwise earn good income from export of these varieties, end up with huge losses due to the export ban/MEP.

1.8 Relationship between onion trade policy and prices

There are numerous studies about price volatility and seasonality in onion but the influence of factors on retail prices have barely been studied. A few articles claim that MEP is ineffective (Anonymous, 2020) but there is a lack of empirical evidence supporting this claim. Higher export price to a produce indicates improved terms of trade, as it earns the valuable foreign exchange, required for it to import the required commodities. The price realization in international trade is calculated through Export Unit Value realization. This study presents a comparative picture of Export Unit Value of Indian onions vis-à-vis onion of other onion producing countries.

With this brief background on various related aspects of onion prices, this study addresses this research gap of analyzing the influence of MEP on domestic retail prices. In

addition, the role of MEP on unit value realization and export volume is also assessed. The specific objectives of present study are as follows.

1.9 Research Objectives

1. To analyse temporal and spatial pattern of onion production in India.
2. To compare variation in production, demand, export and import of onion in India and its influence on domestic price.
3. To assess relative impact of Minimum Export Price (MEP) on export unit value (price) realization of onion.

1.10 Hypothesis of the Study

1. A few Indian states dominate in onion production
2. Interconnected parameters may have a considerable influence on price
3. Minimum Export Price (MEP) has no impact on export unit value realization of onion

1.11 Usefulness of the Study

This project work is an effort to bring out the latest profile of onion production, acreage and productivity at both all India and state level. Onion production being bound by seasonality, production contributions reveal the importance of certain states in different seasons categorized as kharif, late kharif and rabi seasons. The main purpose of the study is to bring to the fore, the dual purpose of MEP policy in containing domestic prices on one hand and boost EUV realization in its exports and analyze its efficacy in achieving the same. As elaborated in our results and conclusions, MEP though may be containing soaring onion prices, it was not so significant statistically, while EUV seems to have received a boost. The explorations of the study provide insights for policy makers while also paves the way for future research in this field.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

Onion is the most debated, controversial, policy researched and politically sensitive vegetable crop in India, because of surging prices. Ever since Green Revolution has set the trend of increasing crop productivity, onion has been continuously in news, every now and then. Onion is typically sensitive and is widespread throughout the country, unlike other vegetables. Even in case of tomato and potato which are attached equal importance by the policy makers, the price controversies are mostly localized and not widespread. The search for research articles pertaining to onion price and related studies yielded considerable number of studies. The ensuing section presents objective-wise review of literature in chronological and alphabetical order. An attempt has been made to concisely summarize the gist of all the reviews at the end of individual objectives, for better comprehension of reader.

2.1 Temporal and spatial pattern of onion production in India

Deshmukh (2010) studied the trend in area, production and productivity of onion in Maharashtra and analysed the export cost and trend in export of onion in India through coefficient of variation. Compound Annual Growth Rate (CAGR) was estimated using exponential model to examine the growth trends in production and exports of onion in India. Price instability due to unstable production was 67.72 per cent from 1999 to 2011. The research as suggested few solutions to increase productivity and encourage exports of onion from India.

Bisen and Kundar (2013) conducted study on production trends of onion in India and found that despite being the second largest producer, productivity of onion in India was lower at 14.2 ton/ha in 2011 in comparison to other producing countries. India's share in world onion production was 19.90 per cent next to China (26.99%). More than 45 per cent of Indian onion was produced in Maharashtra, Gujrat and Madhya Pradesh and hence conducive for onion export.

Kappa (2014) analyzing area, production and Productivity of onion crop in Andhra Pradesh (1992-93 to 2011-12) the productivity declined at annual rate of 1.84 per cent during the 2007-08 to 2011-12 period, even though its area and production registered positive growth. The annual growth rate of area increase was 25.19 per cent (from 1993-94 to 2011-12). Positive trend was recorded in production but productivity showed negative

trend. In the 2011-12 the productivity growth of onion crop was negative that is -11.53 per cent, despite increase in area.

Saxena and Chand (2017) observed that Onion production had increased at the rate of 3.13 per cent per year during 1974-75 to 2000-01 with the growth rate of 12.47 per cent per year, thereafter. Onion was the only food crop to witness such kind of growth during the recent past. The study noted very high year to year fluctuations in output. The increase in production of onion not only increased per capita domestic availability and consumption, but also raised onion exports from India from 330 thousand metric tonnes in year 2000-01 to 1115 thousand tonnes in 2015-16 at an annual rate of 8.16 per cent in volume and 15.56 per cent in value. The per capita annual availability increased from 4.6 kgs during biennium 2000-02 to 15.2 kgs in 2013-15.

Chavan, Salunkhe and Perke (2018) conducted an analysis of economic conditions of exported onion growers and non-export onion producers in Nasik district, a predominant export-oriented onion producing district in Maharashtra. It was found that per hectare gross income obtained in Non-Exported Onion farm was ₹ 212450 and in Exported onion farm was ₹ 418764.78. Output-Input ratio was 1.50 in case of Non-Exported Onion Production and 2.42 in case of Exported Onion Production. Per quintal cost of production in Non-Exported and Exported Onion was ₹ 951.51 and ₹ 942.81, respectively. Per hectare cost of cultivation of non-Exported onion was ₹ 140824 and that in Exported Onion was ₹ 172629. It showed that the export of onion is more profitable to farmers over non-exported onion.

Nivetha and Uma (2020) computed growth and instability performance of Indian onion over two decades (1999-2019). Growth in area (6.56%), production (5.06%), productivity (1.04%) and exports (4.22%) of onion in second decade (2008-19) were less when compared to the first decade (1999-2008) (area - 12.4%, production - 7.53%, productivity - 4.59% and exports - 20.99%). Coppock's Instability Index inferred that instability of area (4.88), production (4.3), productivity (2.91) and export performance (4.47) declined in second decade (2008-2019) over first decade (1999-2008) (area - 5.53, production - 9.86, productivity - 4.37 and export performance - 10.4)

Gummagolmath *et al.*, (2020) analysed the arrival, price and its volatility in onion markets using seasonal indices and co-efficient of variation for the period 2000-19. In the year 2017 Odisha (30.86 %), Rajasthan (19.78 %), Maharashtra (5.59 %), Bihar (4.26 %) and Madhya Pradesh (0.07 %) recorded positive growth in area while remaining states had

negative growth that led to the overall decline in area in India by 1.58 per cent in 2017-18 as compared to 2016- 17. Maharashtra state recorded more than 31.47 per cent increase in production while other states had negative trend.

Key findings from the review

- Growth performance in first decade of 2000s were better than second decade, while instability declined in second decade over the first decade.
- Onion production growth took a leap from a mere 3 per cent annually up to 2000s to 12 per cent then on upto 2016, while there were year to year fluctuations, which became more predominant after 2011. Growth in production accompanied consumption and exports also to increase.
- Area & production increased but yield declined in Andhra Pradesh.

2.2 Variation in production, demand, export and import of onion in India and its influence on domestic price

Chengappa *et al.,* (2012) analyzing possible collusion in onion value chain explored its production, area, yield, prices, output and demand relationships. It recognized onion market to be dictated by a few large traders, anti-competitive elements depicting oligopoly situations. Export ban and arbitrary Minimum Export Price (MEP) fixation often makes Indian exporters to lose credibility in international market as irregular suppliers.

A study by Gummagolmath (2012) observed that the top 50 markets accounted for around 95 per cent of the total onion arrivals in India. Through time-series analysis it was found that onion production had gone down by 20 per cent in Maharashtra, Karnataka and Madhya Pradesh during 2009 and 2010 due to unseasonal rain. The study concluded that hoarding, higher retailer mark-up, reduction in MEP and increase in export, lack of timely data available to market intelligence to be causal factors of price rise in domestic market.

Reddy *et al.,* (2012) studied variation in onion arrivals and prices, their relationship and price integration among different wholesale markets of India using coefficient of variation and correlation matrix. The study compared the stability in export before 2003 and after 2003 (pre-WTO and post-WTO respectively). It was found that the instability in export reduced from 23.6 per cent to 16.89 per cent. Among importers, Malaysia had high growth in import value (14.93%) and quantity (10.42%). The Nominal Protection Co-

efficient (NPC) value of 0.80 indicated the increase in export competitiveness of Indian onion post-WTO. The study observed that raising export of onion has led to increase in area and production as well.

Shukla and Rai (2014) conducted a study in Lucknow and Kanpur markets of Uttar Pradesh and concluded that the extent of variability in market arrival of onion was lower in Lucknow market (-0.77) but higher in Kanpur markets (-0.82). The study confirmed a negative relationship between market arrivals and prices of onion.

Choubey (2014) conducted a study to understand the effect of area and yield on production and export trends of onion in India. The fluctuation in area for the last three decades is mainly determined by the price fetched in markets, while fluctuation in production was due to dependency on rainfall and monsoon. The secondary data is analysed using ordinary least square method. About 95 per cent of the variation in Production of Onion is explained by area and yield and the remaining 5 per cent was unexplained (R^2 - 0.95). Production fluctuation is observed to be only a small cause for onion price surge. The share of export in total onion production was 5-15 per cent during the period of 1980 to 2011.

Paul *et al.,* (2015) stated that India does not follow any mechanism of administered price policy for onion and hence prices are largely determined by the market. This paper investigated the long-run and short run relationships between export price and domestic prices of onion. The study on the price transmission and export volatility using SARIMA-EGARCH model has captured the volatility in onion export quite satisfactorily. The analysis of structural breaks in volatility has revealed the situations of price shocks in the years 2007, 2010, 2011 and 2013, when onion prices went abnormally high and created disturbances in the markets. The Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root tests have suggested that the domestic market price series and export price series are integrated of the order one.

Darekar *et al.,* (2015) explained using ARIMA forecasting model, as to how it is important to note that the high inflation of food commodities cannot always be attributed to risks, exogenous shocks and mismatch between demand and supply, but also due to market inefficiencies, weak supply chain and monopoly like conditions imposed by large traders in the market which highlights the ineffective functioning of market institutions.

Premi and Premi (2017) studying the Indian onion supply chain identified yield gap in comparison with major producers in the world. Productivity remained almost stagnant during the last 50 years. Maharashtra being the top onion producing state, its productivity is below national average. The seasonal concentration of onion arrival during January - March in Gujarat and Karnataka during September to December is observed. Arrival in Maharashtra has showed a lot of fluctuation. Similar to most farm produce, sometimes even onion prices fell below cost of production making it uneconomical for the farmers. Government of India uses MEP as a tool to ensure regulated exports so that there is an adequate supply of onion in the domestic market.

Saxena and Chand (2017) pointed that the volatility in Indian onion exports is attributed to both domestic production instability and export policy uncertainty. It was noted that the export shares from India were higher in price shock years as compared to the preceding years. The hike in onion MEP led to decline in onion exports during those months. Indian exports moved almost in tandem with global exports, indicating close linkage between the two. The concerning feature of the exports from India was high volatility in comparison to the global exports. Unreasonable MEP in bumper production (2013-14) lowered the export quantity. In 2014-15, a smaller decline in production (-3.43 %) led to much larger decline in exports (-20.04 %). Plotting MEP against WPI depicted that MEP had lowered the inflation in the domestic WPI during subsequent months of MEP imposition (December 2013, August 2014 and July 2015) after price surge months (November 2013, July 2014 and June 2015)

Shah (2017) conducted a study in Maharashtra to find out variety-wise onion prices in wholesale, retail and export trade. It was found that percentage mark-up for a wholesaler was 18 – 35 per cent, for retailer 19 – 36 per cent, with significant variation in percentage mark-up across the months. The average percentage mark-up for an exporter was 30 – 60 per cent. Onion retailers cornered higher share of consumer's price while their marketing cost considerably lower compared to wholesalers. In case of onion sold domestically, producer's share in consumer's rupee varied from 49 to 52 per cent while the same in exported onion was estimated at 30 – 35 per cent. The study suggested fixing Minimum Support Price for Rabi onion which is sold at lesser price due to surplus arrivals.

Indhushree *et al.,* (2017) analysed export performance of vegetables and fruits from India. The study showed that the highest share in the vegetables export from India was

accounted for by onions and shallots both in value (22.46 %) and quantity terms (32.81 %) followed by dried onions. The study identified considerable instability in Indian vegetables export (Coppock's Instability Index: in value - 37.1%, in quantity - 35.2% and Unit Export Value - 48.6%) increased in the period from 2000-16 when compared to 1988-99. There was a considerable Geographic Concentration of onions and shallots Export from India (Hirschman Concentration Index was more than 40) indicating greater dependence on our exports in a few countries. The overall concentration index for dried onions export was less than 40 (35.38) which imply its higher diversification in terms of geographic coverage and thus limiting the possibility of risk from price variability of exports. Markov chain analysis showed that Nepal and Belgium were stable export market for onion and shallots (79%), dried onion (60%) respectively.

Setiya and Muthuselven (2018) identified onion demand and supply fluctuations to be causing Government to increase, decrease or lift MEP to ensure stability in domestic price. Based on interaction with traders, the study observed that some big wholesalers would procure at lower price in domestic market in advance and manage to sell at prices below MEP. It calls for designing better export policy while supported by effective production and price forecasting system.

A study by FCCI (2019) discussed the onion export policy. It discussed effect of export ban on international clients and offered various solutions such as Increase investment in producing dehydrated onion, agriculture market reforms, removing onion from Essential Commodities Act and to promote research-oriented planning, production protocols by ICAR Directorate of onion and garlic research to avoid onion price crisis in future.

Amand and Gummagolmath (2019) analysed volatility in onion wholesale prices in major domestic markets and its causes using coefficient of variation, correlation coefficient and seasonal indices. They have concluded that there has been a significant increase in wholesale price index since 2009 with high intensity in the months of October to January and the index varies between the markets. Unlike typical negative correlation of arrivals and wholesale prices in Agricultural commodities, Bangalore (0.39), Chennai (0.28), Mumbai (0.06), Ahmedabad (0.24) and Hubli (0.26) markets mostly had a positive correlation the rest, Kolkata (-0.61) and Jaipur (-0.09) markets showed negative correlation

thus indicating role of exogenous factors such as stock holding and speculations by traders, and the sudden spurt in price is a cyclic trend.

Birthal (2019) identified high price volatility of onions. There was a 22 per cent probability of slumping onion prices to exhibit unusual behaviour. Price volatility behaves cyclical, typically lower during March–May and start rising from June until September but, volatility of arrivals did not have that pattern. The study observed uncertainty in market arrivals, price inelastic nature of demand, spatial integration of markets. Raising/imposition of MEP and banning of export did not have immediate effect on price volatility.

Gummagolmath *et al.,* (2020) analysed the arrival, price and its volatility in major onion markets using seasonal indices and co-efficient of variation for the period 2000-19. In 2018, there was an increase in the prices of onion during January to February (harvest season) despite increase in arrivals, due to higher MEP during these months and hence traders resorted to large scale purchase of onion. On the contrary, during 2019, for the same months, there was a decline in prices with increase in arrivals. The study concluded that regulations in onion trade is required as flaws in pricing policy costs consumer and farmer, whereas high margins are enjoyed by intermediaries.

Roy (2020) found that prices have tended to inflate during the second half of the year when the Rabi onions start depleting and the Kharif harvest has not entered the market. Seasonal Indices of arrivals are above average (>100) from January to June and below average (<100) in December. The months of January to May had the highest levels of Seasonal Index for arrivals. The highest Seasonal Index for arrivals was in January (119.23) followed by May (117.62). The other important finding is that Ray Instability index for onion arrivals (18.33%) are very weakly correlated with its price (21%). A more than proportionate increase in price raises doubts of hoarding and price manipulations by market intermediaries.

Kakutse (2020) found perishability, climate change, use of poor-quality seeds, high cost of inputs and labor, lack of scientific storage facilities, poor transportation network, adverse export and import policies to be responsible for onion price volatility. Despite trader's robust demand and supply forecast abilities, abrupt Exim policies like sudden export ban or increase in MEP not only hampered their profit margin but also damage their credibility in the international market and adversely affects country’s reputation.

Mulla *et al.,* (2020) analysed price behaviour and forecasted onion prices in Kurnool market. Seasonal variation, cyclical movements, irregular variations are found using ARIMA Model for 2003 to 2017 and arrived at a conclusion that the annual increase in prices of onion in Kurnool market was Rs. 6.22/quintal per annum. The highest seasonal index was observed in the month of August and lowest in May. Price cycles were not identified in onion prices. The study suggested reliable and robust price forecast model brings stability in the onion market.

Anonymous (2020) reported against the amendment of essential commodity act, 2020 stating that Onion is an essential commodity consumed by common men of low income and if its supply is unregulated, hoarding and artificial price rise will be encouraged by the new amendment, which could affect the poor people. The State would regulate the production, distribution, supply, movement, transportation, etc of the essential commodities through issuance of permits, licences, etc. Ministry of Consumers Affairs stated that Onion, garlic and tomato were primarily responsible for food inflation in September and October 2019

Anonymous (2020) conducted study in Chikamaglur (33% production) a major onion growing cluster in Karnataka and noted that Karnataka is a significant kharif onion producer. The onion seed were broadcasted in the month of May-June, while harvesting commencing from September extends till November. Despite being major producing cluster and APMC being located in close proximity, because of meagre local demand, farmers preferred to sell in Bangalore APMC which is almost ~200 km away, citing the reasons of slightly better prices and more demand when compared to Chikmagalur. Many a times, farmers end up selling at the prevailing price, since they do not access market intelligence and information.

Debopam *et al.,* (2021) studied price volatility of onion using ARCH, GARCH with ARIMA methodology as mean model and arrived those different markets mainly Lasalgaon and Bengaluru market responds differently to volatility due to positive and negative shocks.

Gulati *et al.,* (2021) revealed that the nominal protection coefficient calculated for onions is consistently less than 1, indicating high export competitiveness of onions from India. The Nominal Rates of Protection (NRP), indicating a consumer bias in trade policies. Market price differential (MPD) for onion is negative for all years studied, which indicates a pro-consumer bias in trade policy. This is evident from the fact that the government

imposes MEP and other trade restrictions as soon as prices shoot up to safeguard consumers. It also resulted in a unstable trade policy for onion. However, among TOP, onion had less variability in NPC with a coefficient of variation (CV). Onion (15%) for potato (30%) and tomato (22%). The same bearing higher values indicating that potato and tomato had higher degree of variation in domestic and international prices, while onion prices have lesser degree of variation.

Dey (2021) found unexpected supply shock of onion in 2019 caused by low productivity due to the heavy rainfall damaging 40% of crop in Maharashtra and the South Indian states, the prolonged monsoon season and fungal disease. She analysed the inelastic nature of demand for onion and movement of the demand curve in normal and price-crisis situation and found that in normal conditions that is, when the price is stable, producers are benefitted but in price-crisis situation, hoarders are benefitted and producers incur losses due to abnormal weather conditions. She stated that lowering the MEP could reverse the selling channels from external markets to domestic consumers.

Ghosh *et al*., (2022) pointed out the causes of price fluctuation in onion like yearly and seasonal variation in production, low and inefficient storage capacity, low price elasticity of demand, market inefficiencies, weak supply chains and market monopolies. Gradual reduction in onion stocks July onwards, leads to price rise together with rotting and sprouting of stored onions. Lack of retention power by growers and unregulated exports. During low or moderate rainfall year higher production and lower damage of Kharif onion leads to lower market prices while during excessive rainfall season, heavy damage to fresh as well as stored onions cause severe price rise. The study pointed an interesting fact about onion imports stating that imported onions were demanded mainly by hotels and institutions but not by retailers. Although imports pull prices down in the short term, the real price correction happens only when the new Kharif crop hits the market post-November.

Key Findings from the review

- High degree of wholesale onion market concentration; MEP reduction, apart from export rise and market intelligence data deficiency to cause price rise
- Market collusion, monopoly conditions; demand, supply not sole reason for price fluctuation

- Yield gap, Gujrat (Jan-Mar), Karnataka (Sep-Dec) seasonality, price < cost of production, Maharashtra low productivity; MEP to increase domestic onion supply
- MEP-export, linkage, higher onion export in years of price shock, MEP-WPI linkage
- Profit mark-ups: wholesaler/retailer 18-36 per cent, exporter-30-60 per cent; wholesalers incurred more marketing cost than retailers
- Raw onion export concentrated in a few countries (high risk of losing market) while processed onions have diverse markets; Nepal & Belgium reliable importers of Indian raw and dried onions respectively
- Procuring cheaper in domestic market and exporting below MEP
- Export ban can hamper India's reputation in international market
- Oct-Jan price (WPI) surge months; positive price-arrival correlation in southern & western states; cyclical trend in onion price
- Low price (Mar-May), rising trend (Jun-Sep), inelastic demand
- MEP does not have immediate effect
- High MEP level caused domestic price rice in Dec-Jan 2018

2.3 Relative impact of MEP on Export Unit Value realization of onion

Tuhinsubhra (2011) stated that production of onions declined by about 20% in three major growing states (Maharashtra, Karnataka and Gujarat) during 2009-10 and 2010-11. The MEP $475/ton set by the union government in September and October 2011 was higher than the prevailing global price, which made Indian onion costlier in international markets. China being major competitor in global market gets less value because of tasteless bulbs of yellow colour. Pakistan has emerged as a strong competitor in West Asia. Higher MEP is disadvantageous to Indian exporters and Indian clients import from China and Pakistan when MEP is high in India.

Kalamkar and Makwana (2015) pointed out the bottlenecks faced by farmers and traders in Onion Market such as competition by imports, poor infrastructure facility, transportation, varied freight charges across ports, lack of proper storage facility, lack of insurance facility, lack of floor price in surplus situations. It pointed the flaw that, when MEP is fixed at very high levels, exporters actually sell at prices below MEP though the L/C (letter of credit) is prepared at MEP. Therefore, the profit realized by exporters shows an inflated figure leading to higher tax liability. Also, fixation of MEP makes exporters

reluctant to export which sometimes leads to excess supplies in domestic markets, leading to fall in prices. Farmers also loose when prices show downward trend. In view of these difficulties, export ban on onions coupled with fixation of MEP must be discouraged. In crisis situation retailers sell at higher mark up because there is no regulatory mechanism for retail price.

Varma and Issar (2017) observed competitive market structure in majority of the destination markets. They analysed the exchange rate induced market power, asymmetric effect of exchange rate and impact of MEP on the export price using port-level prices by using PTM model by Knetter. The negative co-efficient for Bangladesh (-0.142), Oman (-0.128), Qatar (-0.136) indicated that exporters price discriminate and they adjust downward the mark-ups of price when they face residual demand. The study points out that exporters were reducing the price when the Indian currency appreciates against importer's currency indicating even in the presence of MEP, exporters were able to adjust their price downward and sell in those markets.

Saxena and Chand (2017) observed variations in the unit value realized (UVR) among the importing destinations. Despite being a major importer, Bangladesh UVR was quite low as compared to other importing countries. The UVR of Malaysia and Indonesia are usually found to be higher as compared to other importing destinations. It was pointed that UVR for Indian onion export was quite low in Asian countries. It was further noted that the export prices of onion remained higher than the prices prevailing in domestic markets. Export prices exhibited a pattern that is, it attained peaks with one month lag to that of peaks in domestic prices. This indicated that the origin of price spikes was in domestic market and not in overseas market.

Jagatap *et al.,* (2018) studied growth and instability in Indian onion export. The study examined export growth and variability (Cuddy and Della's instability index) and Nominal Protection Coefficient (NPC) for export competitiveness. It concluded that there was a wide scope for increasing the export of onions from India.

Anonymous (2020) stated that given the domestic price and production volatility of certain agricultural commodities, there has been a tendency to utilize trade policy as an instrument to attain short term goals of taming inflation. Such circumstantial measures are often product and sector specific. For instance, the *ad hoc* ban or imposition of MEP for onion and non-Basmati rice exports. MEP is classified as Stable Trade Regime policy under

strategic recommendations of Agricultural Export Policy. This breaks export supply chains and affects India's image as a reliable supplier affecting price realization for Indian produce. The country is seen as a source of high-quality agricultural products and changes in export regime on ground of domestic price fluctuations, religious and cultural belief can have long term repercussions.

Key findings from the review

- Unnecessarily Fixing MEP at high level leads to excess domestic price and thus lowering domestic price; even exporters though mention MEP on LC, sell actually at lower price, thus losing money.
- Spike in Indian onion market price causes spike in overseas UVR with one month lag; Asian importers UVR lower.

METHODOLOGY

III METHODOLOGY

In the light of past studies that have given sufficient insights into the various aspects of onion market and its repercussions on policy making, the analysis of success/failure of policy efforts. This chapter presents the scientific approach followed in exploring the objectives envisaged in the introduction chapter, data, variables, its sources and analytical tools employed for a clear understanding of the reader. Attention is also drawn towards some of the important concepts such as working of MEP, calculation of Export Unit Value (aggregation method). It is to be noted that some of the crucial data on onion area, production and productivity by season[3] is not accessible from any of the concerned agencies. Such a data limitation is a serious short coming in the policy analysis that need to be addressed for a clear analysis of production and marketing problems of the crop. The present chapter follows presentation as per the objectives of the study as follows, after briefly discussing the study area:

- To analyse temporal and spatial pattern of onion production in India.
- To compare variation in production, demand, export and import of onion in India and its influence on domestic price.
- To assess relative impact of Minimum Export Price (MEP) on export unit value (price) realization of onion.

3.0 Study Area

The present study focuses on India as a major onion producing and consuming nation. The representative situation given by all India level production, market variables and export statistics are considered in this context. The study of domestic price behavior of onion in the context of consumer (i.e., not wholesale prices as key) is of prime concern. Hence, India's onion production and prices is the subject matter of analysis. India's export policy as a tool to contain domestic prices, is another related aspect. Thus, the study area shall be the whole of India and efforts have been made to consider pertaining data from authentic sources and have been analyzed suitably.

[3] Karnataka state department of Horticulture compiles season-wise data for major horticulture crops including vegetables, of the state through 'Horticultural Statistics of Karnataka at a Glance'. Similar search for major states was attempted, but in vain.

3.1 Data and sources

The study has made use of secondary data from various sources. For analyzing the spatial and temporal pattern of onion production in India, area, production and productivity data of the onion crop both at national and state levels is utilized. Data on these variables is sourced from the various issues of National Horticulture Board (NHB) reports. Precisely, data pertaining to the past decade from 2010 to 2020 is analyzed for a clear understanding of the latest scenario. Further, having a clear understanding of the seasonal variation attracted a serious concern. Hence, the *area, production and productivity* related information has been collected from the Monthly Report on Onion of the Department of Agriculture, Cooperation and Farmer's Welfare, Government of India. In our exploration, the State Department of Horticulture of the Government of Karnataka compiles season-wise production of major horticulture crops of the state and publishes 'Horticultural Statistics of Karnataka at a Glance' annually. Onion Area, Production and Productivity related data is utilized wherever necessary.

Though addressing the second objective required the monthly data on onion production, demand, export and domestic price, many of these variables were not available on a monthly basis. Both production[4] and demand (consumption) data is not available, while export data[5] has been obtained from ITC Trade Map by digital registration to its website. In the wake of non-availability of monthly production data, a proxy variable of monthly market arrival[6] has been considered. The data on *market arrivals* was sourced from agmarknet website for all the markets of the country and summed together for further computation.

Domestic onion prices are highly volatile and differ widely across the spatially separated markets (Saxena *et al*., 2019). Lasalgaon and Pipalgaon markets of Maharashtra are renowned as Asia's largest onion market, which lead the onion prices for other wholesale markets of the country. These two markets are responsible for handling most of the rabi onion produced in the country. On the contrary Hubli, Bangalore, Gadag and Chitradurga APMCs of Karnataka handle the bulk of Kharif onions. Azadpur mandi of New Delhi is another market, but is a major terminal market rather than a primary or

[4] Even season-wise data is not compiled. Only production estimates are reported.
[5] This data is also available from other sources such as Agricultural and Processed Products Export Development Authority (APEDA) and Director General of Foreign Trade (DGFT) of the GoI.
[6] In fact, this variable integrates both production and demand information. In peak seasons it includes even export and import. Since the exact data is not available, proxy has been considered for the analysis

secondary market. There is a considerable difference in prices across the markets. Hence a common representative price is to be considered for analysis of retail prices. Hence, the monthly Consumer Price Index data pooled for urban and rural consumers of onion is sourced from the MOSPI database and the same is utilized for further analysis (See Annexure – I for more details). Though Wholesale Price Indices could have been used, they represent the scenario of wholesale onion markets, while the dynamics of retail markets would be lacking[7]. Onion being a seasonal crop, there would be a considerable lag in the production and consumption. Hoarding and other mal practices, misrepresent the prevailing actual supply conditions, thus impacting the retail prices rather than wholesale prices. Considering these facts, retail price index is more reasonable and depictive of the scenario at the consumer end and hence ideal to be used in the present analysis.

The data pertaining to *quantity of onion export* and *Export Unit Value (EUV)*[8] was obtained from ITC Trade Map – Trade statistics for international business development website. The EUV data is provided in USD/unit quantity. This indicator can be used as a proxy for average price. It does not take into account, the differences in product quality/variety etc under the same HS code, seasonal prices, currency fluctuations, etc. In this study monthly EUV data is collected for the duration 2011 to 2021. The original unit for the export unit value USD per Kg is converted to USD per ton (ITC trade map glossary) by multiplying the value with 1000.

The *Minimum Export Price (MEP)*: The Agriculture Export Policy, brought out by the Government of India in December 2018 aims at a stable trade policy for agricultural products, providing assurance that the processed agricultural products and all kinds of organic products will not be brought under the ambit of any kind of export restriction (viz. MEP, Export duty, Export bans, Export quota, Export capping and Export permit) even though the primary agricultural product or non-organic agricultural product is brought under some kind of export restrictions. The export and import policies for agricultural products, which include the decisions on lifting/imposing bans on export/import of individual agricultural products are framed keeping several factors in mind, such as

[7] The Review of Literature suggested that retail market dynamics differ from that of wholesale market with higher retail mark-ups and hoarding, it was decided to use a representative consumer price rather than wholesale price.

[8] EUV means value or unit quantity of produce. It refers to the average price realized in export of produce. Export price of any given consignment is a result of an exclusive negotiation. There will be many such transactions during a given period of time. The average of price realized in all transactions, is EUV.

availability of surplus over the domestic requirements (including the requirement of buffer stock and strategic reserve, if any), concerns of food security, diplomatic/humanitarian considerations, international demand and supply situation, price competitiveness, need to balance between remunerative prices to the growers and availability of agricultural products to common man at affordable prices etc.

The MEP was considered by the Government of India to be used a tool to contain domestic prices of some of the agricultural commodities in the year 2011 (Premi and Premi, 2017). Onion was one of the crops considered, while other crops for which it was used alongside were Potato, Rice and Edible oil. The MEP for any individual produce is fixed at some particular level considering various factors such as domestic prices, production fluctuations, import arrangements, consumer wellbeing etc apart from complying to the trade rules under the WTO agreement. The authority of fixing MEP is under the purview of inter-ministerial group. It is announced by the head of Director General of Foreign Trade (DGFT) of India from time to time specifying the commodity and date from which the announcement comes into vogue, through notifications. This becomes binding on shipment and freight agencies to abide by and verify and ensure compliance to the announced MEP by thoroughly scrutinizing the export agreements for specification of export price to be above MEP.

The MEP is revised from time to time, with the dynamics in its determining factors. Thus, the main purpose of MEP is to ensure stability in supply and prices of agricultural commodities. The MEP data required for the present study is not available directly as a data series. The MEP related notifications have been posted on the website of the APEDA as well as DGFT. The values from each individual notification have been extracted and compiled into data series by the date of its enforcement. Many a times, MEP has been revised 4-5 times in a month (e.g., February, March, August and September 2011). Such values have been aggregated into monthly MEP by averaging. When the market situation becomes normal and domestic prices are stable, MEP is either reduced or withdrawn. When withdrawn, such months MEP value is taken as '0'. Thus, the MEP data series is generated on a monthly basis, for the duration 2011 to 2020.

3.2 Tools for Analysis

Addressing the objectives of research requires eliciting the underlying behaviors and patterns of the variables under consideration. Therefore, a suitable analysis of variables

through employing appropriate tools of analysis is essential. The next section briefly presents the tools employed and the way it is executed by mathematically specifying the analytical framework. The statistical tests conducted and the criterion of interpreting results of test is also discussed. The above is convenient to be presented by objectives.

3.2.1 Temporal and spatial analysis of onion production in India

There are substantial changes in production of Onion, across both time and space. While over time, changes in crop acreage, technology (productivity), price, monsoon or other such factors could influence production over the years, there could be intra-year differences that is a result of seasonality in weather factors. Because of wide diversity in agro-climatic conditions, it favors production of certain crops in certain locations with an edge. Onion crop also exhibits such a spatial pattern. Fig. 1 represents the onion production concentration across the states of India. The unit of analysis, dealt with in this thesis is at the state level. The spatial-seasonal pattern of analysis is also attempted.

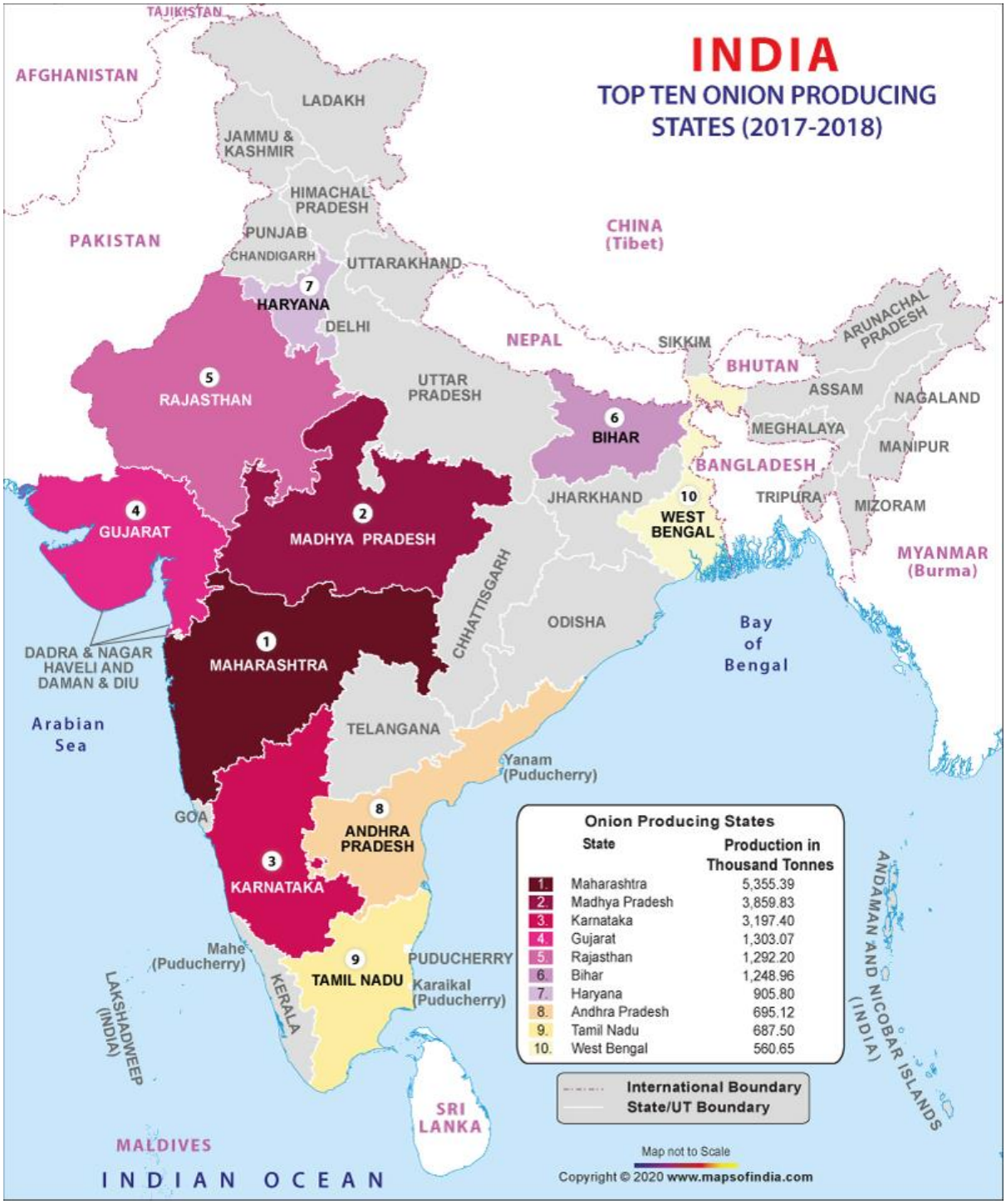


Fig. 1: Top ten onion producing states of India in 2017

Source: maps of India

3.2.1.1 Temporal time trend – Exponential Growth Rate Analysis

The temporal changes in the area, production and productivity of onion during the last decade (from 2010 to 2020) is first analyzed. The Compound Annual Growth Rate (CAGR) tool is employed for estimating growth, which is of the form $Y=ab^t$. Where, Y is the variable under consideration, a & b are constants and t is time variable. This equation represents an exponential growth model. Generally, most of the time series variables (with an exception of prices, which is mostly erratic) is assumed to possess an exponential trend. The equation being multiplicative, is applied with logarithms to convert it into an additive model. Exponential equation used for the study was of following form,

$Y = ab^t$

On applying natural logarithm, we will get the equation of the form,

$$\ln Y = \ln a + t \ln b$$

Where Y is area or production or productivity,

a is the intercept and

b is the regression coefficient and

t is the time period.

The growth rate is given by the formula, $g(r) = [\text{anti ln } (\ln b) - 1] \times 100$

Significance of the growth rate is assessed in two ways. One, the R^2 value of the regression depicts the model fitness and the degree of accuracy of model itself. Two, the Student t-test is applied to the b coefficient which is calculated as [$\hat{b}$ ÷ Standard error of $\hat{b}$]. The resulting value which is calculated as t-calculated is compared with the corresponding values in t-table at corresponding degrees of freedom (n-k) to draw conclusions about significance. The same can be alternatively obtained from most of the analysis software as p-value. If p-value is greater than 0.1, then the coefficient is significant at 10 per cent level of significance. 0.1 to 0.05 – 5 per cent level and 0.01 to 0.05 – 1 per cent level.

3.2.1.2 Spatial variations – Tabular and Exponential Growth Rate Analysis

The state level pattern (or composition) of area, production and productivity of onion crop provides a considerable insight. Among the 29 states of India, since onion production is substantial among a few, the spatial analysis is approached considering the top 10 states. Top ten onion producing states were selected based on their per cent share in total onion production in the year 2021. The per cent contribution of individual states to

total onion production was calculated in order to understand the spatial pattern. Further, changes in area, production and productivity for each individual top onion producing states is computed using CAGR tool.

3.2.2 Influence of changes in MEP on domestic prices

3.2.2.1 ARIMA with X-reg transfer function

In the ordinary course, onion price is determined by several factors such as temporal variations in production, export, import, demand etc. Monthly data for demand[9] is unavailable. Hence, Market arrivals, Export Quantity and MEP are treated as independent variables in the analysis. The domestic price represented by CPI is considered as a dependent variable. As explained in data section above, monthly data on market arrivals (which includes imported onion and all those factors seen in production data is covered in market arrivals), export, MEP and CPI (onion) is analyzed to explore the possible influence of first three factors on the CPI. Only under contingent situations, government imposes MEP to contain onion prices so that the consumers are not burdened of peak prices. Thus, during 6-8 months of the year, MEP will not be operational. Since price variation is explained by all the above factors including MEP, a multiple regression analysis was envisaged initially. But since it is a time series, before proceeding with analysis test of stationarity of data is a must to find out if the data suffered the problem of autocorrelation. Market arrivals, Export and CPI data were tested for stationarity and in case the data was not stationary, with first differencing was taken and again tested for stationarity using ARIMA model (Codes are given in Annexure – II)

The analysis was carried out using R-studio software. Auto ARIMA for CPI, Export and Arrivals was done and residuals (the difference between predicted values of dependent variable and observed values of that variable) for the ARIMA models were arrived at the residuals of ARIMA model for dependent and the individual independent variables were subjected to Cross Correlation analysis with the dependent variable to identify the number of lags with which the two variables were related.

The cross-correlation graph indicated that exports lagged by 11 months and arrivals lagged by 3, 6 and 11 months. Respective number of lags was adjusted to current data and

[9] Actually, demand which is represented by consumption is estimated by NSSO only during its consumption surveys which are conducted once in 5-7 years or so. Hence, monthly demand estimates are not available.

thus adjusted data was subjected to transfer function ARIMA Xreg. Xreg is used to fit a regression model with ARIMA errors. The period used in xreg was 12, indication 12 months in the data. The AIC (Akaike's Information Criterion) is a method for evaluating how well the current model fits the data, the model with lowest AIC value is selected as best model. The above exercise is carried out in order to overcome the problems involved in time series analysis and to obtain results that can minimize errors.

3.2.2.2 Seasonal Indices for CPI

Seasonal indices are calculated for CPI for the last five years (2017 to 2021) and ten years (2011 to 2021) separately and using moving averages method. Analysis of seasonality in the onion prices (CPI-onion) is carried out following multiplicative hypothesis (Acharya and Agarwal, 1994) and applied to monthly CPI. Since price at any given point of time is a result of the four factors (Trend-T, Cyclical-C, Irregular-I & Seasonal-S), it has been demonstrated to be possible to delineate the same. The process is called as decomposition of a price series. It is assumed that the different components (T, C, I, S) of time series is clubbed together in an additive or multiplicative fashion:

Additive Model: Yearly data: $P_t = T + C + I$; Monthly data: $P_t = T + C + I + S$

Multiplicative Model: Yearly data: $P_t = T \times C \times I$; Monthly data: $P_t = T \times C \times I \times S$

Where, P_t is Price of onion at time 't'; T is Trend; C is Cyclical (2 long-run factors – T&C , which influence price even in the short-run); I is Irregular and S is Seasonality (2 short-run factors).

Assuming multiplicative hypothesis, the monthly onion prices have been constructed into 'Monthly Seasonal Index' assuming that the seasonality pattern has not undergone a change during the period of analysis. The index values represent a set of numbers showing relative prices during different months of a year, the average of year being equal to 100. The sum of index numbers for 12 months (of the year) will thus be equal to 1200. The percentage of monthly moving average method was found to be more comprehensive as it removes the other (trend, cyclical and irregular) components in a step-by-step manner, as compared to other methods. Hence, the study followed percentage of centred 12-months moving average method in constructing the seasonal index. Therefore, the ratio of the original price series to the corresponding moving average provides an index of seasonal and irregular components combined are as follows:

$$\frac{P_t}{MA_t} = \frac{T \times C \times S \times I}{T \times C} \; x \; 100 = (S \times I)100$$

An average of individual month index, over the years and adjusting through correction factor, would provide a better estimate of seasonal index. The specific steps followed are:

1. Calculate 12-month average of price series and place the value obtained at the centre of 12 months (*i.e.*, between 6th and 7th Month), next average value between 7th and 8th month, and so on...
2. Calculate centred 12 month moving average. Take the average of 2 subsequent moving averages calculated above and place the value in front of the latter. *E.g.*, consider the first 2 moving averages, calculate their average and place it in front of 2nd one. This is done in order to centre moving average values exactly to 12 months. Note that the 1st and last 6th months do not have moving average values.
3. Express each original value as percentage of corresponding centred moving average (as indicated in equation above). The resulting values encompass seasonal and irregular components only.
4. Arrange percentages of moving average in monthly arrays.
5. Average of each month is calculated.
6. Adjust average in such a way that, their sum adds up to 1200 (because, 12 months multiplied 100). This is done by working of correction factor (k=1200/R; where k is correction factor and R is sum of the average for 12 months). Multiplying the correction factor with corresponding months average results in 'Seasonal Index' for that particular month.

Finally, the Seasonal Index (SI) values are interpreted considering the average value to be '100'. If the SI value is above 100, we say the price to be above average and vice-versa. Higher the SI value, higher the price surge in the month and vice-versa.

3.2.2.3 A note on seasonality in onion production and marketing in India

While onion is produced in three seasons viz., Rabi, Kharif and Late-kharif. Rabi sowing is undertaken in November and harvested April onwards. These onions endure in market upto September (Fig. 2). Kharif being next major onion season, sowing is mostly done between June and July which is harvested in October. The produce is available in market upto January. The market months for late-kharif are August – December and March – April. The three onion season ensure that the onion availability in market throughout the year.

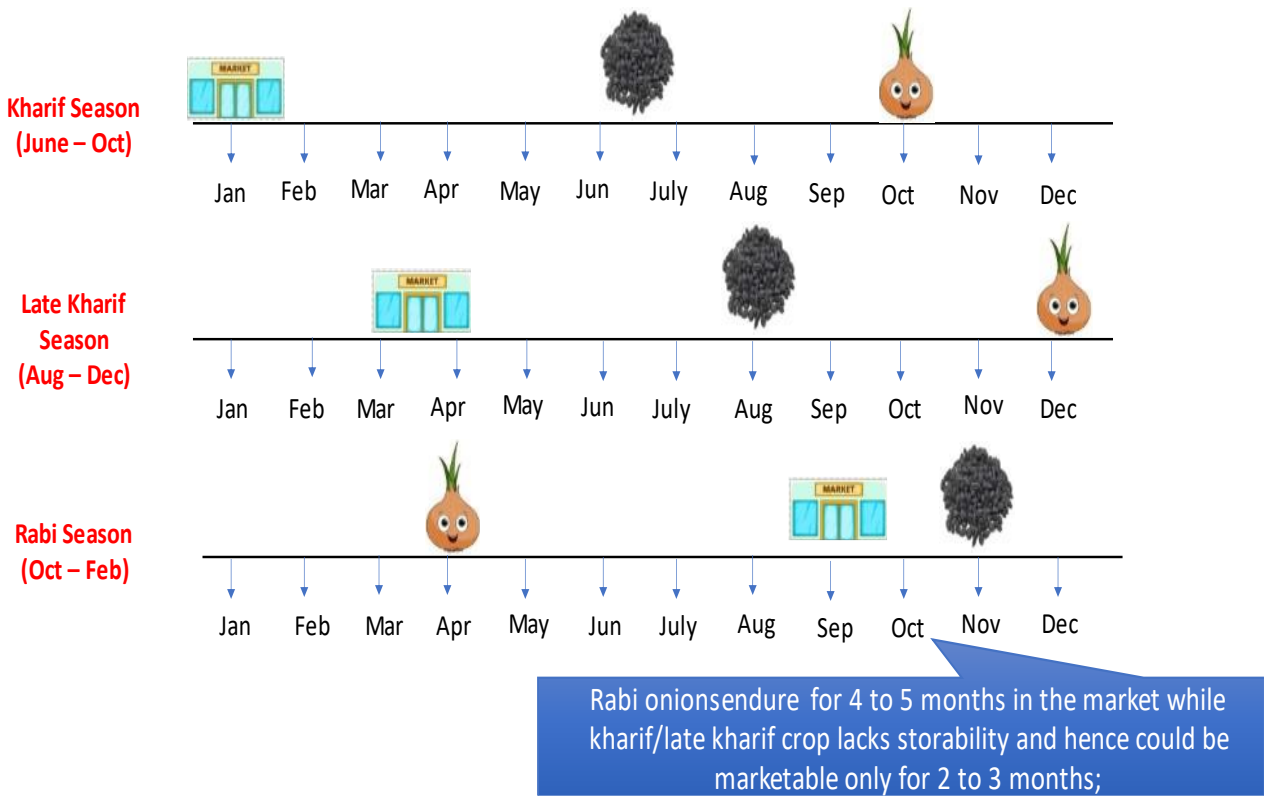


Fig. 2: Seasonality in onion production and market endurance

Source: Developed by author; see Soundarya, 2022

3.2.3 To assess relative impact of Minimum Export Price (MEP) on EUV (price) realization of onion

The monthly data for the period from January 2011 to March 2021, on country-wise Export quantity, export value and export unit value are sourced from ITC International Trade map website. The measure of quantity is in kilograms and Export unit value in $/kg. Considering the export quantities (1,537,496.89 MT in 2021), top 10 exporting countries were identified. A small tabular analysis to depict the export composition both by quantity and value is depicted in terms of pie graphs.

3.2.3.1 Seasonal Compilation of World onion Trade

Season wise (Rabi, kharif and late kharif) export quantity of top 10 onion exporting countries is calculated for the year 2018 and 2019. Months considered for these seasons are deliberately coincided with the respective season's onion marketing months (Fig. 2). That is, the period during which that season's onion is available in the market. Thus, rabi (April

– September), kharif (October – January), late kharif (February – March) onion marketing season is customized. Such delineation has based on previous studies (Kalamkar and Makwana, 2015), (Shah, 2017), (Premi and Premi, 2017). Aggregate of each season for two years is calculated and their average is denoted as total export quantity of the season. In each of onion marketing season, it was attempted to identify the number of exporters, so as to assess the supply concentration in the international market. The average Export Unit Value is calculated using weighted average method (export quantities considered as weights).

$$\overline{X} = \sum \frac{w_i x_i}{w_i} = \frac{w_1 x_1 + w_2 x_2 + w_3 x_3 + \ldots + w_n x_n}{w_1 + w_2 + w_3 + \ldots + w_n}$$

Where,

$\overline{X}$ = weighted average

W_i= weights applied to x values (export quantity) in the year 'i'

x_i= data to be averaged (Export Unit Value) in the year 'i'

Pie charts are used to depict the top ten onion exporting countries in different seasons.

3.2.3.2 Simple Linear Regression – Impact of MEP on Export quantity and EUV

Linear regression is used to estimate the influence of MEP on both export quantity and Export Unit value on the top eleven onion importers from India. Quantity is measured in tons, Export Unit Value as $/ton and MEP as $/ton for this analysis.

Y = a + bX

Where,

X is the independent variable (MEP)

Y is the dependent variable (Export Quantity or EUV)

b is the slope of line

a is the intercept

In addition, the graph containing MEP, Export quantity from India and Export Unit value is plotted for these major importers (See Annexure – IV).

RESULTS AND DISCUSSION

IV RESULTS AND DISCUSSION

This chapter attempts to bring out the relevant facts and possibilities of handling price fluctuations, to keep the interests of consumers, especially during the period of price surge. While farmers' interest is more important, most of the benefit of price surge is encashed by trading community, containing price peaks is important.

4.1. Temporal and Spatial Analysis of Onion Production in India

Onion is cultivated in India in three seasons *viz.,* Rabi, Kharif and Late Kharif. The area, production and productivity numbers of onion in India presented in table 1 is a total of all the three seasons put-together. It is observed that in the last decade (2010-18), the onion production evidenced a continuous increase, mostly supported by increase in productivity, while area expansion is also seen. The growth rate numbers clearly spells out an annual growth of 5.36 per cent per annum in production, an increase from 15 million tonnes in 2010 to 26.6 million tonnes in 2020. Onion area hovered around 1 to 1.3 million ha, highest being in the years 2015 and 2017, while there was a considerable inter-year variation. A 2.74 per cent growth in onion area could be an indicator of growing commercial importance of the crop among farming community (Shah, 2017). Onion yields have been reliably performing with a steady growth of 2.3 per cent annually.

Table 1: Area, Production and Productivity of Onion crop in India over the last decade

Year	Area ('000 HA)	Production (000 MT)	Productivity (MT/HA)
2010	1063.8	15117.7	14.21
2011	1087.2	17511.1	16.11
2012	1051.5	16813.0	15.99
2013	1203.6	19401.7	16.12
2014	1173.35	18927.41	16.13
2015	1320.04	20931.21	15.86
2016	1292.61	22409.24	17.34
2017	1315.24	22071.24	16.78
2018	1219.25	22819.43	18.72
2019	-	26091.38	-
2020	-	26641.02	-
CAGR (%)	2.74***	5.38***	2.30***
R-square	0.67	0.95	0.71

*Note: *** indicates statistical significance at 1% level; CAGR means Compound Annual Growth Rate*

The seasonal spread of onion production in India is as follows: onion seedlings transplanted in July-August are harvested in October-December constitute Kharif crop, while late kharif onions are transplanted in October-November which are harvested in January-March. Similarly, rabi crop is transplanted in December-January and harvested in March-May span. Table 2 presents season-wise production of onion from 2014 to 2019[10]. Onion production in India is majorly concentrated in Rabi season (65-78% during 2014 to 2019), (Reddy *et al*., 2016) while there is fluctuation in the contribution over the years mainly because of weather factors. The key weather factor is monsoon, the degree of which affects the extent of onion that can be sown/transplanted and harvested in the kharif season. If timely sowing in kharif is affected, late kharif crop is sought. In the recent decade since frequent monsoon (during kharif) aberrations are evidenced in the key producing state, Karnataka and to some extents in Maharashtra, production in the season is not quite reliable. A growth rate of 3.72 per cent p.a. for rabi onion production indicates its reliability (note that it has an R^2 of 0.9), while in kharif onion production grew at a rate of 3.59 per cent, but the model goodness is quite lower (0.69), indicating inter-year fluctuations. Production share of rabi onion is showing an upbeat over the last five years mainly due to the decline in production of late-kharif onion (Kalamkar and Makwana, 2015). The decline could be mainly due to the monsoons.

Late kharif onion production evidenced a decline from 38 lakh tonnes to 15.7 lakh tones (-7.62% growth) since late kharif sowing takes place when there is delay in kharif sowing due to delay in rainfall or excess early rains. The growth rate in production is higher in Rabi season (3.72%) than in kharif season (3.59%). All the 3 growth rates were significant at 1% level, while the growth model showed a considerable goodness of fit (R^2). In terms of percentage, the kharif onion production has retained a share of around 15 per cent (except in year 2018 during which it was 21%). It should also be noted that in kharif season, onion production is majorly concentrated in the southern states of Karnataka, Andhra Pradesh and Tamil Nadu. In general, onion production profile of India is distributed as 70:20:10 across Rabi, kharif and late-kharif seasons. Similar percentage distribution of onion production across seasons is reported by FICCI (2019) (65:15:20 for Rabi, Kharif

[10] It is worthy to note that the area and productivity figure by seasons is not published by any secondary source. Even the season-wise production data is available for the period 2015 to 2019 in the monthly reports about onion production by the Ministry of Agriculture, Government of India.

and Late kharif) and Ministry of Agriculture and Farmers' Welfare (2014) (70:20:10 for Rabi, Kharif and Late kharif).

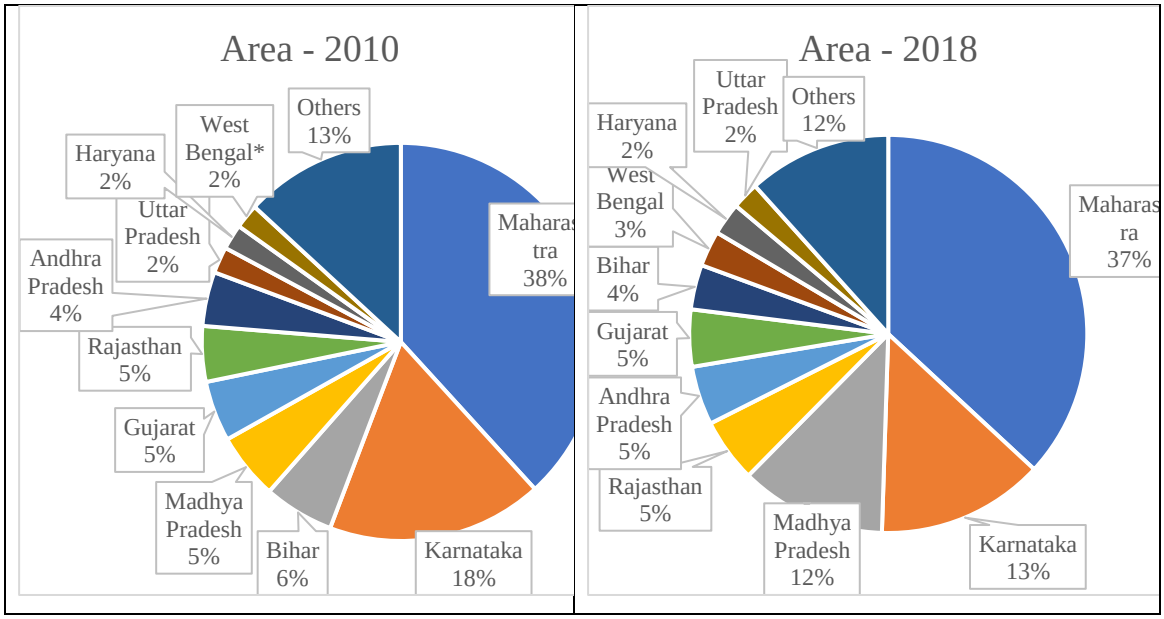
Table 2: Season-wise trend of Onion Production (in Lakh tonnes) in India

Year	Kharif		Late Kharif		Rabi		Total
	Production	Per cent	Production	Per cent	Production	Per cent	
2014	29.00	15.34	38.00	20.11	122.0	64.55	189.00
2015	31.00	14.83	42.00	20.10	136.0	65.07	209.00
2016	34.00	15.18	45.00	20.09	145.0	64.73	224.00
2017	35.00	15.09	46.00	19.83	151.0	65.09	232.00
2018	48.41	21.21	21.50	9.42	158.3	69.36	228.19
2019	39.00	15.36	15.74	6.20	199.2	78.44	253.94
CAGR (%)	3.59***		-7.62***		3.72***		
R square	0.69		0.57		0.90		

*Note: *** indicates statistical significance at 1% level*

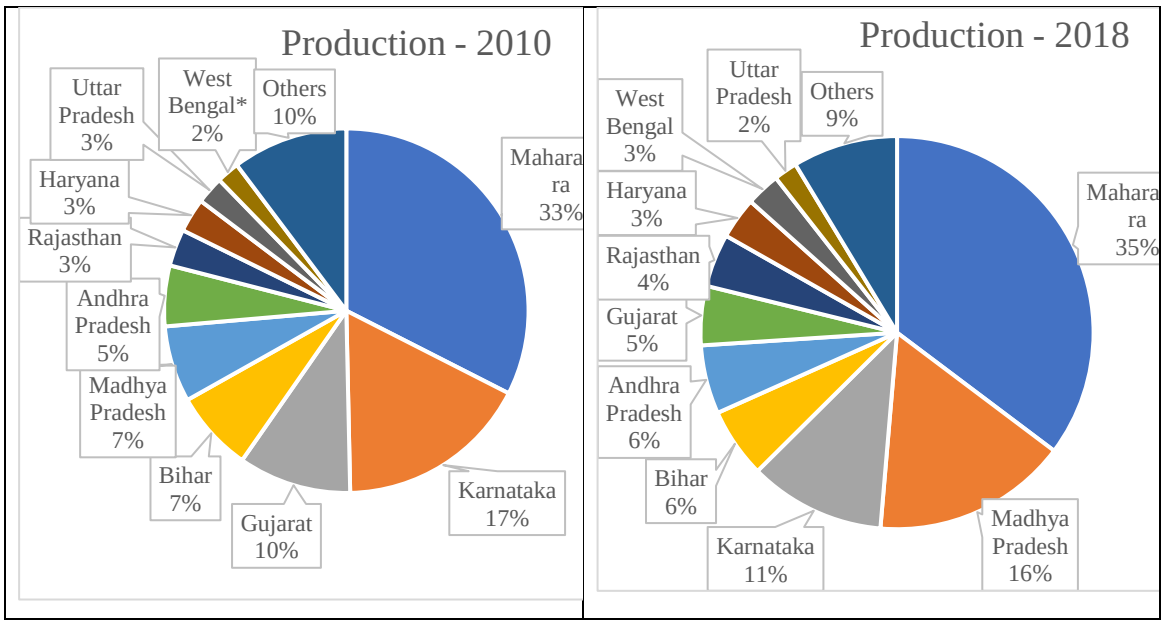
Maharashtra (37-38%) and Karnataka (13-18%) put-together account for over half of onion area in India (Fig. 3). These two states also accounted for half the total production (Fig. 4). By production Maharashtra is the ace producer with 33-35 per cent contribution while the share of Karnataka was unstable with 18 per cent contribution in 2010, declining to just 11 per cent in 2018. The decline in production share in the latter could be mainly due to the excess rainfall, as the state is predominant kharif producer and monsoon pattern is a key influencer of its production. The other major producers are Madhya Pradesh, Rajasthan, Andhra Pradesh, Bihar with around 5 per cent of total onion crop area in India, with exceptional increase in onion acreage in Madhya Pradesh (from 5% to 12%). West Bengal, Haryana and Uttar Pradesh contributed about 2-3 per cent to onion area as well as production. The onion acreage of top 10 states constituted to more than 85 per cent.

Top 10 producers contributed 90 per cent of nation's onion production (Fig. 4). Madhya Pradesh onion production share exceeds its area share. All the top onion producer's production shares were about the same, as their area shares.



*Note: *West Bengal data of the year 2011*

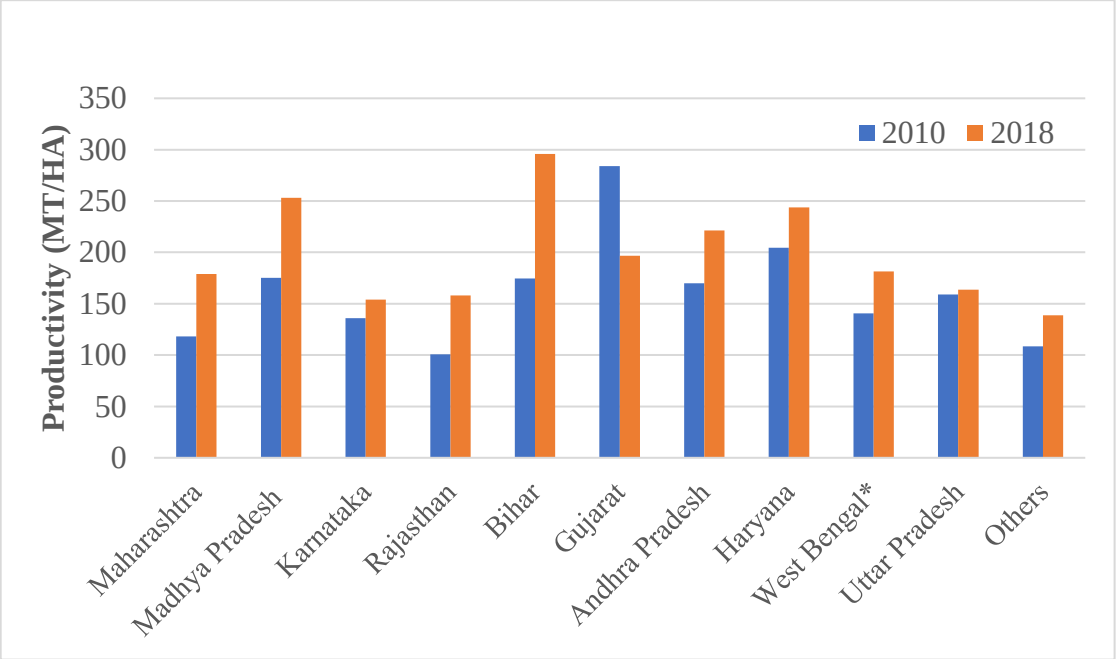
Fig. 3: Comparison of Area under Onion production among states in 2010 and 2018



*Note: *West Bengal data of the year 2011*

Fig. 4: Comparison of production of Onion among states in 2010 and 2018

In terms of productivity, there was considerable difference (Fig. 5). All Indian states evidenced increased productivity over 2010 to 2018, with the only exception of Gujarat. Productivity of all states was over 100 MT/ha. Productivity of lead states, Maharashtra and Karnataka was around 125 to 150 MT/ha, while states like Bihar, Andhra Pradesh, Uttar Pradesh and Haryana bid relatively better productivity. Possibility of expanding onion area in these states could be beneficial to harness increased production. But, since the main problem in onion supply has been in kharif/late kharif seasons, it would be desirable to know if these states could grow onions in this season.



*Note: *West Bengal data of the year 2011, instead of 2010*

Fig. 5: Productivity comparison among top ten onion producing states in 2010 and 2018

Growth in area and production of onion across major Indian states over the last decade is presented in Table 3. Top ten onion producing states in India is analysed by calculating the exponential growth rates. The statistical significance of growth rates and model fitness (R^2) is also presented. Rest of the states are pooled together and analysed separately as 'others'.

Madhya Pradesh (9.85% and 10.89% p.a. respectively) and West Bengal (8.26% and 10.93% p.a. respectively) evidenced a commendable growth in both area and production over the last decade. These two states contributed 18 per cent and 3 per cent, respectively to onion production of India in the year 2018. Maharashtra being the highest

onion producing state (35%), accomplished 4.08 per cent growth in area and 8.89 per cent growth in production. Uttar Pradesh (-4.49%) and Gujarat (1.49%) hit a decline in area, while production increased satisfactorily (1.93% & 1.97% respectively). Karnataka being another major producing state (Kharif season), area and production had almost stagnated (0.8% and 0.74%, respectively). Andhra Pradesh has negative growth rate in terms of production (-0.75% per annum) despite the positive growth in area (0.62%). Rajasthan with a production share of just 3 per cent in 2010 accomplished 10.11 per cent growth in production, though there was fluctuation in area under the crop (0.04% p.a.), probably supported by contribution from enhanced productivity. All the growth rates in both area and production were statistically significant either at 1 per cent or 5 per cent, while the goodness of fit of many growth functions was above 0.6, meaning that the exponential model explained the growth with over 60 per cent of accuracy.

Table 3: State-wise growth in area and production of onion during 2010 to 2018

States	Area		Production	
	Growth Rate (%)	R^2	Growth Rate (%)	R^2
Maharashtra	4.08 **	0.27	8.89***	0.89
Madhya Pradesh	9.85***	0.78	10.89***	0.78
Karnataka	0.80 **	0.03	0.74 **	0.04
Rajasthan	0.04 **	0.00	10.11***	0.74
Bihar	0.52 **	0.62	1.58***	0.64
Gujarat	-1.49 **	0.02	1.97 **	0.03
Andhra Pradesh	0.62 **	0.01	-0.76 **	0.01
Haryana	3.27***	0.66	1.90 **	0.14
West Bengal	8.26***	0.86	10.93***	0.95
Uttar Pradesh	-4.49 **	0.04	1.93***	0.58
Others	1.71 **	0.19	1.98 **	0.45

*Note: ***&** indicates statistical significance at 1% & 5% level respectively*

4.2 Production, demand, export and import of onion in India and its influence on domestic onion price

Demand for onion in India is generally assumed to be constant throughout the year, with no much seasonal variation. Production of onion in rabi season is a direct function of area, since climatic variations seems to be of less influence. Though in general onion export and import is free, it is regulated during kharif (and late kharif) season in order to protect the interests of consumers, with the imposition of MEP, especially since last one decade. The domestic onion prices are being mainly measured at two major levels, *viz.*, wholesale and retail. Though there are several studies that have analyzed wholesale price of onion (Roy, 2020, Saxena and Chand, 2017), to conclude the onion price behavior and its relationship with MEP, studying intricacies on retail prices is of utmost importance mainly because several studies have cited the fact that there exists a parity between the wholesale and retail prices of onion (Fig. 6). This parity is because of malpractices such as hoarding which has indicated that though wholesale prices come down because of government intervention or supply bridging, the retail prices may not follow the suit. As per our review, there has been no studies analyzing MEP with retail prices. Hence, the present study has chosen the Consumer Price Index of onion for analysis.

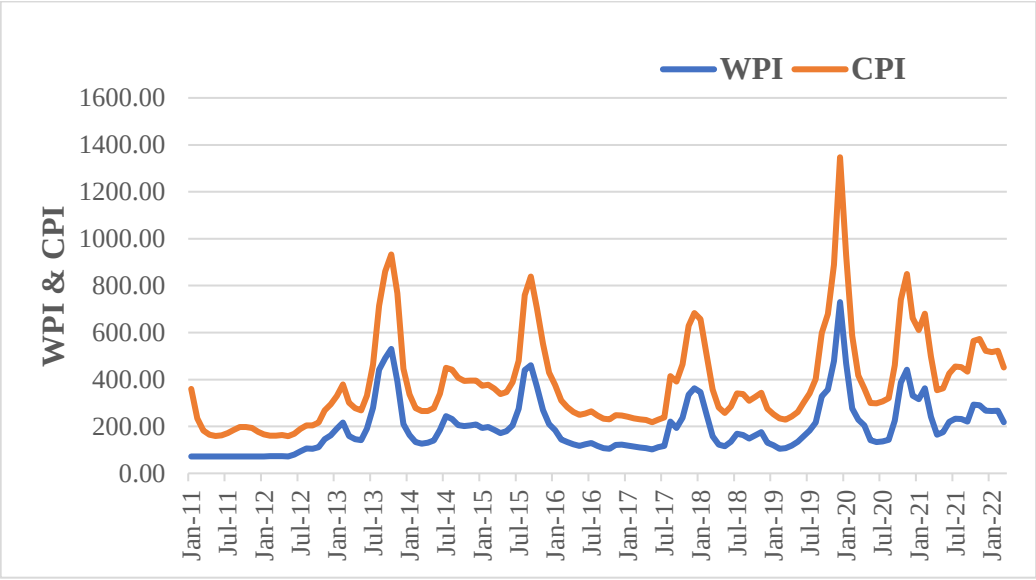


Fig. 6: Parity between Wholesale Price Index and Consumer Price Index

It would be interesting to understand the monthly seasonal pattern of onion at the all-India level. The monthly CPI for the time period from 2011 to 2021 is analyzed to generate monthly seasonal indices that are devoid of other components such as trend,

cyclical and irregular, that are an integral part of any time series. Fig. 7 represents the monthly seasonal price index of onion for the time period 2011-21 and 2017-21 separately, which represents the long-period and short-period (more recent) scenarios, respectively. From September to February months of the year, onion prices generally remain above the average (index value above 100), while for the rest of time (March to August) prices dip below the average. The peak price is noticed in the month of December while the lowest being in the months of April to July (peak rabi onion harvest months). The long-period seasonality depicted relatively flatter seasonality as compared to seasonality in recent years.

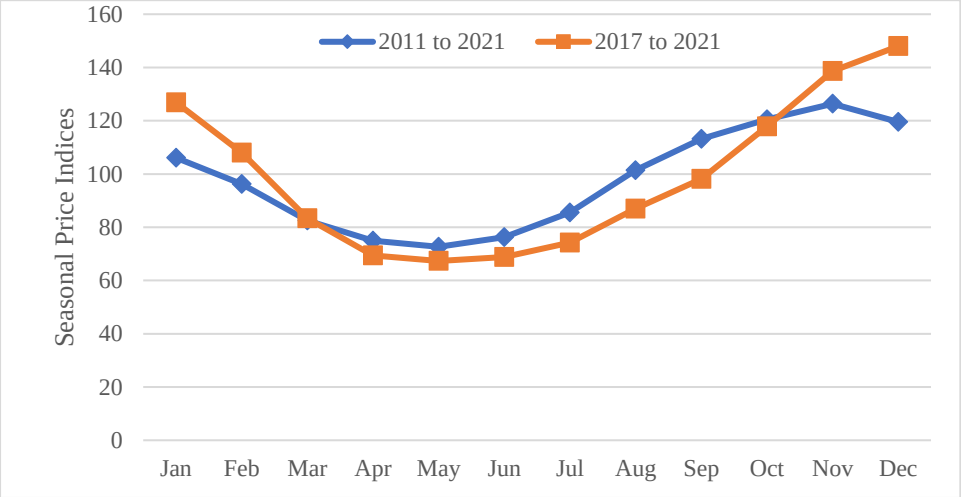


Fig. 7: Seasonality indices of CPI for 10 years (2011 to 2021) and 5 years (2017-2021)

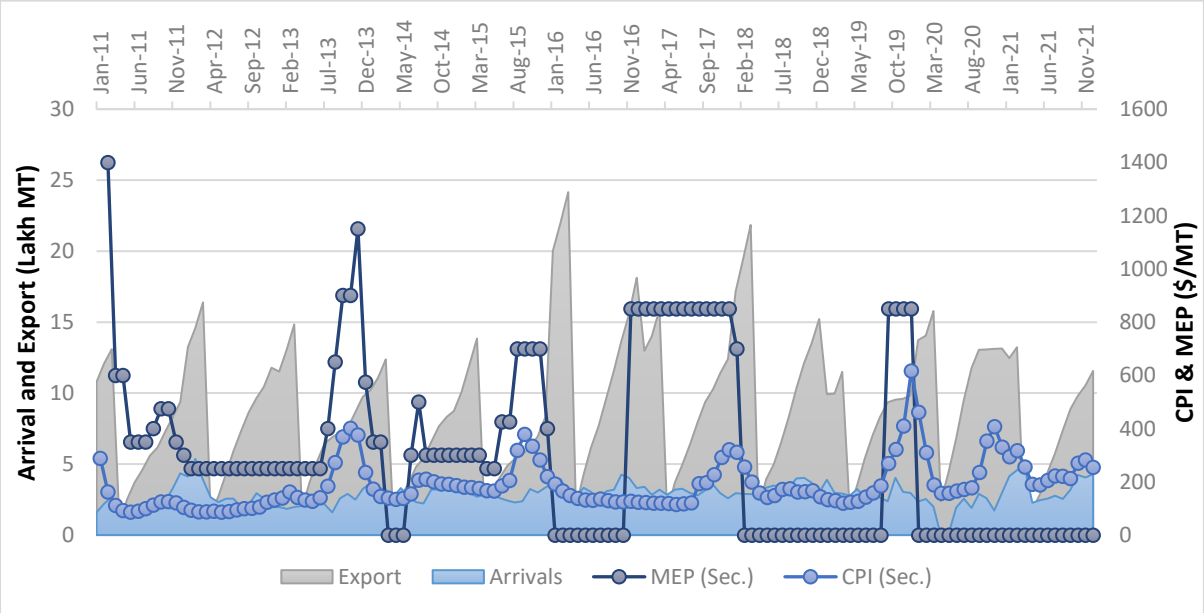


Fig. 8: Graph inter-relating all the variables (Export, Arrivals, MEP and CPI) 2011 to 2021

For a deeper understanding of production, export and prices all parameters have been depicted together in the Fig. 8 in order to understand the interconnected aspects in a single glance. The graph represents export quantity and market arrival at the all-India level on the Primary vertical axis, while CPI and MEP are read on secondary vertical axis. It is evident from the figure that the onion exports depicted higher fluctuations than domestic market arrivals. The data indicated export quantities to be more than domestic market arrivals (with the exception of April month in which arrivals were higher than exports in each year) which raise doubts! Since export quantity is a part of market arrival (unless the commodity is re-exported), the latter should be higher than former, but in reality, the data shows the contrary.

During a period of 11 years (between 2011 to 2021), onion exports saw distinct peaks in almost as many times. Export peaks are attained mostly in and around the month of January, while production peaks are evident in the months between April to June (though rabi onions are available in the market upto September) which accounts for 65-78 per cent of total onion production in India. Exports have been the least during the month of May. The reason could be that the rabi onion harvest may probably be used as buffer for local market to span up to the month of September-October, when the kharif harvest is expected. This phenomenon might require further elaboration, but it is not the purpose of present thesis. The arrivals ranged from about 9 thousand MT to 5.3 lakh MT a month during the study period. The market arrival and export also followed a similar monthly trend. The pattern of MEP and its specifics are discussed in the next section, while certain aspects relevant to this section is dealt with here. Regarding the retail price (CPI), though there are monthly variations, there were distinct peaks in every alternative year starting from 2011, in months ranging from September and January. Price peaks indicate the shortage in supply (kharif or late-kharif crop) forcing a surge in price, while the rabi onions are getting exhausted and export demand also playing a crucial role. It is noteworthy that the MEP have also been raised during price surge months, but the price spikes have mostly been unaffected. The only exception is 2017 in which though price surge was onset in the month of September (193.6), it peaked only in the month of December (320.6), while in most of the previous years, it peaked in September-November months. Since the last 5 years or so, the price peak months seem to have shifted to November-January months. This change in peaking trend is also seen in the Fig. 7.

The objective to test the effect of changes in arrivals (used as proxy for production and import), export and MEP on onion retail prices is carried out using regression analysis. Since the time series data exhibits many problems such as autocorrelation, multicollinearity etc, using usual regression models as such was not suitable. Hence, the stationarity of data is first tested with (auto)ARIMA model for individual variables used in the analysis (Table 4)[11]. The model significance test results have also been presented in the table. While CPI data was stationary at first differencing, exports and market arrivals were stationary without any differencing. From the ARIMA model estimated using the (p,d,q) values depicted in Table 4, the residual terms were calculated. The purpose of this calculation is to use the residues to find the number of lags with which the independent variables influenced the dependent variable (CPI).

Table 4: Test of stationarity of variables for estimation of residuals for cross correlation

Variable	Arima Order	Coefficients	Standard error	Log likelihood	AIC	BIC
CPI	(1, 1, 3)	0.5525 -0.2436 -0.1531 -0.5801	0.1003 0.1034 0.0765 0.0809	-678.95	1367.89	1382.27
Export	(2, 0, 1)	1.3120 -0.5506 -0.7258	0.1097 0.0762 0.1042	-1887.66	3785.32	3799.74
Arrival	(1, 0, 1)	0.5679 0.2014	0.1097 0.1320	-1634.1	3276.2	3287.73

The depictions in Fig. 9 represents the autocorrelation and partial autocorrelation function of the residual terms (of independent variables) obtained in ARIMA model for various lags. The horizontal tick lines indicate the benchmark, crossing which the autocorrelation is to be considered significant. It is clear that for both the variables, the significant lags was either 'zero' or were evident over 12 (months). Since, the lags were

[11] The whole analysis is carried out in R-Studio software and pertaining codes are presented in annexure - II.

more than a year, the same could be ignored and further analysis could be carried out to use residual terms.

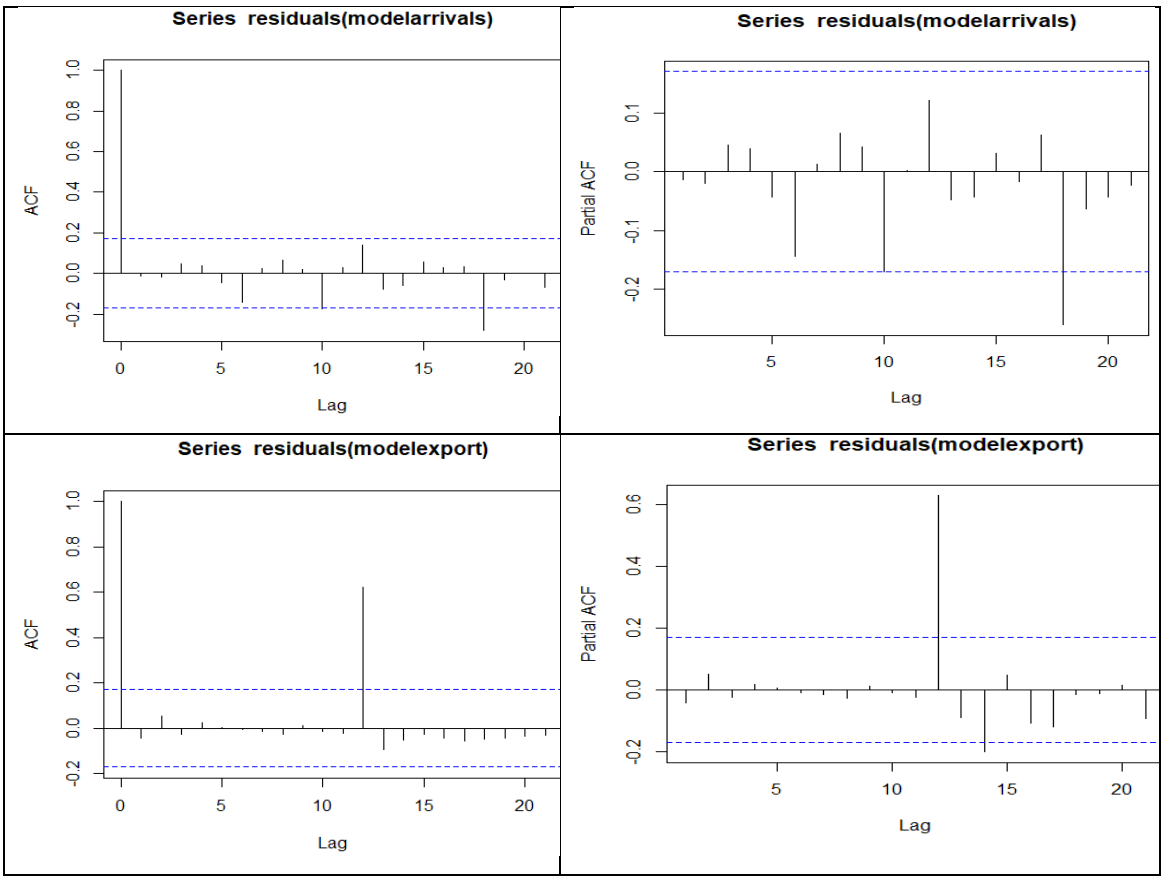
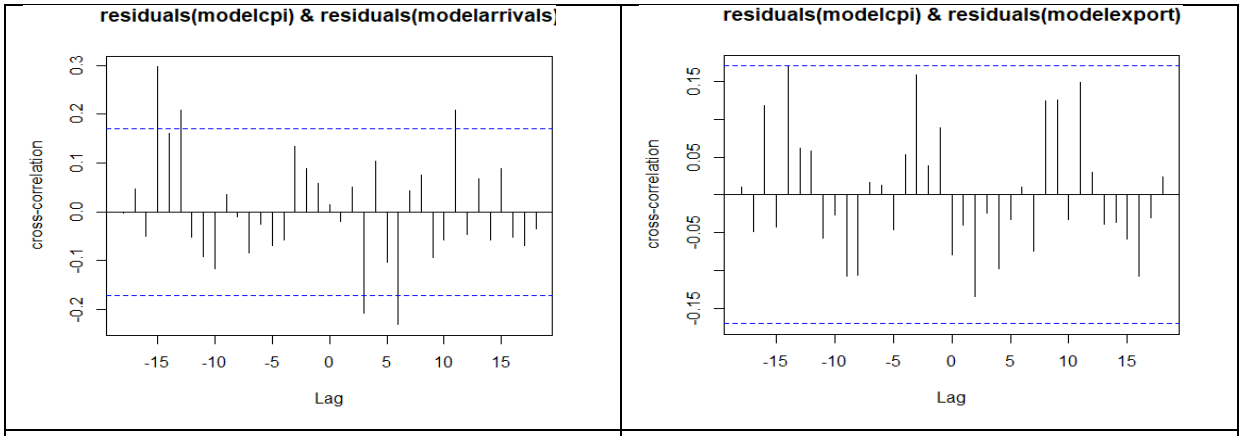


Fig. 9: Auto-correlation (ACF) and Partial auto-correlation (PACF) functions of the independent variables (arrival & export)

Fig. 10 depicts the cross-correlation between CPI with arrival (Fig. 10 A) and CPI with export (Fig. 10 B) which represents the number of lags of one variable influencing the other. Since the X-axis depicts lags in both positive and negative directions, they have to be interpreted differently. The negative side (on X-axis) indicates influence of CPI on arrival (or export as the case maybe) and the positive side indicates vice-versa. That is influence of arrival (or export) on CPI. Since our objective is to study the influence of arrival and export on CPI, our focus would be on the positive side of X-axis. Thus, for arrivals (Fig. 10 A), the number of lags of arrivals significantly influencing the CPI are considered to be 3, 6 and 11 months (crossing tick mark line). For export, since there are no lags crossing the tick-line, none were significant. But, the highest line (11) was considered for further analysis. Thus, the further analysis was carried out with the ARIMA X-reg function to include CPI as dependent variable and MEP at base and 3, 6 and 11 lags of arrivals and 11 lags of export as independent variables in the analysis.



(A) CPI with Arrival | (B) CPI with Export

Fig. 10: Cross-correlation between residual terms of dependent (CPI) and independent (arrival and export) variables

The results of ARIMA X-reg function indicated above is presented in Table 5. It was expected that at least some of these variables had influence on the retail price of onion. Though it is observed that export at 11 lag and arrival (all three lags) on the CPI, their magnitudes close to zero. While arrival and 3 and 6 lags and export at 11 lags exhibited negative influence, arrival at 11 lags showed a positive influence. A significant but close to zero influence means almost no influence. The variable MEP had a positive influence (as against expected negative influence) on CPI to a moderate extent (coefficient 0.05) and was statistically significant too. Though it was hypothesized that the retail price would be influenced (reduced by increasing MEP) by the MEP along with the other variables, there was no such significant influence being observed.

Table 5: Influence of arrival, export and MEP on CPI analyzed using ARIMA X-reg function

Variable	Arima order	Coefficients	Standard error	Log-likelihood	AIC
CPI	(1, 1, 0)	0.3547 -0.3147 -0.5021	0.1043 0.1673 0.1627	-633.82	1285.65
Export lag by 11 months		-1e-04	2e-04		
Arrival lag by 3 months		-1e-04	2e-04		
Arrival lag by 6 months		-1e-04	2e-04		
Arrival lag by 11 months		0e+00	3e-04		
MEP		0.0537	0.313		

This phenomenon of MEP's positive influence on CPI is further confirmed in the Fig. 8. The soaring trends in CPI coincide with MEPs being held up. This is rightly an indicative that the MEPs have not helped in reducing the domestic consumer prices. Perhaps, alternatively, the CPI could have shot up too very high if MEP were not imposed. Thus, the present study could not convincingly conclude about the effectiveness of the fact that MEPs in reducing domestic retail prices of onion.

4.3 To assess relative impact of Minimum Export Price (MEP) on EUV (price) realization of onion

Minimum Export Price regulates exporters from selling the produce to overseas buyers at a price lesser than the one specified. If there were to be prior agreements committing on price (with appropriate documentation), exporters will be allowed to sell below MEP only upto the committed quantity. Hence, it would affect both the Export Unit Value (EUV) and the quantity exported. This section analyses these interrelationships for Indian onion and further presents the comparative EUV of Indian onion with other top exporting countries. India being one of the top onion exporters, comparative value realization would throw more light on average prices of domestic onions vis-à-vis the

others. An attempt has been made to depict the export by Indian crop season, so as to observe if there is any perceptible difference.

The MEP as a tool of domestic price control was sought from 2011 (Premi and Premi, 2017). It is imposed when there is an onset of surging trend in onion price, which is usually encountered at the beginning of kharif onion harvest season, if there is a heavy downpour damaging standing onion crop. Reduced sowing of onion due to typical drought could also be another reason. By this season rabi onions would have got exhausted, thus fuelling price surge that is already onset. Hoarding by trading community with profit motives is another major cause identified (Gummagolmath, 2012). In initial years of MEP imposition upto 2015, MEPs was in vogue for the whole year (Fig. 11). The MEPs are specified separately for 'rose onion and Krishnapur onions', while for onions in general there is a separate MEP. Upto June 2013, the two MEPs were different, with rose onion MEPs being fixed higher, as they are key export crops destined mostly to the gulf (Indhushree *et al*., 2017). Then on, there seems to be no distinguishing between MEPs of rose onions and onions in general. There used to be frequent revision in MEP, even on weekly basis, to increase it progressively when the retail prices could not be contained. Again, even in withdrawal, MEPs were gradually decreased. But later on, it seems that as price pattern and MEP relationships were perceived, probably the MEPs are maintained at a stable level. It also seems that there was a considerable experimentation before stabilizing on MEP policy.

The pattern of MEP during the study period is explained here. MEP was on from February 2011 (600$/tonne) to January 2014 (350$/tonne) with no turning off. From January to April 2011 (170 $/tonne) the MEP gradually declined, while ascended from June 2011 onwards which peaked in September to October 2011 (350$/tonne). Upto June 2013, it was maintained at 150 $/tonne, while July 2013 (400$/tonne) onwards, MEP started increasing and reached maximum in November 2013 (1150$/tonne). Then on declining gradually to nil MEP in March 2014. From June 2014 to December 2016, MEP was revised about 8 times, while peaking during Aug to Oct 2016 at 700$/tonne, which declined then on. Again, from Oct 2016 to Feb 2018, MEP was held at 850$/tonne. While it was off during whole of 2018, it got turned on in September 2019 (850$/tonne) up to Dec 2019. Then onwards, probably onset of COVID seems to have shifted the focus onion export

policy away from MEP[12]. During the last decade, heavy monsoons coinciding with kharif onion harvest are evidenced every alternate year (Ghosh *et al*., 2022). Thus, to contain surging onion prices MEPs were sought during such years. It is to be noted that, MEP was not triggered during 2012, 2016 and 2018. The decadal pattern of MEP is documented by Gulati, 2020. At times, Government has sought the quantitative restrictions and blanket ban on export, as subsidiary tools to contain onion exports.

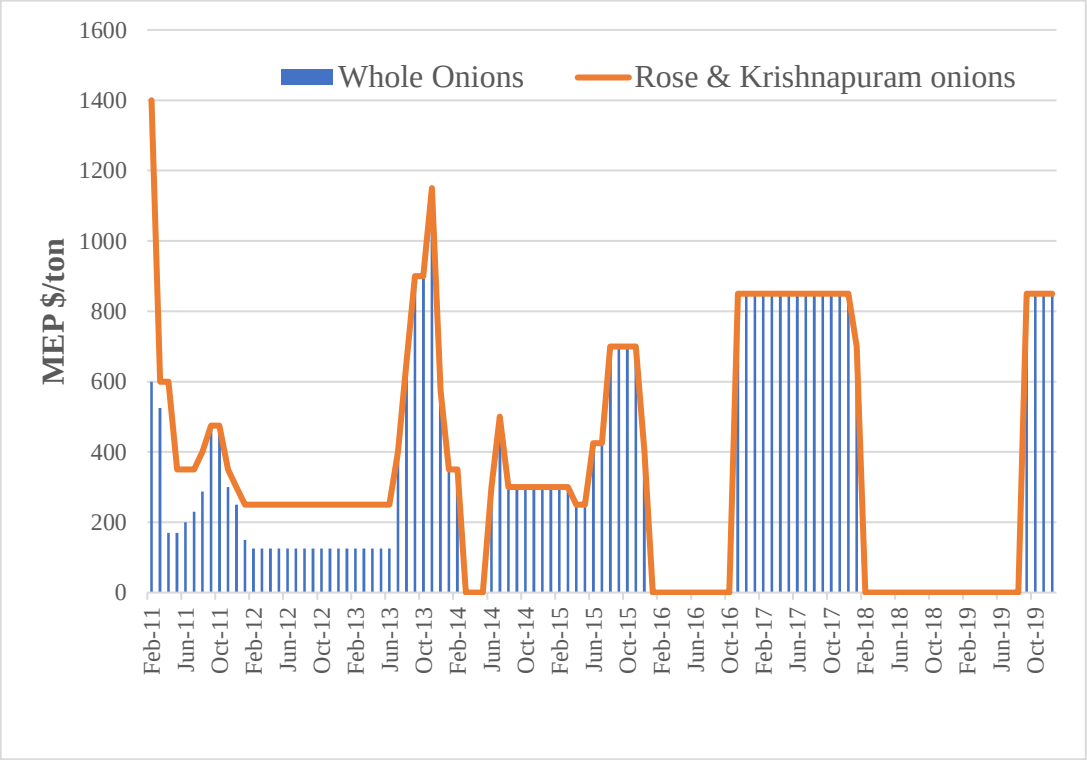


Fig. 11: Minimum Export Price Policy imposition timeline for Whole Onions and 'Rose & Krishnapuram Onions' from 2011 to 2019.

In order to provide an overview of global onion trade, the monthly export data has been grouped into Indian onion marketing seasons (see Fig. 2). The overview of onion trade is presented in Table 6.

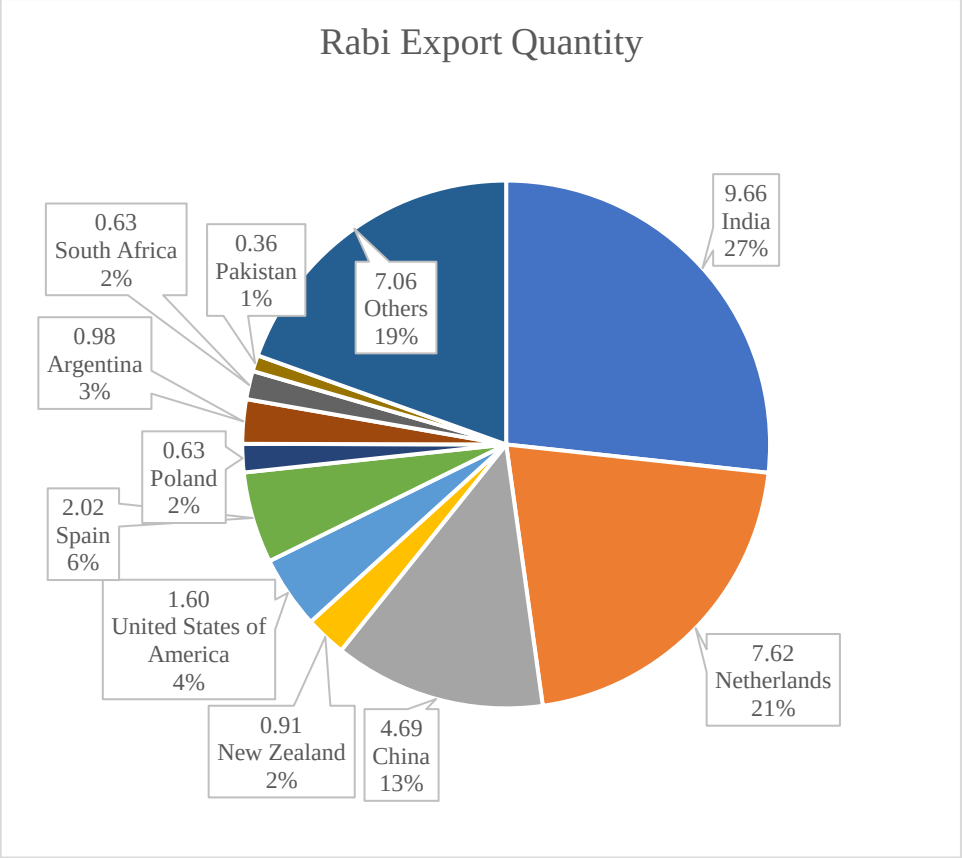
[12] It is observed during 2021 and 2022 years in which though abnormal monsoon affected onion crop, the prices did not shoot up during November – December months. It is given to understand that the government is using Price Stabilization Fund, instead of MEP which seems to be effective in containing onion retail prices. At the same time, interest of farmers has been jeopardized, which requires deeper analysis.

Table 6: Season-wise World export of onion during 2018

Onion Seasons	No. of exporting countries	Quantity (Tonnes)	Percent share of quantity	Average EUV ($/tonnes)
Rabi	98	2829095.81	47.55	1534892.446
Kharif	91	2125681.18	35.73	1162174.835
Late Kharif	83	994500.052	16.71	587588.5128
Total	**272**	**5949277.04**	**100**	**3284656**

Source: https://www.trademap.org/Country_SelCountry_MQ_TS.

The table indicates that highest onion export is observed in the Rabi season (47.55 %) followed by Kharif (35.73 %) and Late Kharif season (16.71%). The proportion is a bit different from that of Indian onion production (75:15:10). Same pattern is also seen in the number of exporting countries, Rabi (98), Kharif (91) and Late Kharif (83). This indicates that the Rabi season contributes the highest share in export globally.

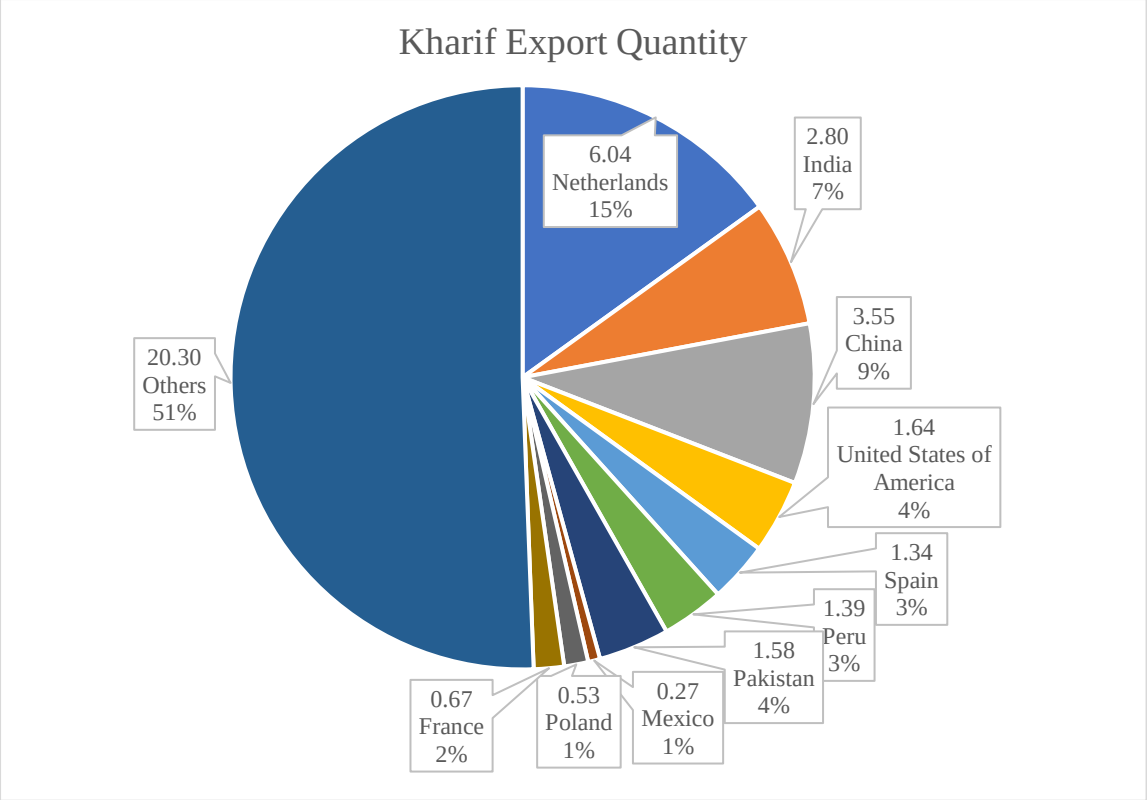


Note: Export Quantity in lakh tonnes

Fig. 12: Global top ten Onion exporters during Rabi (average of 2018 and 2019)

Source: https://www.trademap.org/Country_SelCountry_MQ_TS

The following analysis provides a glimpse of onion trade pattern in the world. While there was considerable difference in world onion export across the seasons, India is the topmost exporter (1.06 trillion tonnes, 27%) in rabi season (Fig. 12), while in other seasons (Fig. 13&14) it's export share remained smaller (5-7%). India, along with Netherlands (0.83 trillion tonnes; 21%) and China (0.5 trillion tonnes; 12%) were major exporters. Top 10 exporters constituted over 75 per cent of world rabi onion exports.

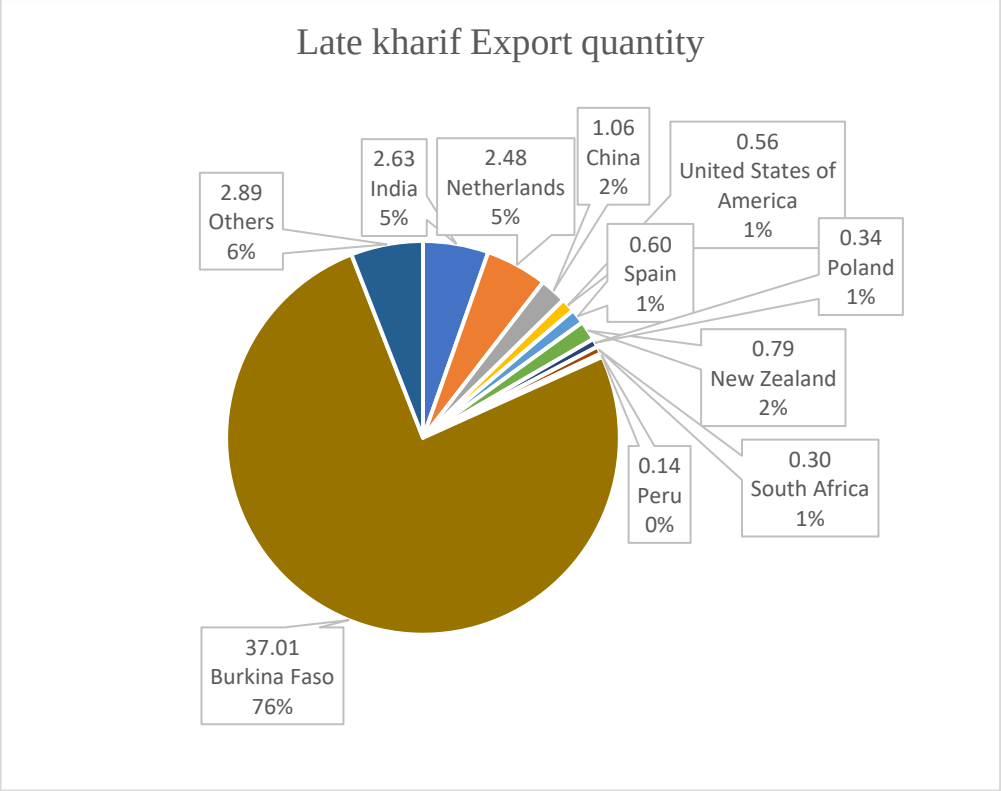


Note: Export Quantity in lakh tonnes

Fig. 13: Global top ten Onion exporters during kharif (average of 2018 and 2019)

Source: https://www.trademap.org/Country_SelCountry_MQ_TS

Kharif exports is predominated by Netherlands (0.6 billion tonnes; 15%), China (0.36 billion tonnes; 9%) and India (0.28 billion tonnes; 7%). The top 10 kharif onion exporting nations contributed to less than half the total. Rest of the world (labelled as 'others') exported 2.03 billion tonnes of onion. But, during late kharif season, export was totally dominated by Burkino Faso (76%) exporting 3.7 billion tonnes of onion. Though India (0.26 billion tonnes), Netherlands (0.24 billion tonnes) and China (0.11 billion tonnes) figured among top 10 exporting countries, their share was considerably small. About 2 per cent export contribution from New Zealand and one percent each from USA, Spain, Poland and South Africa (ranging from 30-78 million tonnes) constituted major late kharif onion exporters. Rest of the world contributed about 6 per cent.



Note: Export Quantity in lakh tonnes

Fig. 14: Global top ten Onion exporters during late kharif (average of 2018 and 2019)

Source: https://www.trademap.org/Country_SelCountry_MQ_TS

When a country has option to import a similar quality of a given produce from several producing nations, it would prefer to buy from the one which sells at a cheaper price. If there are no trade restrictions, prices of the produce are determined by the forces of demand and supply freely (Sudhir, 2004). A trade restriction such as MEP would invariably increase its export price. In such a circumstance, the importing nations would explore and compare prices in other exporting countries, before finalizing purchase agreement. Therefore, onion purchase quantity and price might have got affected too, because of MEP imposition. An effort has been made to quantify such an effect of MEP enforced by India on EUV realized and quantity of onions that could be exported to the major importers with the help of linear regression analysis. It can be observed from table 5 that all the top importers of Indian onion were neighbouring South-East Asian and Middle East countries (Saxena and Chand, 2017). On an average, these countries contributed to 85-90 per cent of total onion exports of India. Usually, MEP values fixed by India have been

in the range of 850 to 250 $/ton. Recently in 2019 the MEP stood at $850/ton in kharif and late kharif months, while during the rest of the year it used to be nil.

Table 7: Impact of MEP on EUV and Export Quantity of top-ten Indian Onion Importers during 2011 to 2021

Importing Nations	EUV ($/tonne)		Export Quantity	
	b value	R^2	b value	R^2
Bangladesh	0.38 ***	0.37	-7.76 **	0.02
Malaysia	0.27 ***	0.09	-7.52 **	0.05
Nepal	0.21 **	0.04	-3.85 ***	0.08
Sri Lanka	0.34 ***	0.27	-6.54 ***	0.05
Indonesia	0.29 ***	0.21	-0.16 **	0.00
UAE	0.38 ***	0.32	-7.98 ***	0.07
Kuwait	0.41 ***	0.30	-2.46 ***	0.07
Oman	0.44 ***	0.29	-2.71 ***	0.12
Saudi Arabia	0.39 ***	0.21	-2.84 ***	0.07
Singapore	0.33 ***	0.29	-0.88 ***	0.08
Qatar	0.41 ***	0.35	-2.48 ***	0.08
Overall	-	-	-57.42 ***	0.11

*Note: ***&** indicates statistical significance at 1% & 5% level respectively*

Source: https://www.trademap.org/Country_SelCountry_MQ_TS

An attempt is made to analyse impact of MEP on export quantity and EUV separately. The linear regression analysis was carried out on the monthly data on MEP, EUV and Export quantity from January 2010 to December 2020. It could be seen from the Table 7 that though the estimates are not statistically significant, they could be indicative of the probable direction of change in two parameters due to changes in MEP. The b-coefficient values lying close to zero, while being non-significant, could be indicative of the fact that MEP has not impacted the EUV realized by Indian onion export. This can be better understood by referring to both quantities exported and EUV together. The negative values of EUV - b value indicates that an increase in MEP is negatively influencing the export quantity. Thus, the EUV need not be affected as a result of increase in MEP as import quantity may decrease. This could be mostly because, those countries may be pursuing to import from other nations. In fact, the EUV will be fixed by the international onion demand

and supply situations. While exports from countries like Netherlands and Burkina Faso goes mostly to the developed countries, their EUV will be higher. The traditional importers of Indian onions may not be willing to buy at such high prices. They may buy from other exporters selling at lower prices.

Annexure – IV presents the movement of Export quantity and EUV realized in relation to changes in MEP between 2011 and 2020, individually to the major importing countries. The X-axis depicts the months, Primary Y-axis represents the MEP and EUV in $/ton and export quantities are depicted in Secondary Y-axis. It is clear from all the graphs depicted that the MEP seems to be quite effective, being able to pull up the EUV, when imposed or raised, except in the November 2016 to June 2017 (70^{th} and 77^{th} months in the graph) during which EUVs remained below MEP when the MEP was 850 $/ton. The export quantities fluctuated, with not much relevance to MEP, in case of all the countries analyzed. This could be typically due to the domestic demand (and may be international supply as well) situation prevailing in the importing countries.

SUMMARY

V SUMMARY

The present research work attempted to concisely understand the production pattern, seasonal dynamics of onion across the Indian states as well as at the national level. India being among top producer and consumer of onion, it also is a major exporter of bulbs with unique pungent characteristics. Any change in Indian stance on export of produce seems to have global repercussions. Given the seasonal dynamics which is complicated by unseasonal and heavy monsoon downpour, which has become a recurrent every alternative year, since the past decade, Indian onion export policy catches global attention. The consumer behaviour being 'Indian cooking without onion even for a day is almost impossible', the produce is considered to be as essential as salt. As propounded in the economic theory, consumers tend to be sensitive to exorbitant increase in price. Onion price spikes due to production fall is further aggravated by free export policy followed by India under the WTO regime. This compels the Union Government to pursue a set of different policies of which pegging Minimum Export Price (MEP) at a higher level has been persistent since the last 15 years. It has both positive and negative repercussions to domestic and free trade segments respectively. In this pretext, analytical investigation was held and the following key conclusions are drawn.

The analysis considered the data pertaining to the latest decade from 2011 to 2020 to keep the study more relevant to current and more recent scenario. Data from authentic sources about area, production and productivity at all India and state levels and by seasons, monthly total market arrivals, production, consumer price index and MEP, Indian and major country export quantity and unit value are collected and suitably analyzed. Major analytical tools used were Compound Annual Growth Rate analysis, ARIMA with X-reg, linear regression analysis and tabular analysis have been used to draw meaningful conclusions.

Temporal and Spatial Analysis of Onion Production in India

An outlook of area, production and productivity of onion, its changes at both national and state levels has given significant insights into the existing pattern. Key producing states and seasonal profiling have been brought about

- The research support majorly contributed by public sector agencies coming out improved variety seeds and its increasing adoption by farmers has brought about

increasing productivity. Even in the last decade, productivity grew at 2.30 per cent annually.

- Productivity growth is further supported by area expansion occurring at 2.74 per cent per annum which have collectively brought about increase in onion production over the last decade (5.36% per annum) during the period 2010 to 2020. Area expansion is also supported by growing domestic and overseas market demand depicting its commercial importance. Annual growth of 2.7 per cent in area from 2010 to 2018
- Onion production in India is majorly concentrated in Rabi season, with its contribution ranging from 65-78 per cent during 2014 to 2019.
- Onion being produced in India in three seasons viz., Rabi, Kharif and late kharif, it is majorly concentrated in the rabi. Changes in onion production across the seasons during the last decade indicated an increase in onion production in rabi (3.72% p.a.) and kharif (3.59% p.a.) while during late kharif there was a decline from 38 lakh tonnes in 2014 to 15.7 lakh tonnes in 2019 (-7.62% growth per annum)
- It could be noted that onion production profile of India is distributed at a ratio of 70:20:10 across Rabi, kharif and late-kharif seasons.
- Across the states, onion production is majorly concentrated in the states of Maharashtra (37-38%) and Karnataka (13-18%) put-together contributing to over half the area at the national level.
- By production Maharashtra is the ace producer with 33-35 per cent contribution while the share of Karnataka was unstable with 18 per cent contribution in 2010, declining to just 11 per cent in 2018.
- Maharashtra being key onion producer in Rabi season, is free of monsoon disruptions and hence its contribution stood stable at 35 per cent while Karnataka producing onion during kharif season is often haunted by heavy rainfall and floods affecting onion growing locale. Kharif onion share was thus unstable and ranged between 13-18 per cent.
- The other major producers are Madhya Pradesh, Rajasthan, Andhra Pradesh, Bihar with around 5 per cent each of total onion crop area in India. With exceptional increase in onion acreage in Madhya Pradesh (from 5% to 12%). West Bengal, Haryana and Uttar Pradesh contributed to 2-3 per cent each, to onion area. The onion acreage of top 10 states constituted more than 85 per cent.

- All the top Indian states evidenced increased onion productivity over 2010 to 2018, with the only exception of Gujarat. The overall productivity was over 100 MT/ha. Productivity of lead states, Maharashtra (178 MT/ha) and Karnataka (158 MT/ha), while the minor states like Bihar, Andhra Pradesh, Uttar Pradesh and Haryana bid relatively better productivity.
- Madhya Pradesh (9.85% and 10.89% p.a. respectively) and West Bengal (8.26% and 10.93% p.a. respectively) evidenced a commendable growth in both area and production over last decade (2010 to 2020).
- Maharashtra being the highest onion producing state (35%), accomplished 4.08% growth in area and 8.89 per cent growth in production.
- Karnataka being another major producing state (Kharif season), area and production had almost stagnated (0.8% and 0.74%, respectively).
- Uttar Pradesh (-4.49%) and Gujrat (-1.49%) hit a decline in area, while production increased satisfactorily (1.93% & 1.97% respectively).
- Andhra Pradesh evidenced a production decline (-0.75% per annum) despite an increase in area (0.62% p.a.)
- Rajasthan with a production share of just 3 per cent in 2010, accomplished a whopping 10.11 per cent growth in production.
- Major Rabi producing states were Maharashtra, Madhya Pradesh, Gujrat, Bihar and Northern states.
- Southern states Karnataka, Andhra Pradesh and Tamil Nadu produced during Kharif season.

While there is considerable difference in growth performance across the states, most of them saw an increase in both area and productivity over the last decade. Unstable production of onion in Kharif season in the states of Karnataka and Maharashtra is a major cause of concern.

Production, demand, export and import of onion in India and its influence on domestic onion price

Demand for onion in India is generally assumed to be constant throughout the year, with no much seasonal variation. Production of onion in rabi season is a direct function of area, since climatic variations seeming to be of less influence. Though onion export and import is free, it is regulated during kharif (and late kharif) season in order to protect the interests of consumers, with the imposition of MEP during the last decade.

- From September to February months of the year, onion prices generally remain above the average (index value above 100), while for the rest of time (March to August) prices dip below the average
- The peak price is noticed in the month of December while the lowest being in the months of April to July (peak rabi onion harvest months).
- The long-period seasonality of CPI (2011 to 2021) depicted relatively flatter seasonality as compared to seasonality in recent years (2017 to 2021).
- The onion exports depicted higher fluctuations than domestic market arrivals. export quantities to be more than domestic market arrivals (with the exception of April month in which arrivals were higher than exports in each year)
- Export peaks are attained mostly in and around the month of January, while production peaks are evident in the months between April to June
- The MEP have also been raised during price surge months, but the price spikes have mostly been unaffected. MEP has peaked in September and November months.
- Through ARIMA Xreg analysis, it was found that the variable MEP had a positive influence (as against expected negative influence) on CPI to a moderate extent (coefficient 0.05) and was statistically significant too. Though it was hypothesized that the retail price would be influenced (reduced by increasing MEP) by the MEP along with the other variables, there was no such significant influence being observed.

Relative impact of Minimum Export Price (MEP) on EUV (price) realization of onion

The MEP has dual impacts of impacting the export (quantity as well as price) on the one hand and supporting the domestic consumption on the other. Indian onions being one of the least earners of Export Unit Value (EUV) in the normal course, raising MEP bars could obviously rise EUV. Points of conclusion about such behaviours is presented below.

- The MEP is in vogue in India for Basmati rice, non-basmati rice (imposed since 2007, but probably stopped since 2011 or so; since then, following quantitative restrictions), onion (2011 till 2019, not imposed since then), edible oil (imposed only once in 2015; $1100/MT), potato ($300/tonne; imposed only once in

2013). Generally, Bangalore rose onion & Krishnapuram onions have been assigned a higher MEP than other onions, during the study period.

- The MEP as a tool to contain domestic onion prices is being enforced in India since January 2011 ($600/MT) decreased upto April 2011 ($170/MT) then again ascending upto September-October 2011 ($375/MT).
- During the whole of 2012, the MEP was pegged at $125/MT as it was a normal monsoon year with no crop loss and hence MEP might not have affected exports.
- Again, with heavy rainfall haunting growing regions, in July 2013 MEP was hiked to $400/MT which saw an upbeat peaking in November 2013 (1150$/tonne), then onwards declining gradually to nil MEP in March 2014.
- From June 2014 to January 2016, MEP was revised about 8 times, with a peak between August to October 2015 pegged at $700/ MT. Jan-Oct 2016 remained MEP holiday. Again, from Nov 2016 to Dec 2017 MEP was held constant at 850$/MT (2017 again being a heavy monsoon year). In the consequent month, MEP was first reduced to $700/MT and then again to nil in Feb 2018, remaining nil until Aug 2019.
- With monsoon again haunting kharif onion season, MEP was again turned on and kept at one of its maximum at $850/MT from September 2019 up to Dec 2019. The onwards MEP has been turned off and not imposed then on. It is not clear if the MEP has been discontinued as a price containing tool by the Government.
- It seems like the Government is favouring usage of Quantitative restrictions and blanket ban on export than MEP, as during the past 2 years, it has been imposed thrice for onion in general and Krishnapuram/Bangalore rose onions.
- From the analysis on world onion export quantity/value, it was noted that India is a major exporter (1.06 trillion tonnes, 27%) in rabi season, while in kharif and late kharif seasons (fig. 6&7) it's export share remained smaller (5-7%).
- Going by the Indian onion production seasons, the world onion exports dominated in rabi season (47.6%) followed by kharif (35.7%) and late-kharif (16.7%).

- India, along with Netherlands (0.83 trillion tonnes; 21%) and China (0.5 trillion tonnes; 12%) were major rabi exporters, with the top 10 constituting over 75 per cent world exports.
- Kharif exports is predominated by Netherlands (0.6 billion tonnes; 15%), China (0.36 billion tonnes; 9%) and India (0.28 billion tonnes; 7%).
- The top 10 kharif onion exporting nations contributed to less than half the total.
- During late kharif season, export was totally dominated by Burkino Faso (76%) exporting 3.7 billion MT of onion. About 2 per cent export contribution from New Zealand and one percent each from USA, Spain, Poland and South Africa (ranging from 30-78 million tonnes) constituted major late kharif onion exports. Rest of the world contributed about 6 per cent.
- The top importers of Indian onion were neighbouring South-East Asian and Middle East countries. On an average, these countries accounted for 85-90 per cent of India onion export basket (Table. 7).
- An assessment of impact of MEP on EUV and export quantity for top 10 importers of Indian onion was carried out using regression analysis, while it did not depict much of influence. But, the signs of regression coefficients indicated the possible trend. While for EUV, the coefficient values were positive and significant, for export quantity it was negative and significant. That is, a rise in MEP causes EUV to rise, vice-versa being true about export quantity.
- MEP seems to be quite effective, being able to pull up the EUV, except in the November 2016 to June 2017 during which EUVs remained below MEP.
- While exports from countries like Netherlands and Burkina Faso goes mostly to the developed countries, their EUV remained higher.

Policy Implications

- It is highly appreciable that despite difficulties in maintaining systematic production statistics on horticulture crops, the NHB is compiling and bringing out horticultural statistics on a yearly basis. But, specific to onion, whose prices are highly volatile due to vagaries in production, season-wise, state-wise statistics are scarce in availability. The Monthly onion report of the Ministry of Agriculture, GoI is giving estimates of onion production (those on area and productivity are not accessible) by season. In order to devise effective policies, the state-wise, season-wise data on area, production and productivity are highly desirable. This becomes more imperative, since onion production especially in kharif season is specific to the southern states like Karnataka, Andhra Pradesh and Tamil Nadu.
- Increasing onion production during kharif season would be inevitable, given recurring monsoon aberrations every alternative year, evidenced during the last decade. Given the circumstance, increasing onion area in non-traditional areas may be thought of. Such planning needs to be supported by a more systematic and real-time season-wise, state-wise data on onion production.
- The study notes a contrast between production/arrival peaking in the months of May to September (supply of rabi onion) (13,51,863 kg) and export peaking in the months of February (13,23,711 kg) which is against the expectation. It becomes more important because, the global onion exports are the highest in rabi (47.55%) and also there is a production crunch during the kharif season in India. This requires a further probing.
- The analysis has shown that the MEP is not so very effective in immediate succession of its imposition, but with a lag in time, mainly because of prior contracts held by exporters with their importing counterparts, which becomes binding to abide by. Hence, it not so effective in bringing down onion retail prices. Further, since 2019, the union government seems to have discontinued employing MEP as a policy tool, which seems to be a welcome step. The PSF being used since then is found promising.
- It is surprising to note that the onion exports is more during price surge years, during the last decade, during which the analysis is carried out. Since MEP is in vogue, it was expected that the exports would decline. But, as a matter of fact there is a export

surge. Prior contracts may be the reasons for increased exports. Hence, MEP may not be a very effective tool to contain domestic prices by containing exports.

- The database maintained by the concerned authorities paves way for a considerable doubt. As per official data, the Indian onion exports during many years are more than market arrivals. Since exported onion is also reported under onion arrivals in the domestic markets, export quantity cannot exceed its arrivals. Therefore, it calls for an efficient database management system in order to have a proper market intelligence (Fig. 8).
- The PSF being employed by the Government of India in several occasions, especially during 2020 and 2021, seems to have been effective in controlling domestic prices, though there were supply shortages (due to flood). Given this fact, pursuing this policy option could be more relevant and hence a deeper probing of the same is desirable.
- Since MEP has mostly been pursued as an ad-hoc tool, it has resulted in India to be considered as an unreliable exporter in the world market. A few repercussions are, the countries like Bangladesh, which is one of the consistent importer from India, has started cultivation of onion by itself, and also switching over to import from the countries like Egypt and Turkey in the latest years. This calls for a serious concern to review opting MEP is a price containing tool.
- The MEP seems to be impacting positively on the EUV (increasing its export prices) and inversely on the quantity. But it could lose its reliability in the export market, which could be a concern of policy.
- In the WTO regime, India's policy of imposing MEP has been highly criticized (as it leads to global price rise) by the countries like USA and Japan. The WTO provisions exception for the staple food commodities to impose either export ban or restricting its trade, in order to protect the interests of its consumers. Hence, India may represent itself in the WTO negotiations to declare onion as a staple vegetable and thus rescue itself from the objections of its trade partners.

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ANNEXURES

ANNEXURE – I

The CPI is designed to measure the changes over time in general level of retail prices of selected goods and services that households purchase for the purpose of consumption. The CPI measures price changes by comparing, through time, the cost of a fixed basket of commodities. The basket is based on the expenditures of a target population in a certain reference period. Since the basket contains commodities of unchanging or equivalent quantity and quality, the index reflects only pure price. In India, segment specific CPIs, namely CPI (IW)[1], CPI (AL)[2], CPI (RL)[3] are being compiled regularly, catering to the need of specific population group. CPI (UNME)[4] which has been discontinued with effect from December, 2010, was meant for urban, non-manual employees. The National Statistical Commission (NSC), under Dr. C. Rangarajan, in its Report (2001) recommended for compilation of CPI for rural and urban areas. The resources proposed to be utilized for revision of CPI (UNME) may be used for compilation of CPI (Urban) and CPI (Rural). Consumer Expenditure Survey (CES) data of the NSS[5] 61st round may be used for construction of weighing diagrams for proposed CPI (Urban) and CPI (Rural) series. Accordingly, the Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation started releasing Consumer Price Indices (CPI) on base 2010=100 for all-India and States/UTs separately for rural, urban and combined every month with effect from January, 2011. The Price Reference Year[6] for this series is 2010, whereas Weight Reference Year[7] is 2004-05. The base year has been accordingly revised from 2010 to 2012, and the revised series is released w.e.f. January, 2015. The present study considers CPI of both Urban and Rural combined considering 2012 as the base year. (Mospi publication, 2015)

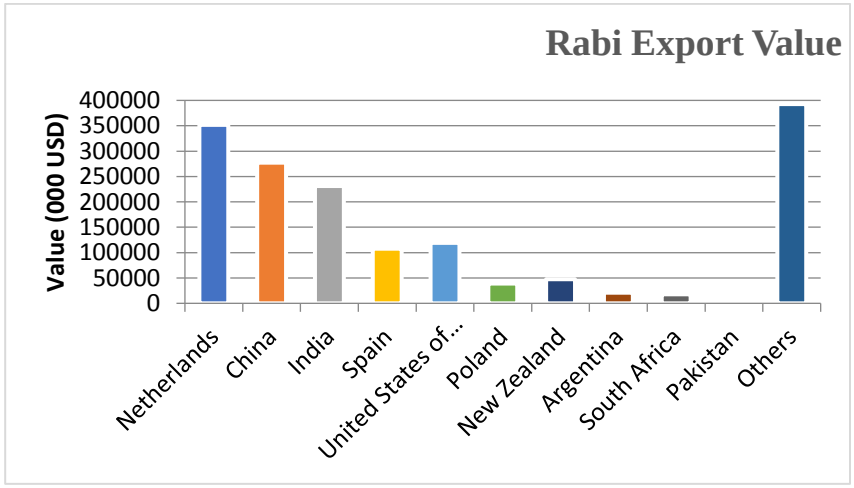
[1] CPI (IW)- Consumer Price Index for Industrial Workers
[2] CPI (AL)- Consumer Price Index for Agricultural Labourers
[3] CPI (RL)- Consumer Price Index for Rural Labourers
[4] CPI (UNME)- Consumer Price Index for Urban Non-Manual Employees
[5] NSS- National Sample Survey
[6] The year in which the average prices, of goods and services consumed, are taken as base price and equated to 100 and accordingly, CPI for Base Year is 100.
[7] The year in respect of which the data of consumer expenditure survey was used to compute weights for aggregating elementary indices to compile higher level indices that is sub-group, group and overall indices

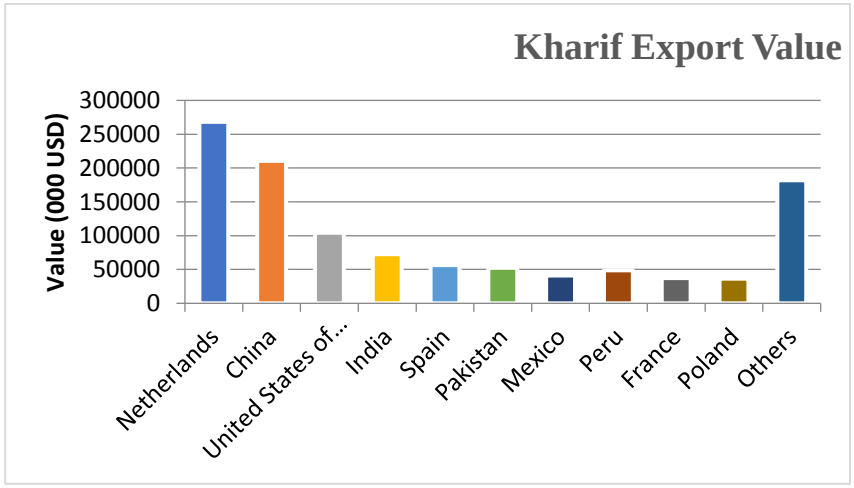
ANNEXURE – II

R codes to Test the stationarity of variables (CPI, MEP, Arrival and Export quantity) for estimation of residuals for cross correlation

```
View(TSA*)                    *TSA – name given to dataset while analysing.
summary(TSA)
library(forecast)
library(tseries)
acf(TSA$CPI)
pacf(TSA$CPI)
auto.arima(TSA$CPI)
modeltsa=arima(TSA$CPI,order = c(1,1,3))
modeltsa
acf(modeltsa$residuals)
pacf(modeltsa$residuals)
tsaforecast=forecast(modeltsa,level=c(95),h=10*12)
tsaforecast
residuals(modeltsa)
auto.arima(TSA$Export)
modelexport=arima(TSA$Export,order = c(2,0,1))
modelexport
residuals(modelexport)
auto.arima(TSA$Arrivals)
modelarrivals=arima(TSA$Arrivals,order = c(1,0,1))
residuals(modelarrivals)
acf(residuals(modelexport))
pacf(residuals(modelexport))
acf(residuals(modelarrivals))
pacf(residuals(modelarrivals))
ccf(residuals(modeltsa),residuals(modelexport),ylab = "cross-correlation")
ccf(residuals(modeltsa),residuals(modelarrivals),ylab = "cross-correlation")
```

ANNEXURE – III





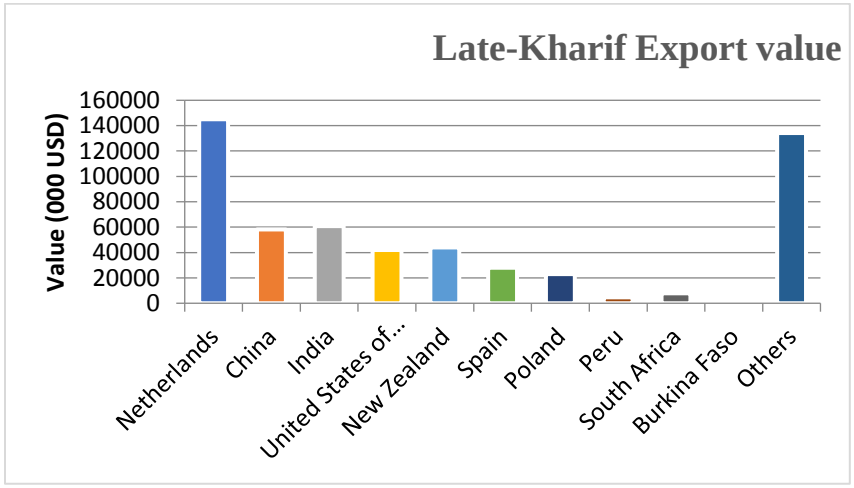
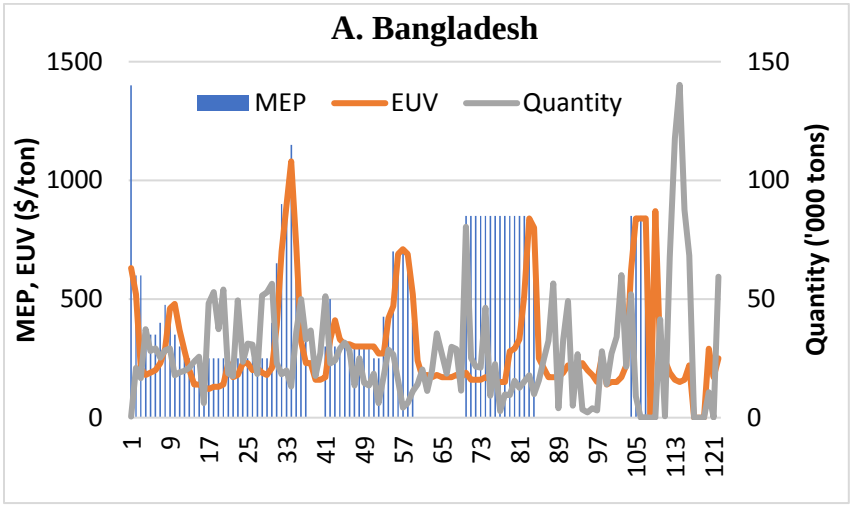
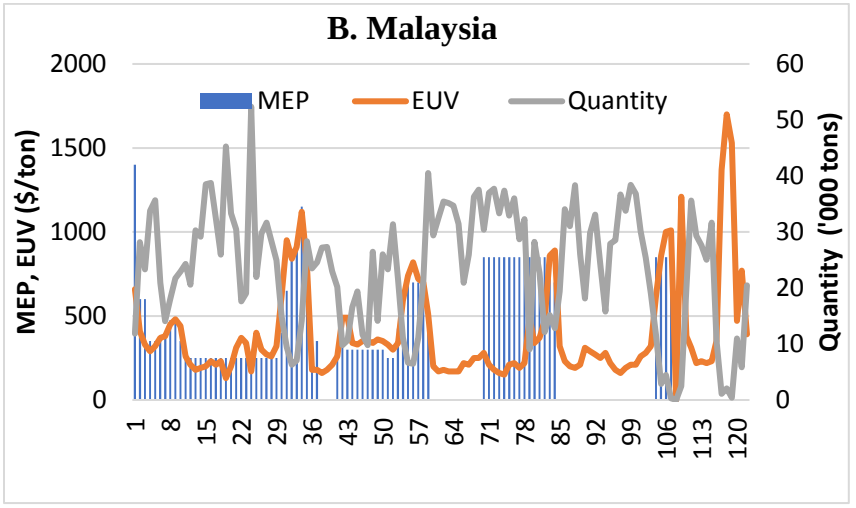
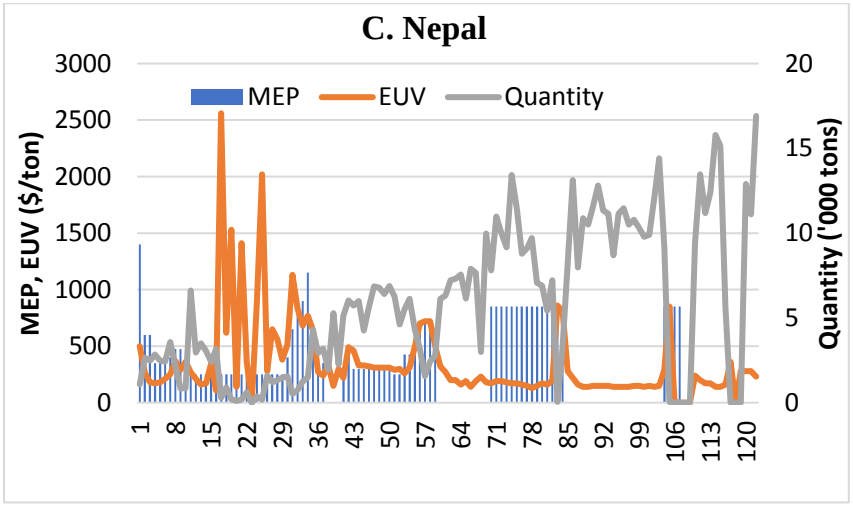


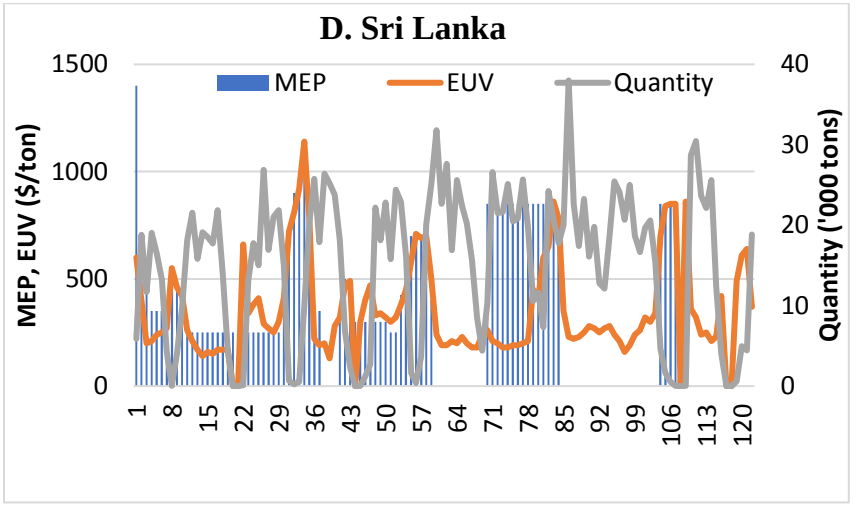
Fig. 15: Season-wise export value of top ten onion exporting nations in 2018 and 2019

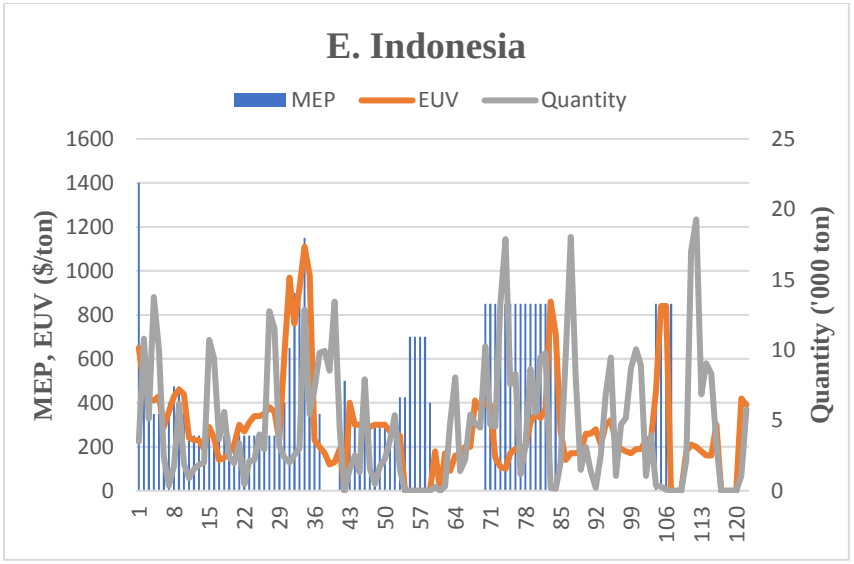
ANNEXURE - IV

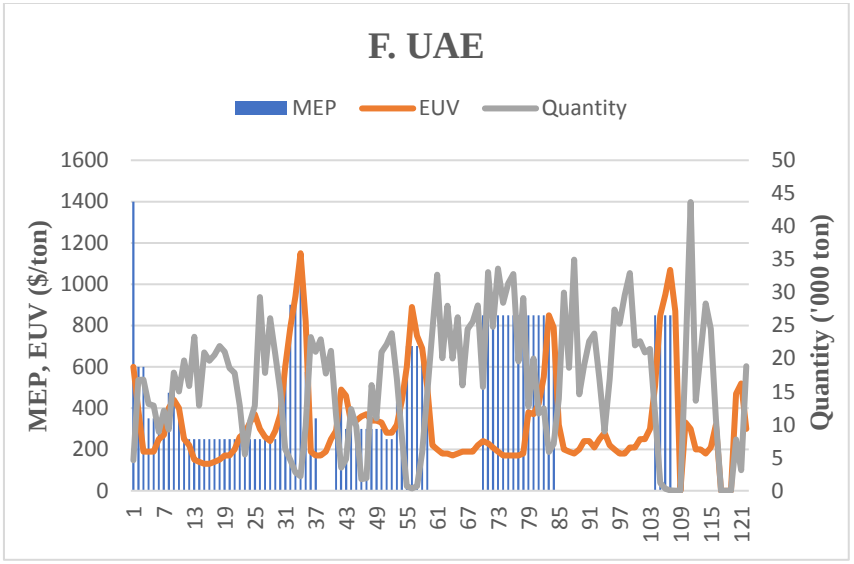

A. Bangladesh
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 tons)
1500
1000
500
0
150
100
50
0
1
9
17
25
33
41
49
57
65
73
81
89
97
105
113
121

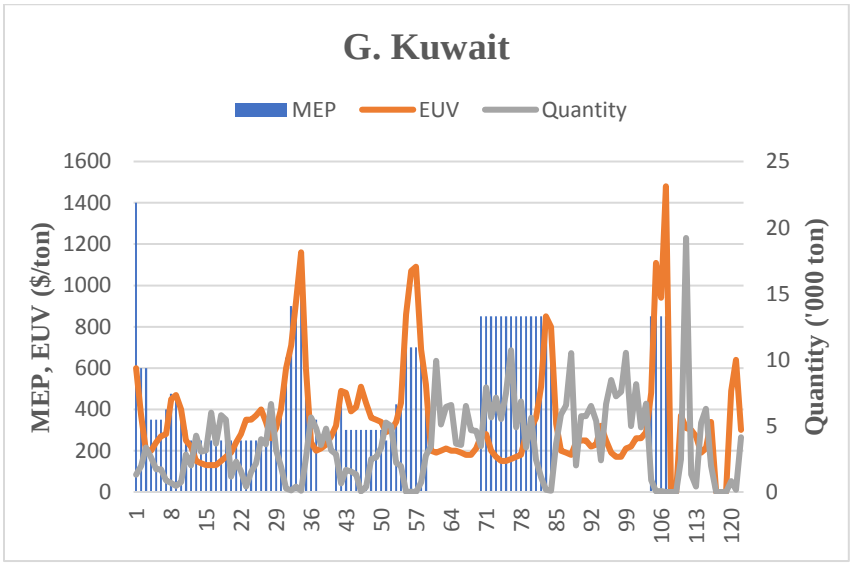

B. Malaysia
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 tons)
2000
1500
1000
500
0
60
50
40
30
20
10
0
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120

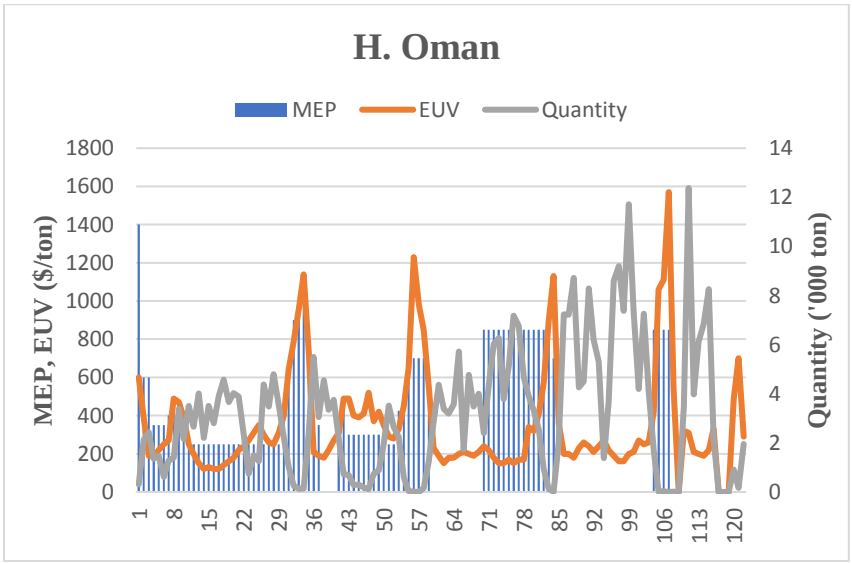

C. Nepal
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 tons)
3000
2500
2000
1500
1000
500
0
20
15
10
5
0
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120


D. Sri Lanka
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 tons)
1500
1000
500
0
40
30
20
10
0
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120


E. Indonesia
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 ton)


F. UAE
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 ton)


G. Kuwait
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 ton)


H. Oman
MEP
EUV
Quantity
MEP, EUV ($/ton)
Quantity ('000 ton)

vi.

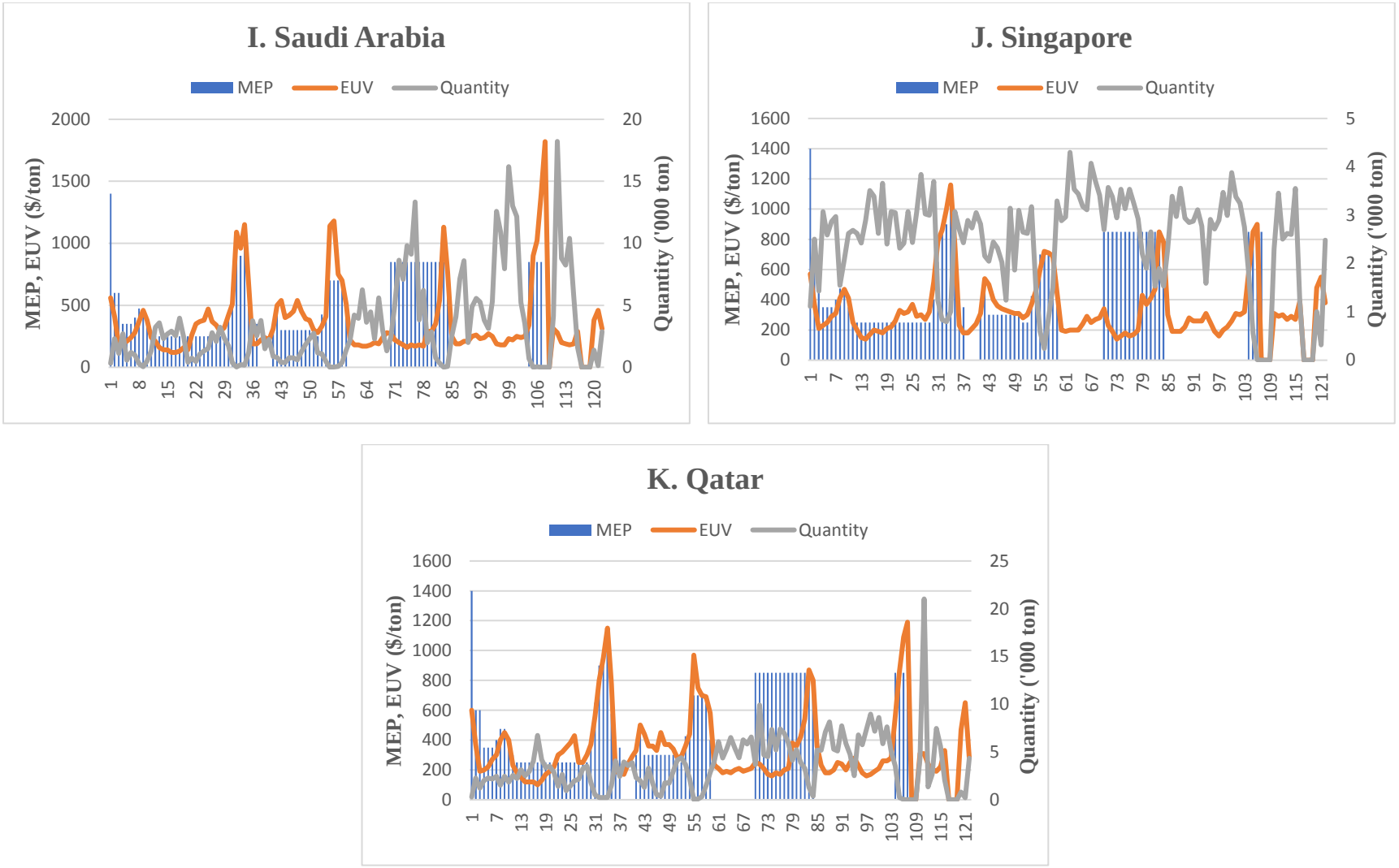


Fig. 16: MEP, EUV and Import quantity of top Indian onion importers from 2011 to 2021