Export of Maize from India: Performance and Determinants

R. S. Geetha[1*] and S. K. Srivastava[1]

[1]*Department of Agricultural Economics, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Author RSG designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author SKS managed the analyses of the study. Author RSG managed the literature searches. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The present study has examined the growth, instability, trade direction, potential and determinants of maize exports from India from the period 1981 to 2016. Compound Annual Growth Rate, Cudda-Della Valle method, Markov Chain analysis, Revealed Comparative Advantage Index and Regression analysis were used in the study. The growth of export quantity and export value in pre WTO has found to be not significant, while unit value had negative growth. In post WTO period, the export quantity, value and unit value grew significantly at the rate of 38.74, 42.12 and 2.43 per cent per annum, respectively. The instability indices for export quantity and its value found to be relatively lesser in post WTO period. The reasons for high instability may be inconsistent domestic production, consumption and international demand. Thus, the export policies should be in line with consistent growth of maize exports with low instability. The Markov analysis reveals that Nepal followed by Bangladesh exhibited a strong preference for maize from India. India is not that efficient in maize

_____

Corresponding author: E-mail: geetharsshivu@gmail.com;

exports as RCA index is not of higher value and it is less than 1 in the years 2001 to 2003, 2005 to 2006 and 2015 to 2016. The variables export price and lagged production are found to be significantly affecting the maize exports from India. As expected, export price had negative association and lagged production had positive association with maize exports. The significant increase in domestic production of the maize crop is the major option for improvement of maize export trade.

1. INTRODUCTION

As a result of economic liberalisation, the agricultural reforms have come upfront in India. The reforms aimed at generating a favourable policy framework for agricultural development and were expected to provide a powerful thrust to growth and modernisation of agriculture in future through favourable terms of trade. Indian trade policy for agricultural commodities is guided by the twin objectives of ensuring national food security and building export markets for enhancing the farmer's income.

In global market, there is huge demand for cereals and it is creating a favourable environment for the export of Indian cereals viz., wheat, rice, maize, sorghum, pearl millet and barley. It is an opportunity for the country to increase the production of cereals and their export share in total cereal exports of the world. Maize accounts for one-third of total cereal trade in the world. Few of the countries in the world produce sufficient maize for their populations; others rely on imports of maize. Hence, it becomes a critical food security risk if major producers or exporters of maize worldwide are unable to meet expected demands in other parts of the world, due to plant diseases, increased domestic use of maize for a variety of purposes, or other reasons [1].

In India, maize is the third most important food grain which constitutes 9.6 % of the total volume of cereals produced, while rice and wheat contribute 44.39 per cent and 39.24 per cent, respectively. As per final estimates, the production of maize in India for the year 2016-17 stood at 25.90 million MT [2]. The major maize importing countries from India are South East Asian countries i.e. Indonesia, Malaysia, Vietnam, Nepal, Bangladesh, Sri Lanka. Also, recent trends show that the consumption of meat in Southeast Asia is expected to grow at ~20% and the processed food industry is to grow at 10 per cent plus rate in the next five years in most countries of the region between 2015 and 2020.

This indicates a clear potential for higher demand from the South East Asian region as well as domestic demand going ahead. Hence to meet the increasing demand of maize in India as well South East Asia, there is need to focus on increasing maize production as well as exports by analysing the performance and determinants thereof.

2. MATERIALS AND METHODS

2.1 Methodology

The proposed study is based on secondary data. The data was collected from various published reports, journals, official record of government, Ministry of Agriculture and Farmers' Welfare and International Trade Centre. Time-series data on maize export was collected for the period from 1981 to 2016.

2.1.1 To estimate the growth in export quantity, export value and unit value of maize, exponential growth function has been fitted

To achieve this, the growth in time-series data of export quantity, export value and unit value of maize have been estimated for pre and post WTO periods as well as for overall period. The periods are specified as follows.

1. Pre WTO period (period I) from 1980-81 to 1994-95.
2. Post WTO period (period II) from 1995-96 to 2015-16.
3. Overall period from 1980-81 to 2015-16.

The pre and post WTO criteria has been considered to estimate whether WTO formation has had any impact on export of maize, since it is one of the major cereals produced in India.

2.1.2 Compound Annual Growth Rate (CAGR)

Compound annual growth rates are worked out in order to examine the tendency of variables to

increase, decrease or remain stagnant over a period of time. In the present study, compound annual growth rates of export quantity, export value and unit value of maize for the country have been estimated by using the exponential growth function of the following form,

$$Y_t = a\, e^{bt}$$

Where,
Y_t = Dependent variable i.e. for which growth has been estimated
a = Intercept
b = Regression coefficient
t = Years i.e. (1, 2, …, n)

2.1.3 To estimate the instability in export quantity, export value and unit value of maize, Cudda-Della Valle method has been used

Instability index is a simple analytical tool to find out the fluctuations in any given time series data. Cudda-Della Valle method is employed to measure the instability in the time series. Cudda-Della Valle method is used as it corrects the coefficient of variation if data are scattered around the negative or positive trend line, over estimation can be avoided. The Cudda-Della Valle (CDI) Index is given as follows,

$$I_x = CV\sqrt{(1-\overline{R^2})}$$

Where,
CV = Coefficient of variation $(\sigma/\overline{X})*100$
$\overline{R}^2$ = Adjusted coefficient of multiple determination

The selection rule of instability index is that implied in the preceding paragraph:

1. If the regression equations of both linear and log-linear form are significant at the 1 per cent level: choose instability measure of equation whose $\overline{R}^2$ is higher.

2. If $\overline{R}^2$ is significant at the 1 per cent level for one equation but is not significant for the other, choose the instability measure corresponding to the 'significant' equation.

3. If the $\overline{R}^2$ is not significant at 1 per cent level of significance and $\overline{R}^2$ <0, then Coefficient of Variation (CV) is chosen to measure instability index

The present study divides the CDI value into three categories, which represent the different range of instability [3].

The ranges of instability are as follows:

1. Low instability = between 0 to 15
2. Medium instability = greater than 15 and lower than 30
3. High instability = greater than 30

2.1.4 To examine the pattern of export destination of maize, Markov chain method has been employed, as given below

2.1.4.1 Markov chain analysis

The countries which are leading importers of maize, importing nearly 82 per cent of total value of maize from India have been selected for framing transitional probability matrix in markov chain analysis. The countries selected namely Nepal, Bangladesh, Sri Lanka, Malaysia, Indonesia and Vietnam and remaining countries are pooled under others category. Annual export data for the period 2001 to 2016 are used to analyse the direction of trade and changing pattern of exports of maize from India, due to availability of continuous time series data.

The trade directions of exports is analysed using the first order Markov chain approach. Central to Markov chain analysis is by the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicates the probability that export switches from country 'i' to country 'j' with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports. In the context of the current application, structural changes are treated as a random process with selected major importing countries. The average exports to a particular regional country is considered to be a random variable which depends only on the past exports to that regional country, which can be denoted algebraically as

$$E_{jt} = \sum_{i=1}^{r} E_{it-1} * P_{ij} + e_{jt}$$

Where,
E_{jt} = Exports from India to j^{th} country during the year 't'.
E_{it-1} = Exports to i^{th} country during the period t-1.

P_{ij} = Probability that the exports will shift from i^{th} country to j^{th} country.

e_{jt} = The error term which is statistically independent of E_{it-1}.

t = Number of years considered for the analysis

r = Number of importing countries

The transitional probabilities P_{ij} which can be arranged in a (c * r) matrix have the following properties.

$$O \leq P_{ij} \leq 1$$

$$\sum_{i=1}^{n} P_{ij} = 1 \, for \, all \, i$$

Thus, the expected export shares of each country during the period 't' are obtained by multiplying the export to these countries in the previous period (t-1) with the transitional probability matrix.

2.1.5 To examine the trade potential of maize, Revealed Comparative Index is constructed

2.1.5.1 Revealed comparative advantage index

The countries which are leading exporters of maize together covering 86.33 per cent of total value of maize export in the world have been selected purposively. The countries are namely, United States, Argentina, Brazil, Ukraine, France, Russia, Romania, Hungary, South Africa and India. The time series data have been taken for the period from 2001 to 2016.

The positive impact of trade liberalization and expansion can be indirectly measured by the revealed comparative advantage (RCA) index. It helps to compare the competitiveness of each country in the trade of a particular commodity group. If the RCA is above 1 the country is said to be specialized in that commodity trade and if the RCA is less than 1, then it is not specialized (or 'under specialized'). It is often constructed using the formula:

$$RCA_{ij} = \frac{x_{ij}/X_{it}}{x_{wj}/X_{wt}}$$

Where,

x_{ij} is country i's exports value of jth crop i.e. maize

X_{it} refer to the country i's total value of agricultural exports.

x_{wj} is world exports value of jth crop i.e. maize

X_{wt} refer to the world total value of agricultural exports.

2.1.6 Determinants of maize exports from India

The multiple regression of log-linear form is used for assessing the factors determining maize exports from India. The present study involved quantitative analysis of the variables by adopting the method of ordinary least square (OLS) econometric technique. Before dealing with a time series, the first and foremost step is to check whether the underlying time series is stationary or not. Augmented Dickey-Fuller test is used for testing stationarity of the variables. If the variables are found to be stationary at unit root, then OLS estimation is employed.

2.1.7 To identify the determinants of maize exports from India

Export quantity is regressed with export price, international price, lagged production, domestic consumption and exchange rate, which is represented as follows:

$$lnQ_t = b_0 + b_1 lnP_t + b_2 lnI_t + b_3 lnL_t + b_4 lnD_t + b_5 lnE_t + \mu$$

Where,

Q_t refers to maize exports from India in tonnes i.e. 1997 to 2016;

P_t is the export price in US Dollar per tonne;

I_t is the international price (US, f.o.b. Gulf ports) in US Dollar per tonne;

L_t is the lagged production of maize in thousand tonnes;

D_t is the domestic consumption of maize in thousand tonnes;

E_t is the exchange rate in Rs/US Dollar;

μ is the error term.

3. RESULTS AND DISCUSSION

3.1 Compound Annual Growth Rates in Exports Quantity, Value and Unit Value of Maize

The compound annual growth rates in export quantity, value of export and unit value of maize export are presented in Table 1. The growth rate of export quantity and export value in pre-WTO period is not found significant, while unit value had negative growth. In post-WTO period, the export quantity, value and unit value grew significantly at 38.74, 42.12 and 2.43 per cent per annum, respectively. The growth rate of 40.92 and 41.91 per cent per annum have been noticed in export quantity and value during the overall period, respectively has not significant growth. The changes recorded in export quantity,

4

export value and unit value during overall period are also represented in Figs. 1 to 3.

3.2 Instability Indices in Exports Quantity, Exports Value and Unit Value of Maize

The instability indices are constructed for export quantity, export value and unit value of maize and the results are presented in Table 2. The table reveals that quantity and export value remained highly instable in both the periods, whereas unit value is having medium instability across the study period.

The export quantity is found more unstable in pre-WTO period than post-WTO period and it may be due to variability in quantum exported. The other cause may be due to somewhat inconsistent domestic production, international demand and exports policy for maize during post-WTO period. Similarly, variability in export quantity along with unit price was the major cause of the variability in export earnings during pre-WTO period.

The above growth and instability findings are in line with the finding of Karthick et al. [4], Mech [5], Ranjana et al. [6] and Yogesh [7].

Table 1. Compound growth rates in maize exports from India

Period	Description	Initial year observation	End year observation	Constant	Trend coefficient	R^2	CAGR (%)
Pre-WTO period (1981-1995)	Quantity	168	18751	4.603	0.207 (0.162)	0.11	22.98
	Value	35	3406	3.135	0.177 (0.163)	0.08	19.43
	Unit value	208	182	5.439	-0.029* (0.017)	0.18	-2.89
Post-WTO period (1996-2016)	Quantity	55363	482848	9.146	0.327*** (0.053)	0.67	38.74
	Value	10395	132700	7.287	0.351*** (0.051)	0.72	42.12
	Unit value	188	275	5.049	0.024*** (0.008)	0.30	2.43
Overall (1981-2016)	Quantity	168	482848	3.701	0.343*** (0.033)	0.76	40.92
	Value	35	132700	1.931	0.349*** (0.033)	0.77	41.91
	Unit value	208	275	5.138	0.007 (0.005)	0.07	0.71

Figures in parentheses indicate standard error
***, ** and * indicate significance at 1, 5 and 10 per cent probability level; NS – Non-significant, respectively
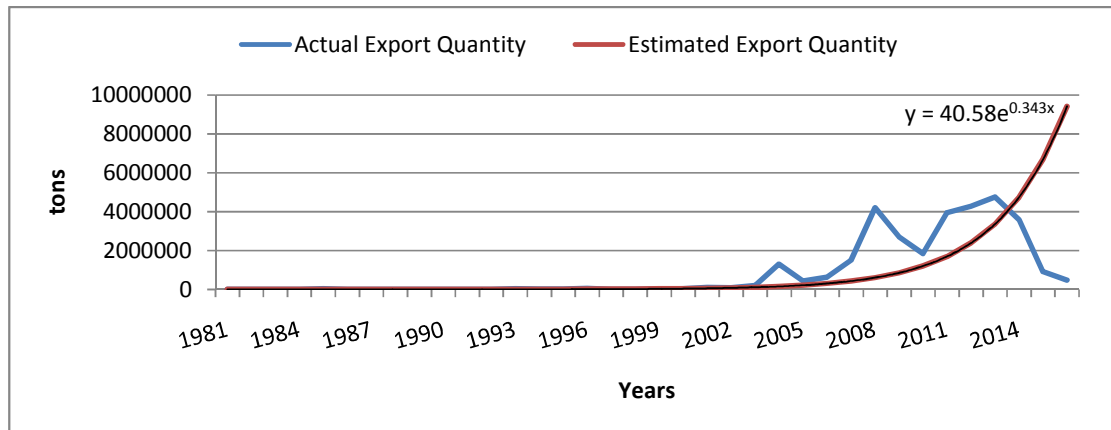

Fig. 1. Actual and estimated export quantity of maize from India for the period from 1981 to 2016

Table 2. Instability indices of maize exports from India

Particulars	Periods		
	Pre-WTO	**Post-WTO**	**Overall**
Medium instability	Unit Price (29.64)	Unit Price (21.31)	Unit Price (26.95)
High instability	Export Quantity (162.76)	Export Quantity (67.41)	Export Quantity (84.88)
	Export Value (164.10)	Export Value (67.18)	Export Value (88.03)

Figures in the parentheses indicates instability indices
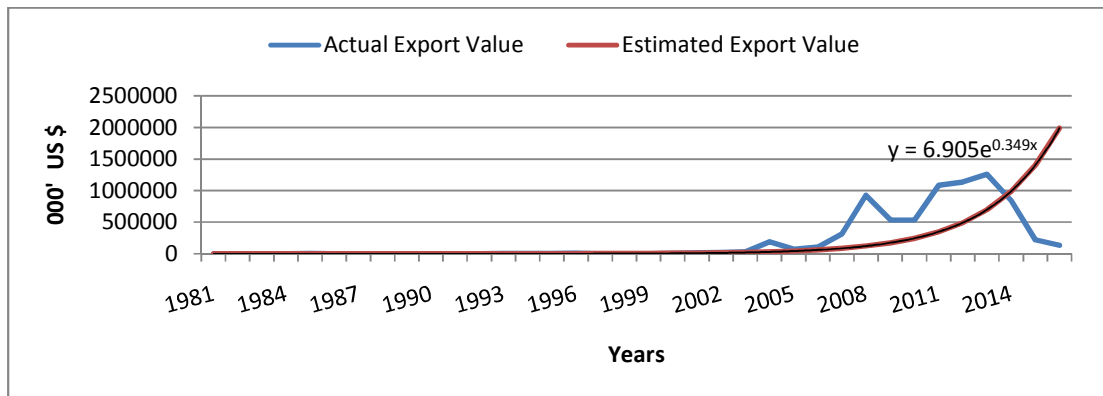
Fig. 2. Actual and estimated export value of maize from India for the period from 1981 to 2016
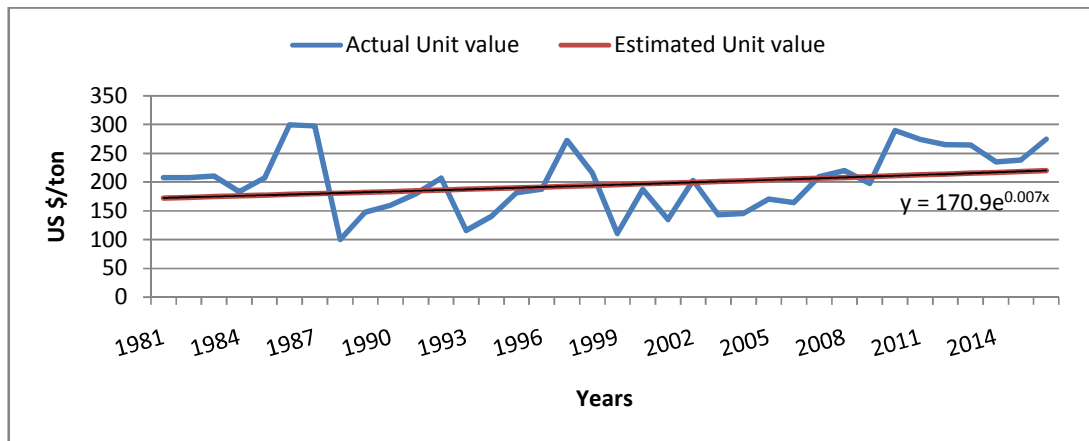
Fig. 3. Actual and estimated unit value of export of maize from India for the period from 1981 to 2016

3.3 Trade Direction of Maize Exports

The trade direction of maize exports to different destinations has been analysed by constructing transitional probability matrix with the help of markov-chain analysis. Table 3 depicts the transitional probability matrix of Indian maize export for the period from 2001 to 2016. There are six major countries that import maize from India and the rest of the countries were pooled under others category. In a transitional probability matrix the diagonal elements represents the probability of retention of the trade, while the column elements shows probability of gain from other competing countries and row elements indicates probability of loss on account of competing countries.

The table reveals that Nepal is the most stable market for maize export among the major importing countries as reflected by highest probability of retention at 0.7439 i.e. Nepal had retained its original export share of 74.39 per cent for the period from 2001 to 2016. The others group of countries are found with a low

Table 3. Transitional probability matrix of Indian maize export, from 2001 to 2016

Country	Nepal	Bangladesh	Sri Lanka	Malaysia	Indonesia	Vietnam	Others
Nepal	**0.7439**	0	0.1052	0	0	0	0.1508
Bangladesh	0	**0.6983**	0.0184	0.0901	0.0391	0	0.1539
Srilanka	0	0.2423	**0.4989**	0	0.2587	0	0
Malaysia	0	0	0	**0.5312**	0	0.0040	0.4648
Indonesia	0.1061	0.0248	0	0.2505	**0.6002**	0	0.0184
Vietnam	0	0	0	0.0282	0.2933	**0.6785**	0
Others	0.0155	0.3897	0.0006	0.0662	0	0.2279	**0.3001**

The diagonal elements indicates probability of retention

probability of retention i.e. 0.3001 which can be defined similarly as above.

After Nepal the major gainer among importing countries of Indian maize over the study period is Bangladesh with 69.83 per cent of retention and gain of 38.97 per cent of market share from other countries, 24.23 per cent from Sri Lanka and 2.48 per cent from Indonesia. In similar manner Indonesia gained 29.33, 25.87 and 3.91 per cent of market share from Vietnam, Sri Lanka and Bangladesh respectively. Nepal in addition to having high probability of retention is also likely to gain 10.61 per cent of market share from Indonesia.

Present finding is in conformity with finding of Adhikari et al. [8] and Yogesh [7].

3.4 Actual and Estimated Share of Maize Exports from India to Importing Countries

The actual and estimated share of Indian maize exported to major importing countries (percentage term) is presented in the Table 4. The comparison of these proportions over the period reveals that observed share of maize exports over the years are consistent with the predicted share of exports which are derived from markov -chain analysis. There are some differences in few years due to limitation of the model that given estimates depends on previous year observed values and also sudden policy changes which is having impact on exports result in abrupt increase or decrease in exports to a country.

3.5 Trade Potential of Maize Exports

The revealed comparative advantage (RCA) index is one of the tools to know the potential of commodity export from a nation. If the RCA is greater than one, then the country possesses a revealed comparative advantage in the commodity. RCA indices for major maize

exporting nations including India for the years from 2001 to 2016 are reported in Table 5. The maize export from the country is more efficient when RCA index is of higher value.

The results in the Table 5 depict that, India had a comparative advantage in maize for the years 2004 and 2007 to 2014. India was not much efficient in maize exports during the years 2001 to 2003, 2005 to 2006 and 2015 to 2016 as RCA indices were not of higher value and were is less than 1. Argentina, Hungary, Romania, United States and Ukraine have very strong comparative advantage in maize exports, whereas, Brazil, France and South Africa are also having comparative advantage in maize exports. Russia is not having a comparative advantage, even though it is one of the major global exporters of maize.

Present finding is in conformity with finding of Bakhshinejad and Hassanzadeh [9], Goyal and Vajid [10], Kapuya and Sihlobo [11] and Suresh and Mathur [12].

3.6 Determinants of Maize Exports

ADF test was conducted to check the stationarity of time series data and presented in Appendix 1. The results indicated that the ADF values for most of selected factors were less than critical value (5%) given by MacKinnon statistical table at level in both cases i.e. only intercept and intercept with trend implying the existence of unit root and non-stationarity. At first differences, the ADF values for all factors were more than critical value (5%) indicating that all the price series were stationary and free from consequences of unit root.

Determinants of maize exports from India are presented in the Table 6 of which regressed results of factors affecting the maize exports from India for the period from 1997 to 2016. In both the cases, 'at level' and 'at difference', the variables export price and lagged production are

Table 4. Actual and estimated values of maize export from India for the period from 2001 to 2017 (In 000' US $)

Years	Nepal		Bangladesh		Sri Lanka		Malaysia		Indonesia		Vietnam		Others		Total	
	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
2001	0 (0.00)		9996 (67.64)		849 (5.75)		723 (4.89)		170 (1.15)		0 (0.00)		3040 (20.57)		14778 (100.00)	
2002	80 (0.44)	65 (0.44)	10293 (56.67)	8375 (56.68)	274 (1.51)	609 (4.12)	111 (0.61)	1529 (10.34)	2624 (14.45)	713 (4.82)	207 (1.14)	696 (4.71)	4575 (25.19)	2790 (18.88)	18164 (100.00)	14776 (100.00)
2003	1040 (3.52)	409 (2.25)	18944 (64.12)	9102 (50.12)	551 (1.86)	337 (1.86)	3175 (10.75)	1952 (10.75)	1053 (3.56)	2109 (11.61)	61 (0.21)	1184 (6.52)	4721 (15.98)	3069 (16.90)	29545 (100.00)	18162 (100.00)
2004	1500 (0.79)	959 (3.24)	44109 (23.34)	15228 (51.55)	15238 (8.06)	736 (2.49)	58926 (31.17)	3971 (13.44)	9811 (5.19)	1533 (5.19)	940 (0.50)	1130 (3.83)	58496 (30.95)	5984 (20.26)	189020 (100.00)	29541 (100.00)
2005	1403 (1.90)	3063 (1.62)	35808 (48.49)	57533 (30.44)	19151 (25.94)	8607 (4.55)	484 (0.66)	41632 (22.03)	1267 (1.72)	11831 (6.26)	114 (0.15)	14205 (7.52)	15614 (21.15)	52139 (27.59)	73841 (100.00)	189010 (100.00)
2006	1788 (1.71)	1420 (1.92)	50588 (48.43)	35761 (48.44)	14676 (14.05)	10370 (14.05)	6711 (6.42)	4838 (6.55)	17106 (16.38)	7148 (9.68)	1588 (1.52)	3638 (4.93)	11997 (11.49)	10656 (14.43)	104454 (100.00)	73832 (100.00)
2007	9652 (3.08)	3331 (3.19)	47517 (15.15)	43982 (42.11)	8782 (2.80)	8448 (8.09)	180052 (57.42)	13247 (12.68)	7669 (2.45)	16507 (15.81)	14567 (4.65)	3838 (3.68)	45317 (14.45)	15089 (14.45)	313556 (100.00)	104443 (100.00)
2008	2672 (0.29)	8696 (2.77)	12920 (1.40)	53159 (16.95)	17115 (1.85)	6298 (2.01)	322118 (34.87)	105257 (33.57)	12969 (1.40)	13005 (4.15)	61744 (6.68)	20932 (6.68)	494298 (53.50)	106197 (33.87)	923836 (100.00)	313545 (100.00)
2009	4566 (0.86)	11025 (1.19)	100569 (18.88)	206119 (22.31)	5380 (1.01)	9354 (1.01)	121093 (22.73)	209986 (22.73)	14294 (2.68)	30826 (3.34)	113456 (21.30)	155832 (16.87)	173424 (32.55)	300689 (32.55)	532782 (100.00)	923832 (100.00)
2010	16892 (3.16)	7601 (1.43)	155284 (29.09)	139469 (26.18)	2087 (0.39)	5119 (0.96)	141723 (26.55)	91647 (17.20)	37238 (6.98)	47180 (8.86)	126789 (23.75)	116988 (21.96)	53807 (10.08)	124758 (23.42)	533820 (100.00)	532761 (100.00)
2011	17021 (1.57)	17351 (3.25)	138156 (12.74)	130834 (24.51)	1235 (0.11)	5708 (1.07)	214718 (19.81)	105740 (19.81)	325079 (29.99)	66149 (12.39)	166142 (15.33)	98856 (18.52)	221675 (20.45)	109151 (20.45)	1084026 (100.00)	533788 (100.00)
2012	20135 (1.78)	50589 (4.67)	55863 (4.93)	191232 (17.64)	140 (0.01)	5082 (0.47)	237523 (20.97)	227298 (20.97)	341179 (30.12)	249563 (23.02)	303434 (26.79)	164106 (15.14)	174285 (15.39)	196136 (18.09)	1132559 (100.00)	1084006 (100.00)
2013	52450 (4.17)	53879 (4.76)	128247 (10.19)	115433 (10.19)	39 (0.00)	3321 (0.29)	266218 (21.15)	236765 (20.91)	328876 (26.13)	295993 (26.13)	273962 (21.77)	246550 (21.77)	208736 (16.59)	180615 (15.95)	1258528 (100.00)	1132556 (100.00)
2014	51533 (6.13)	77147 (6.13)	107435 (12.78)	1790745 (14.23)	25810 (3.07)	8022 (0.64)	146340 (17.41)	256898 (20.41)	259588 (30.89)	282769 (22.47)	144332 (17.18)	234519 (18.63)	105312 (12.53)	220078 (17.49)	840350 (100.00)	1258507 (100.00)
2015	47390 (21.73)	67510 (8.03)	62558 (28.69)	128761 (15.32)	5282 (2.42)	20338 (2.42)	19439 (8.91)	163484 (19.45)	22316 (10.23)	209015 (24.87)	15633 (7.17)	122515 (14.58)	45453 (20.84)	128705 (15.32)	218071 (100.00)	840329 (100.00)
2016	79093 (59.60)	38326 (17.58)	18362 (13.84)	63231 (29.00)	6410 (4.83)	8799 (4.04)	2855 (2.15)	25002 (11.47)	976 (0.74)	21792 (9.99)	741 (0.56)	21043 (9.65)	24263 (18.28)	39860 (18.28)	132700 (100.00)	218054 (100.00)
2017		59317 (44.70)		23855 (17.98)		11871 (8.95)		5043 (3.80)		3179 (2.40)		6044 (4.55)		23379 (17.62)		132688 (100.00)

Figures in parentheses indicate percentage to total export from India

Table 5. Revealed comparative index for major maize exporting nations for the period from 2001 to 2016

Particulars	Argentina	Brazil	France	Hungary	India	Romania	Russia	South Africa	Ukraine	United States
2001	5.04	1.68	1.87	3.64	0.10	0.74	0.002	1.55	1.23	4.22
2002	4.47	0.83	1.95	4.33	0.17	1.34	0.002	2.48	1.11	4.41
2003	5.03	0.96	1.75	3.72	0.26	1.11	0.01	2.03	2.19	4.00
2004	4.63	1.29	1.86	4.34	1.44	1.92	0.01	1.57	2.89	5.13
2005	5.37	0.26	2.15	5.18	0.51	3.09	0.05	3.72	4.29	4.57
2006	4.20	0.86	1.66	6.06	0.57	2.02	0.04	2.01	2.49	5.60
2007	4.28	2.18	1.26	8.70	1.04	2.31	0.02	0.29	1.44	4.86
2008	4.64	1.13	1.51	5.52	2.14	2.21	0.06	3.71	2.92	4.89
2009	3.38	1.33	1.72	6.98	1.92	5.15	0.55	3.99	6.03	4.50
2010	5.25	1.87	1.59	6.21	1.32	5.84	0.11	2.50	4.35	4.08
2011	4.63	1.52	1.48	5.38	1.51	5.56	0.26	4.00	7.08	4.00
2012	5.21	2.88	1.43	5.46	1.25	5.50	0.86	2.43	9.78	2.62
2013	6.86	3.42	1.56	3.57	1.39	5.63	0.96	3.36	10.62	1.93
2014	4.98	2.39	1.41	4.09	1.03	5.99	1.10	2.82	10.24	3.27
2015	5.02	3.48	1.59	5.65	0.35	7.75	1.17	1.22	10.89	2.95
2016	6.21	2.66	1.31	4.00	0.21	5.47	1.89	1.76	8.09	3.51

Figures are rounded off to their nearest integer

Table 6. Determinants of maize exports from India

Variable	At level		At difference	
	Coefficient	Standard error	Coefficient	Standard error
Constant	-42.84**	19.82		
International price	0.88[NS]	1.44	0.92[NS]	1.48
Export price	-1.03**	0.49	-1.04**	0.43
Exchange rate	-2.02[NS]	2.61	-2.51[NS]	3.43
Consumption	2.99[NS]	1.92	2.55[NS]	2.42
Lagged production	3.64***	1.15	3.45**	1.26
R square	0.95		0.55	
DW stat	1.90		1.82	

***, ** and * indicate significance at 1, 5 and 10 per cent probability level

found to be significantly affecting the maize exports from India. As expected, export price has negative association and lagged production has positive association with maize exports. The exchange rate and domestic consumption have not played any significant role on maize exports.

The above findings are in line with the finding of Adhikari et al. [8] and Mech [5].

4. CONCLUSION

The maize export quantity and value found significant growth during post WTO period (1996-2016) but instability indices remained in higher category. The high instability carries a risk of varying export prices and is a concern for assuring income to exporters and for linking them with international markets. The reasons for high instability may be inconsistent domestic production, consumption and international demand. Thus, the export policies should be in line with consistent growth of maize exports with low instability.

India has witnessed a jump in maize exports from 2007 and found comparative advantage up to 2014. The global prices had come down in 2014-15 which lead to fall in subsequent external demand having pushed local prices to lower than MSP, while in 2015-16 the shortage in domestic production pushed prices above international markets, thus making maize exports unviable in 2015 and 2016. The significant increase in domestic production of the maize crop is the major option for improvement of maize export trade. Also the export price of maize must compete with the global prices. The above suggestion is supported by the result of determinants affecting the maize exports from India. The domestic consumption and exchange rate found to be non-significant in affecting the maize exports from India. The reason for this may be slight fluctuations in consumption of maize and exchange rate over the years.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Felicia W, Hasan G. Global maize trade and food security: Implications from a social network model. NIH Public Access. 2013;33(12):1-18.

2. Ministry of Agriculture and Farmers' Welfare of India. Season-wise area, production and productivity of Maize in India; 2017. (Accessed on 22nd December 2017).
Available:https://www.indiastat.com/agriculture-data/2/agricultural production/225/maize/17199/stats.aspx

3. Sihmar R. Growth and instability in agricultural production in Haryana: A district level analysis. International Journal of Scientific and Research Publications. 2014;4(7):1-12.

4. Karthick V, Alagumani T, Anbarassan A. Growth and export performance of ginger in India: An Economic Analysis. Economic Affairs. 2015;60(2):207-214.

5. Mech A. An Analysis of Growth, Instability and determinants and rice production in Assam. Indian Journal of Agriculture Research. 2017;51(4):355-359.

6. Ranjana A, Thakar KP, Burak SS, Arti A. Production and export performance of Indian groundnut. International Journal of Agriculture Sciences. 2017;9(4):3724-3727.

7. Yogesh HC. An economic analysis of production and export of Flue Cured Virginia (FCV) tobacco in India. M.Sc. Thesis, Govind Ballabh Pant Agricultural University, Pantnagar, India; 2017.

8. Adhikari A, Sekhon MK, Kaur M. Export of rice from India: Performance and determinants. Agricultural Economics Research Review. 2016;29(1):135-150.

9. Bakhshinejad M, Hassanzadeh A. Comparative advantage of selected agriculture products in Iran: A revealed comparative advantage assessment. World Applied Sciences Journal. 2012;19(10):1449-1452.

10. Goyal KA, Vajid A. Revealed comparative advantage of India's rice exports with selected countries. Pacific Business Review International. 2017;9(9):51-56.

11. Kapuya T, Sihlobo W. South Africa's Maize Exports: A Strategic Export Market Analysis Model Approach, Conference Paper; 2014.

12. Suresh A, Mathur VC. Export of agricultural commodities from India: Performance and Prospects. Indian Journal of Agricultural Sciences. 2016;86(7):876-883.

APPENDIX

1. ADF results for determinants of maize exports from India

Variables	Linear graph	At Level	At first difference
Export quantity	Intercept	-2.720	-3.230*
	Intercept + Trend	0.126	-5.074*
International Price	Intercept	-1.254	-3.349*
	Intercept + Trend	-2.594	-3.751*
Export Price	Intercept	-1.288	-7.028*
	Intercept + Trend	-4.566*	-7.145*
Exchange Rate	Intercept	-0.405	-3.719*
	Intercept + Trend	-1.132	-3.164*
Consumption	Intercept	1.714	-7.389*
	Intercept + Trend	-2.878	-7.867*
Lagged Production	Intercept	-0.278	-5.695*
	Intercept + Trend	-4.965*	-5.431*

* indicate significance at 5 per cent probability level