GROWTH PERFORMANCE OF POULTRY PRODUCTION AND EGGS EXPORT: A CASE OF INDIA

Abstract

Poultry is one of the most important and fastest-growing sectors of the agricultural sectors in India. Additionally, poultry products were a key contributor towards the export income of agricultural products in India. It was arguable that India with its integration into the global markets could benefit substantially from international trade in eggs and other poultry products. To take advantage of these opportunities, it was important to analyse India's prospects in the international market of poultry products economy by estimating the growth in production and export of poultry in India and measure the growth and instability in export of eggs. Analytical tools used to study these objectives were compound annual growth rates and instability indices. The study period was 1999-00 to 2018-19. The study revealed that that growth in India's production and export of eggs was declining for both production and export, there was a higher growth in period I (1999-00 to 2008-09) as compared to period II (2009-10 to 2018-19). There was more instability for both production and export of eggs in period I as compared to period II, however, unit value of export was more instable in period II as compared to period I.

Keywords: Poultry, eggs, production, export, growth, instability

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I. INTRODUCTION

Poultry is one of the most important and fastest-growing agricultural sector in India. While the production of agricultural crops had been rising at a rate of 1.5 to 2 per cent per annum that of eggs and broilers had been rising at a rate of 8 to 10 per cent per annum. As a result, India is now the world's fifth largest egg producer and the eighteenth largest producer of broilers (APEDA, 2020). The poultry industry in India had endured an exemplary transformation in structure and operation during the last two decades and modified into a mega-industry with the presence of a huge number of workers from a mere backward poultry farming. The Indian poultry market comprising of broilers and eggs was worth Rs.1,750 billion in 2018 and Rs.2,049 billion in 2019. The market was further projected to reach Rs.4,340 billion by 2024, growing at a CAGR of 16.2 per cent during the year 2019 through 2024 (Anon., 2020).

The potential in the sector was due to a combination of factors - growth in per capita income, a growing urban population and falling real poultry prices. Poultry meat was the fastest growing component of global meat demand and India, the world's second largest developing country, was experiencing rapid growth in its poultry sector. In India, poultry sector growth was being driven by rising incomes and a rapidly expanding middle class together with the emergence of vertically integrated poultry producers that have reduced consumer prices by lowering production and marketing costs. Integrated production, market transition from live birds to chilled and frozen products, and policies that ensure supplies of competitively priced corn and soybeans are keys to future poultry industry growth in India. There are number of small poultry dressing plants in the country. These plants are producing dressed chickens. In addition to these plants, there are five modern integrated poultry processing plants producing dressed chicken, chicken cut parts and other chicken products. These plants will manufacture egg powder and frozen egg-yolk for export (APEDA, 2020).

The commercialisation of the Indian poultry industry over the past decades had involved sizeable investments in poultry breeding, hatching, rearing and processing. Indian farmers had moved from rearing non-descript birds to rearing newly developed hybrids like shaver, babcock, hyaline which ensured more rapid growth, good liveability, excellent feed conversion ratio (FCR) and high profits. Other factors that were responsible for the rapid growth of the poultry sector were initiatives of private enterprises, fewer government interventions and very considerable indigenous poultry genetics capabilities and support from the complementary veterinary health, poultry feed, poultry equipment and poultry processing sectors. Apart from this, India was one of the few countries in the world that had put into place a sustained Specific Pathogen Free (SPF) egg production project (Anon., 2020).

Advances in breeding had given rise to birds that meet specialised purposes and were increasingly productive but that needed expert management. The development and transfer of feed, slaughter and processing technologies had increased safety and efficiency but favoured large-scale units rather than small-scale producers. These developments had led the poultry industry and the associated feed industry to scale up rapidly to concentrate themselves close to input sources or final markets and to integrate vertically. One element of the structural change had been a move towards contract farming in the rearing phase of broiler production allowing farmers with medium-sized flocks to gain access to advanced technology with a relatively low initial investment (FAO, 2017). Prabhu *et al*. (2012) concluded that livestock

and poultry population in India had shown a positive trend over the years except for cattle (during 1997 and 2003 census), sheep (1972 and 1987 census) and pig (during 1966 and 2007 census). Vetrivel *et al.* (2013) also asserted that poultry production in India was confined to backyards till recently. Local breed of birds was reared for the supply of eggs and meat. The increasing demand for poultry products necessitates augmenting the supply by importing improved breeds of poultry.

II. METHODOLOGY

The nature of data used for the study was entirely based on secondary data. The data on production, export quantity, value of export, domestic price and international price of eggs were compiled from various sources like the Food and Agricultural Organization (FAO), Handbook of Statistics on Indian States, RBI for various years, animal husbandry statistics (various issues) and Indian livestock census (various).

The data regarding production, export quantity, value of export, domestic price and international price of eggs in India were collected for the years 1999-00 to 2018-19.
The period was divided into three periods,

- Period 1 (1999-00 to 2008-09)
- Period 2 (2009-10 to 2018-19)
- Overall period (1999-00 to 2018-19)

1. **Growth Rate Analysis:** The growth rate was used to measure the past performance of the economic variables. The growth model of exponential was used to study the growth and thereby performance of poultry and eggs in terms of production, export quantity and value of export. Compound growth rate was analysed by using exponential growth function as given below.

$$Yt = a\, b^t\, e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(1)$$

Where,

Y	=	Dependent variable for which growth rate is to be estimated
t	=	Time variable
b	=	Regression coefficient
a	=	Intercept
e	=	Error term

Then the per cent annual compound growth rate 'r' was computed by using the formula

In Y = In a + t In b

Where Y is natural logarithm of Y, In a and b are similarly defined.
The compound growth rate 'r' was computed using the relationship

r = (Antilog of (In b) × 100)

Where,

$$\text{In b} = \frac{\sum(t \ \text{In Y}) - (\sum t \ \sum \text{In Y})/n}{\sum t^2 - (\sum t)^2/n}$$

and n is number of times points
The significance of In b was tested by t-ratio

$$t = \frac{|\text{In b}|}{\text{SE(ln b)}}$$

Where,

$$\text{SE(In b)} \ = \ (\text{SS}_{\text{In Y}} \ (\text{In Y})^2 \ \text{SS}_t) \ / \ ((n-2)\text{SS}_t)$$

Where,

$$\text{SS}_{\text{InY}} = \sum(\text{InY})^2 - (\sum \text{InY})^2 \ /n$$

The critical value is t-table value for n-2 degrees of freedom

2. **Instability Index:** Instability in export was expected to hamper the process of economic development. The degree of instability in production, export quantity and export value of eggs was measured to find out the fluctuation in export of eggs during the last 20 years. To study the export instability, coefficient of variation (CV) and Cuddy Della Valle Instability Index (CDVI) was used to estimate the variation in the export of eggs.

- **Coefficient of variation**

$$\frac{\text{Standard deviation}}{\text{Arithmetic mean}} \text{X } 100$$

The simple coefficient of variation (CV) often contains the trend components and thus overestimates the level of instability in time series data characterized by long term trends. To overcome this problem, the instability index given by Cuddy Della Valle (1978) which corrects the coefficient of variation was used.

- **Cuddy Della Valle Instability Index (1978)**

$$\text{Instability index} = \text{CV}\sqrt{(1 - R^2)}$$

Where,

   CV = Simple estimates of coefficient of variation in per cent and
   R^2 = Coefficient of determination from a time trend regression (linear) adjusted by the number of degrees of freedom.

Index Numbers: An index number is a statistical measure designed to show changes in variables or group of related variables with respect to time. Index numbers were calculated by choosing the first three years average (1999-2000 to 2001-02) as a base year. The following formula was used to estimate the index number.

$$\text{Index number} = \frac{\text{Current year's value}}{\text{Base year's value}} \times 100$$

III. RESULTS AND DISCUSSION

To understand the trend in production of eggs in India, growth rates and instability indices were used. In addition, the proportion of Indian egg production verses the world total production was computed to understand the growth in Indian local production in relation to the world production, which is the total for all the egg producing countries in the world.

1. **Share of the Indian Production of Eggs in the World:** Percentages were used to find out the proportion of Indian production of eggs in the poultry economy of the world. It was found that India's share in world eggs production has been on an upward trajectory as shown in Table 1. In Triennium ending (TE) 2001-02, India produced 3.7 per cent of the total eggs production in the world which corresponded

Table 1: Proportion of Indian Egg Production to the World Egg Production

TE 2001-02	TE 2004-05	TE 2007-08	TE 2010-11	TE 2013-14	TE 2016-17	TE 2018-19
38729000 (3.70)	45201000 (4.09)	53583000 (4.60)	61420100 (4.95)	69731000 (5.29)	82929400 (6.08)	103317631 (6.49)

Note:
- Values in parentheses are the percentage share of Indian egg production to the world egg production
- Values in 1000 numbers to 38.73 billion eggs. By TE 2018-19, Indian production in eggs had improved by 237 per cent from 1999-00 while the world production increased by 57 per cent within the same period; an indication that Indian production was improving faster than the world total production in eggs. Indeed, the share of the Indian production in the world production of eggs had reached 6.49 per cent, corresponding to 103.32 billion eggs in TE 2018-19.

2. **Growth and Instability in Production of Poultry in India:** Compound annual growth rates (CAGR) and Cuddy Della Valle instability (CDVI) indices were used to study the annual growth in the production of poultry products in India. These were employed to compute the annual growth rates and instability indices on production with respect to quantity for a period of 20 years (1999-00 to 2018-19) and the results are presented in

Table 2. While analysing instability, annual growth rates could not be considered solely as they only show the rate of growth over the period while instability allows for judgement on whether the growth performance was stable or unstable over the study period. CAGR and CDVI were employed on the entire period and in addition to two periods which were 1999-00 to 2008-09 and 2009-10 to 2018-19 which will be identified as period I and period II respectively.

The results revealed that the annual growth rate was highest during the first period (1999-00 to 2008-09) for both production of poultry and eggs. compared to the second period (2009-10 to 2018-19). Poultry reported an annual growth rate of 8.5 per cent in the overall period while eggs reported an annual growth rate of 5.46 per cent. This meant that the annual incremental value for poultry was higher than that of eggs in India. The first period was also the most unstable for both poultry and eggs production. However, the overall instability for the entire period was higher than that for the two periods an indication that while taken in totality, the factors leading to instability in the production of poultry and eggs were more conspicuous in the long term than in the short term. These could be due to turbulences in production due to occasional diseases outbreaks within various parts of the country.

Table 2: Period-Wise Compound Annual Growth Rates and Instability of Production of Poultry and Eggs in India

Particulars	CAGR	CDVI
Production of poultry		
Period I	10.02*	3.65
Period II	6.30*	2.32
Overall Period	8.50*	4.81
Production of eggs		
Period I	6.12*	3.14
Period II	5.50*	2.75
Overall Period	5.46*	4.74

Note:
o * denotes significant at 1 per cent level
o Period I: 1999-00 to 2008-09;
   Period II: 2009-10 to 2018-19; Overall period: 1999-00 to 2018-19

3. **Trend Analysis in Production of Eggs in India:** To determine the volatility and stability of the egg production economy in India, trend analysis was conducted on the national production quantity. It was discovered that for the entire 20-year period of study, that is, 1999-00 to 2018-19, the series showed uniqueness at various points mainly due to external factors that affect egg production. Due to this, the series was subjected to break analysis to find the breaks in the data and find the different phases through which egg production. Therefore, the breaks in the series depicted occasions when an exceptional incidence happened, for example, major hindrance in production of eggs like outbreak in disease(s) which in turn altered the sustained trend stability. Indeed, it was found that the entire study period for the egg production, it had more than one trend and peculiarities in growth for the period under study. The results for the break analysis are indicated in Table 3.

   Production of eggs series presented four breaks in its entire study period 1999-00 to 2018-19. These gave rise to five phases, namely, 1999-00 to 2003-04, 2004-05 to 2006-07, 2007-08 to 2011-12, 2012-13 to 2015-16 and 2016-17 to 2018-19. From 2001-02 India reported deceleration in annual egg production growth till 2003 when the series experienced the break after which the production resumed the impressive growth before the 2001-02 salmonella serovars infestation. The decline in growth from 2001-02 to 2003-04 was 20 per cent, 5.7 per cent, 2.8 per cent which culminated in 1.43 per cent in 2003-04 as the lowest point in the deceleration. This was the year when the highly pathogenic avian influenza (HPAI) unusual outbreak was reported in many countries in Africa, Asia and Europe. This was noted as the main reason that could have led to the break in the production trend in eggs in 2003-04. However, due to better prospects in 2004-05, the growth instantly rose to 11.9 per cent. This improvement could have been a ripple effect from the ban of USA poultry products by Ukraine, Russia and Moldova at the time which reduced poultry exports from the USA by 8 per cent. The European Union also suffered avian influenza outbreak mainly in the Netherlands in 2002. Since the gains could not be seen immediately in India; it was seen in the year 2004-05 when the production in eggs rose by 11.9 per cent as India moved to take the market share of the USA and EU that were set back by the outbreaks. This phase presented a second-degree polynomial trend, distinct from the other subsequent phases in the series which had linear trends. It was also the most unstable of all the phases at 0.054 per cent.
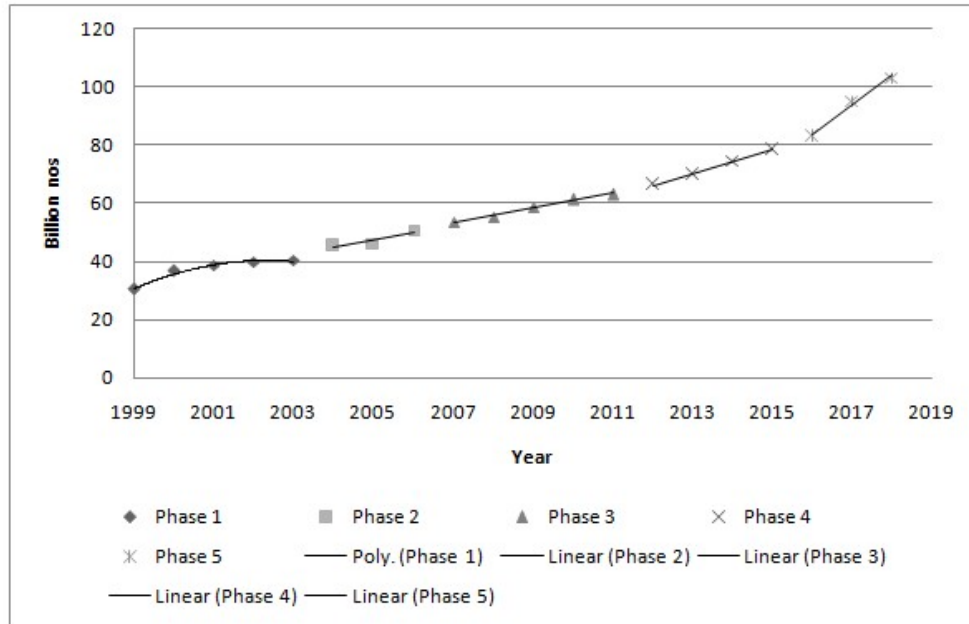
Figure 1: Changes in Production of Eggs Series from 1999-00 to 2018-19

Figure 1 is a presentation of the changes in production of egg. The second phase which ended with a break in 2006-07 could have been caused by the 2006 H5N1 viral outbreak in India. This was one of the largest avian viral outbreaks in the country that oversaw culling of over 253,000 birds while 587,000 eggs were destroyed in just five days. Companies in the hospitality industry also removed poultry products from their menu in droves. Consequently, prices for poultry products dropped as demand deteriorated. These developments in 2006-07 could have led to the break in the eggs production series within this phase as production got battered at the back drop of low demand. In addition, farmers felt disenfranchised to continue producing eggs due to low prospects in prices. The phase presented a linear growth with an annual increment of three billion eggs.

The fourth phase, 2012-13 to 2015-16, marked the end of slow growth in the poultry production all over the world since a spate of successive livestock epidemics and counter measures by respective countries that curtailed growth prospects in the sector. Due to the sensitive nature of the livestock international market, in cases where there were outbreaks, many importing countries refrained from the affected country's exports. This was a case at the time, as the USA market was plagued by the American avian influenza, H1N2. USA was a major exporter of poultry products and when it was affected by the influenza, other countries took the opportunity and grew their production to compensate for the hindered USA products. Indeed, while USA production declined by 3.6 per cent, the production of

Table 3: Trend in Production of Eggs from India (1999-00 to 2018-19)

Phase	Function	R square	Coefficients		CAGR	CDVI
			β_1	β_2		
1	Second degree polynomial	0.979	3,000	-0.9	6.7**	0.054
2	Linear	0.886	3		5.9	0.029
3	Linear	0.9872	2		4.4***	0.035
4	Linear	0.994	4		5.2***	0.015
5	Linear	0.9861	10		11.6*	0.018

Note:
- * denotes significance at ten per cent level
- ** denotes significance at five per cent level
- *** denotes significance at one per cent level
- Phase 1: 1999-00 to 2003-04, phase 2: 2004-05 to 2006-07, phase 3: 2007-08 to 2011-12, phase 4: 2012-13 to 2015-16 and phase 5: 2016-17 to 2018-19
- β_1 and β_2 values in billions

India and the world average increased by 5.7 per cent and 1.4 per cent respectively. This was an indication that USA was a major player in the industry and one of the competitors of India in the international market of poultry products. The phase registered a linear growth trend with an annual growth of four billion eggs at a CAGR of 5.2 per cent. This phase was also the most stable in the Indian production of eggs at 0.015 per cent. The last phase was a phase of rapid growth in poultry eggs production in India which posted a linear trend and increment of 10 billion eggs annually. This phase also had the highest CAGR of 11.6 per cent.

4. **Index Number for Production:** The basic objective of estimating index numbers was to make the trend of eggs. For this analysis 20 years data (1999-00 to 2018-19) was used. The results are presented in Table 4. It was seen from the results that the index numbers of world production and India's production of eggs had shown gradual increase in almost all the years. The index number for India's production and world production were found lowest in 1999-00 with 97.56 and 86.32 respectively and were highest in 2018-2019 with 153.35 and 267.33.

Table 4: Index number of production of Indian eggs

Year	World production	India's production
1999-00	97.564	86.320
2000-01	100.297	103.880
2001-02	102.139	109.801
2002-03	104.737	112.915
2003-04	106.659	114.548
2004-05	108.905	128.178

2005-06	111.287	131.087
2006-07	112.939	143.645
2007-08	116.556	150.434
2008-09	121.723	155.539
2009-10	123.934	164.880
2010-11	126.065	172.440
2011-12	128.455	176.944
2012-13	131.356	186.575
2013-14	133.820	195.774
2014-15	136.170	209.870
2015-16	140.900	220.348
2016-17	145.136	232.823
2017-18	151.525	247.448
2018-19	153.347	267.327
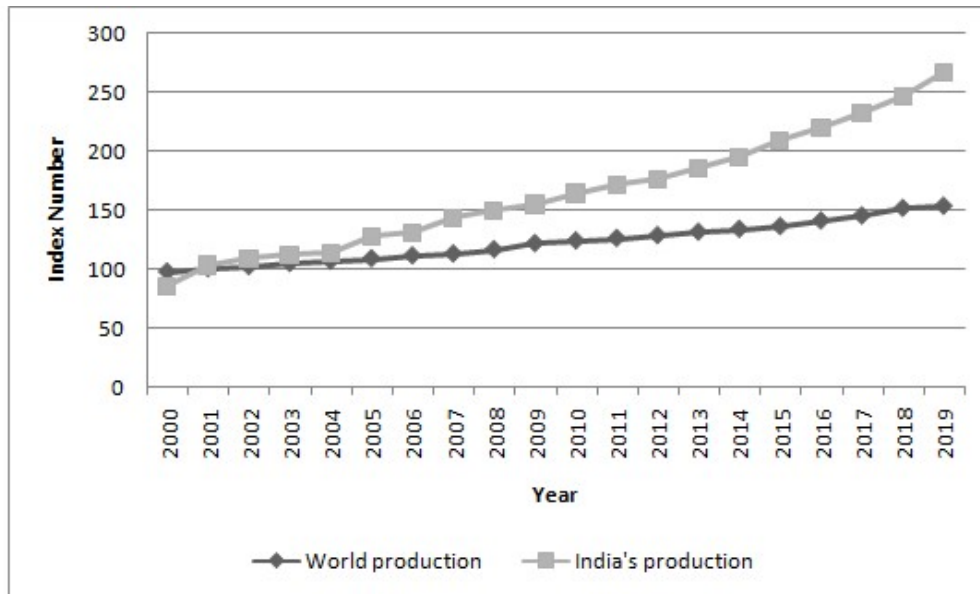
Figure 2: Index Number for Production of Eggs in World and India
(Base year = Triennium ending average of 2000)

Figure 2 shows the comparison between the index number world production and India's production and it can be seen that India's production is increasing fast compared to world production

IV. GROWTH PERFORMANCE OF EGGS EXPORT FROM INDIA

To understand the trend in export of eggs from India, growth rates and instability indices were used on the export quantity and value of export of eggs from India. The proportion of Indian export of eggs in the world was also computed to understand the growth in Indian egg export in relation to the world export of eggs.

1. **Share of Export from India in the World Eggs Export:** Percentages were used to find out the proportion of export of eggs from India to the total export of eggs in the world. It was found that export of eggs from India to the world was increasing from TE 2001-02 till TE 2007-08. From TE 2010-11, export of eggs from India started declining till the end of the study period. The decline in export of Indian eggs in the international market could be due to several factors. One major reason could be due to increased domestic consumption of eggs which led to less quantity left for onward export. The international market could also had reduced on its demand for eggs from India. Lastly, due to stiff competition from highly mechanised countries like China that were able to produce eggs at a fraction of production cost in India, Indian exports could have become uncompetitive in the international market leading to reduction in the amount exported.

Table 5: Proportion of Indian Egg Export to the World Egg Export

TE 2001-02	TE 2004-05	TE 2007-08	TE 2010-11	TE 2013-14	TE 2016-17	TE 2018-19
10593 (1.05)	35343 (3.19)	58358 (4.34)	43817 (2.33)	31348 (1.60)	29004 (1.35)	27948 (1.23)

Note:
- Values in parentheses are the percentage share of Indian egg export to the world egg export
- Values in tonnes

2. **Growth and Instability of Export of Eggs from India:** Compound annual growth rates (CAGR) and Cuddy Della Valle instability (CDVI) indices were used to study the annual growth rates in the export quantity of eggs and value of eggs exported from India. To understand the pattern of changes in the level of export and value of eggs in India, the coefficient of variation was computed. Since the coefficient of variation contains the trend component of the series which in turn affects the level of instability, the study used instability index given by Cuddy Della Valle Index, which corrects the coefficient of variation and the results are presented in Table 6.

   The study revealed that as in the case of CAGR for poultry and eggs, the CAGR was higher in period I (1999-00 to 2008-09) for both export quantity and export value compared to period II (2009-10 to 2018-19). However, unit value was higher in period II compared to period I which reported a negative growth of 1.38 per cent. While the export quantity reported a negative CAGR in the second period (-3.83%), the export value was positive (10.47%). This could be an indication that as export of eggs from India declined in the international market, the monetary value of the export increased. Definitely during this phase, the exchange of US dollars to rupees increased by a CAGR of 5.4 per cent.

Export value reported CAGR of 15.32 per cent in the overall period while the export quantity reported 3.17 per cent. Instability was highest for the three in the first phase as show by 27.58 per cent for export quantity, 25.53 per cent for value of export and 29.98 per cent for unit value of export. Export quantity reported the highest instability (48.29%) in in the overall period while the export value reported the lowest (16.35%).

Table 6: Period-wise Compound annual growth rates of production of poultry and eggs

| Particulars	CAGR	CDVI
Export quantity		
Period I	26.92*	27.58
Period II	-3.83*	15.55
Overall Period	3.17*	48.29
Value of export		
Period I	25.17*	23.53
Period II	10.47*	11.22
Overall Period	15.32*0	16.35
Unit value of export		
Period I	-1.38*	29.98
Period II	14.87*	8.99
Overall Period	11.77*	33.54

Note:
- *- denotes significant at 1 per cent level
- Period I: 1999-00 to 2008-09; Period
- II: 2009-10 to 2018-19; Overall period: 1999-00 to 2018-19

3. **Trend Analysis in Export of Eggs from India:** Trend analysis was conducted on the exported quantity of eggs and its value in the same manner as production of eggs to find out the volatility in the trend of export of eggs from India. Breaks were also computed on the series to understand the factors that could have impacted the trends at different times of the period under study. The findings are discussed below under quantity of export and value of export of eggs.

4. **Trend Analysis for Quantity of Export of Eggs from India:** It had been pointed out in this chapter that the poultry and poultry products market was highly sensitive to disease outbreaks. These always played out in instances of closure of poultry product markets and imposition of quantitative restrictions or non-tariff barriers (NTBs) like the sanitary and phytosanitary (SPS) restraints on another country. To understand the responsiveness of the poultry export quantity over the study period to factors inherent in the industry, break point analysis to find the volatilities in the export of poultry products was undertaken. Two breaks were realised in the export quantity of eggs from India to other countries. These were in 2002-03 and 2009-10. These gave rise to three phases; 1999-00 to 2002-03, 2003-04 to 2009-10 and 2010-11 to 2018-19.

At the start of the century, India reported declining export of eggs to other countries. The decline in quantity of export could have been due to the structural adjustment programmes (SAPs) instituted by the WTO in the 90s as India came to terms with effects of gradually lifting protectionism of local production. As more countries were able to import into the country, this could have affected the capacity to produce optimally due to the influx of cheaper poultry products thereby hampering the quantity India could export at the time. This led to decline in export from India by seven per cent in continuation with the decline that the country had been experiencing at the start of the 2000s. It was only in 2002-03 when the country recovered and the export of eggs improved by 44 per cent. The break therefore showed that this was the start of a phase of impressive growth in export of eggs from India as depicted in figure 3. Another reason could have been less demand of Indian poultry products in the international market. In this context, while the share of export to import of poultry products in India was 100 per cent, an indication that there were no poultry products that was imported into India in 2001-02, the extreme decline in export of poultry products from India in 2001-02 could have been due to less demand of Indian poultry products in the international market. This phase presented a linear trend with an annual increase in eggs of 1468 tonnes of eggs. Due to the impressive recovery at the end of the phase in 2002-03, the phase had the highest CAGR of 12.5 per cent of all the phases.

In 2009-10, the world experienced the swine flu pandemic that could have triggered deceleration in movement of livestock products as countries took precautionary measures to counter the spread of the flu by hindering movement of livestock products that could have acted as vectors.
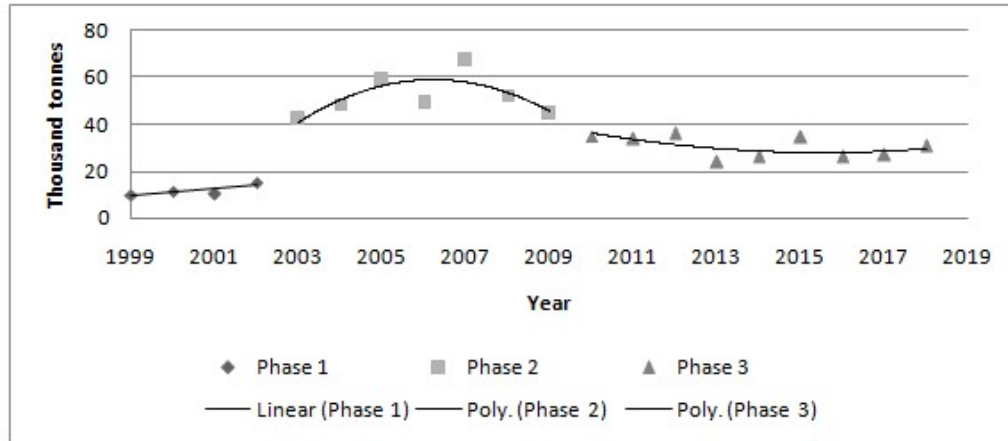
Figure 3: Changes in Export Quantity from India (1999-00 to 2018-19)

The trend in export quantity of eggs is presented in figure 3 which shows the various breaks during that period. Indeed, the export of poultry products from India in 2009-10 dropped by 15 per cent which was the start of decline in export that was sustained for the next four years till 2013-14 and only improved marginally in 2012-13. Therefore, the break marked the beginning of decline in export of India's eggs in the international market and an end in growth in export of Indian eggs in the international market. This phase was the most unstable (0.18%) while it had a growth of 1.5 per cent.

The third phase 2010-11 to 2018-19 was a phase of decline in export of Indian eggs. The decline could have been due to a sequence of rather less pronounced outbreaks in poultry diseases at different times within the phase. However, due to the sensitive nature of the poultry industry, despite the less noticeable intensity, the international market could have taken notice and reduced demand for the Indian poultry products. Thus, this phase marked the period of decline in export of Indian eggs. Despite the phase being stable at 0.143 per cent as the first phase, it registered negative CAGR in export of eggs at -2.5 per cent. The results for the break analysis are indicated in Table 7

Table 7: Trend in Export Quantity of Eggs from India (1999-00 to 2018-19)

Phase	Function	R square	Coefficients		CAGR	CDVI
			β_1	β_2		
1	Linear	0.6562	1467.6		12.5*	0.143
2	Second degree polynomial	0.5653	7,000,000	-1688	1.5**	0.180
3	Second degree polynomial	0.3438	1,000,000	259.75	-2.5***	0.143

Note:
- * denotes significance at ten per cent level
- ** denotes significance at five per cent level
- *** denotes significance at one per cent level
- Phase 1: 1999-00 to 2002-03, Phase 2: 2003-04 to 2009-10, Phase 3: 2010-11 to 2018-19

5. **Trend Analysis Value of Export of Eggs from India:** The breaks computed from the export value from India data series produced two breaks: 2002-03 and 2006-07 which gave rise to three phases as 1999-00 to 2002-03, 2003-04 to 2006-07 and 2007-08 to 2018-19. Apart from the break in 2006-07, these breaks were like the breaks for the exported quantity due to the reason that the export value is derived from the exported quantity. In this context and as discussed under the export
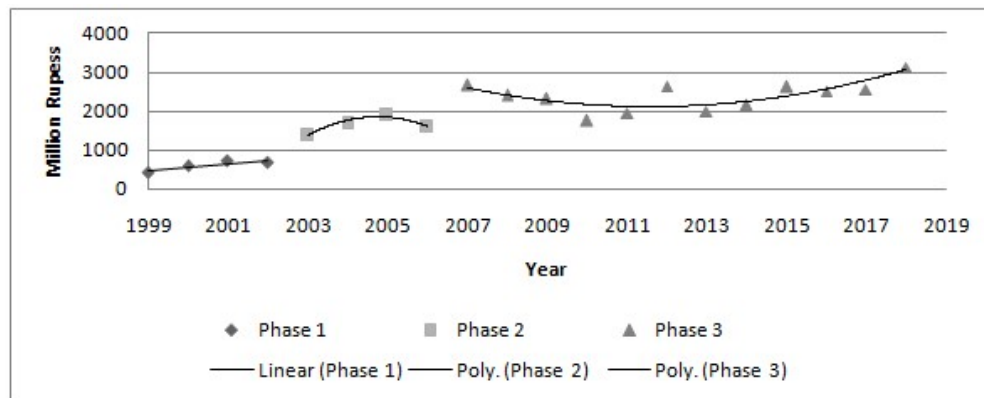
Figure 4: Changes in Value of Export from India During 1999-00 to 2018-19

quantity, India was experiencing decline in its export of eggs at the turn of the 21st century as presented in figure 4. Consequently, due to the decline in the quantity exported, the value also declined in suit. Therefore, the factors that led to breaks in the exported quantity in 2002-03 could have led to the break in the value of export in 2002-03. This phase had a linear trend with an increase of ₹ 90 million per year. This phase also had the largest CAGR of 17.8 per cent. Despite the highest annual growth rate, this phase was the most stable at 0.137 per cent.

As noted in the discussion of production of eggs, India experienced one of the worst avian flu outbreaks in 2006-07 and that the poultry industry was very sensitive to disease outbreaks. When the outbreak occurred in 2006-07, countries could have instituted blockades on India's export of poultry products due to fear of importation of the avian virus into their countries. While countries could have restricted India's eggs and other poultry export, the country was reeling under extremely reduced production capacity after massive number of chicken being culled and tonnes of eggs destroyed. Therefore, an interaction of these factors led to the break in 2006-07 as exports dropped after an impressive growth from 2002-03. This could explain why the production growth trend declined in this year. Despite production growth period. This phase registered a

second-degree polynomial trend. While the CAGR was not significant, it was positive at 5.4 per cent.

Table 8: Trend in export value of eggs from India (1999-00 to 2018-19)

Phase	Function	R square	β_1	β_2	CAGR	CDVI
1	Linear	0.751	90		17.8*	0.137
2	Second Degree Polynomial	0.9293	600,000	-200	5.4	0.143
3	Second Degree Polynomial	0.6035	-90,000	20	1.7***	0.15

Note:
- *, *** Denotes significance at 10 and 5 per cent level, respectively.
- β_1 and β_2 values in millions
- Phase 1: 1999-00 to 2002-03, Phase 2: 2003-04 to 2006-07, Phase 3: 2007-08 to 2018-19

The last phase 2007-08 to 2018-19 of the trend in export value was a phase of marginal growth. Despite the export quantity registering decline in annual growth during this period, the export value was positive. This meant that despite the quantity declining, the money value of the exported amount was increasing. While the phase registered the lowest growth at 1.7 per cent, it was the most unstable of the other phases.

6. **Index Number for Export:** The index number was worked out for export quantity of eggs for the world as well as India and for export value and unit value of eggs. The basic objective of estimating index numbers was to make the trend of eggs. For this analysis 20 years data (1999-00 to 2018-19) was used. The results are presented in Table 9.

It was seen from the results that the index numbers of world export, India's export, export value, domestic price and international price had shown gradual increase in almost all the years. Comparing India's export and world export, the lowest value was in 1999-00 with 97.86 and 93.93 respectively while the highest index number for India's export was 241.05 in 2018-19 and world export was 634.91 in 2007-08. In the case of export value, the highest index value was 529.73 in 2007-2008 and lowest was 76.77 in 1999-00. The highest index value for unit value of export was 125.01 in 2017-18 and the lowest was 60.12 in 2003-04. Domestic price and international price had the highest index value of 470.63 and 644.25 in 2018-2019 respectively, and the lowest of 58.07 and 96.54 in 1999-00 respectively.

Table 9: Index number of export and prices of Indian eggs

| World export	India export	Export value	Unit value of export	Domestic prices	International prices
97.860	93.927	76.773	81.888	75.787	96.540
100.089	107.086	102.116	95.535	95.256	101.657
102.051	98.987	121.111	122.577	128.957	101.802
106.933	142.807	110.660	77.632	80.418	100.073
109.211	399.487	239.737	60.122	58.058	117.139
112.784	458.609	299.880	65.510	62.728	118.976
118.092	554.537	343.360	62.033	59.769	122.319
129.866	463.216	278.320	60.195	60.898	130.644
152.072	634.918	529.735	83.588	85.941	152.226
180.302	494.736	421.383	85.331	105.602	196.161
188.305	417.055	390.727	93.860	136.179	265.977
191.073	329.084	310.892	94.647	152.087	290.911
189.418	320.154	326.689	102.230	189.799	337.730
188.023	341.385	396.954	116.493	265.602	439.587
204.776	226.237	264.887	117.301	335.706	549.050
215.352	247.580	279.474	113.091	328.698	566.905
214.275	325.091	322.289	99.321	318.165	580.961
209.992	248.722	300.826	121.172	418.134	562.005
227.050	254.377	317.416	125.013	427.665	573.046
241.054	288.379	358.227	124.450	470.625	644.254

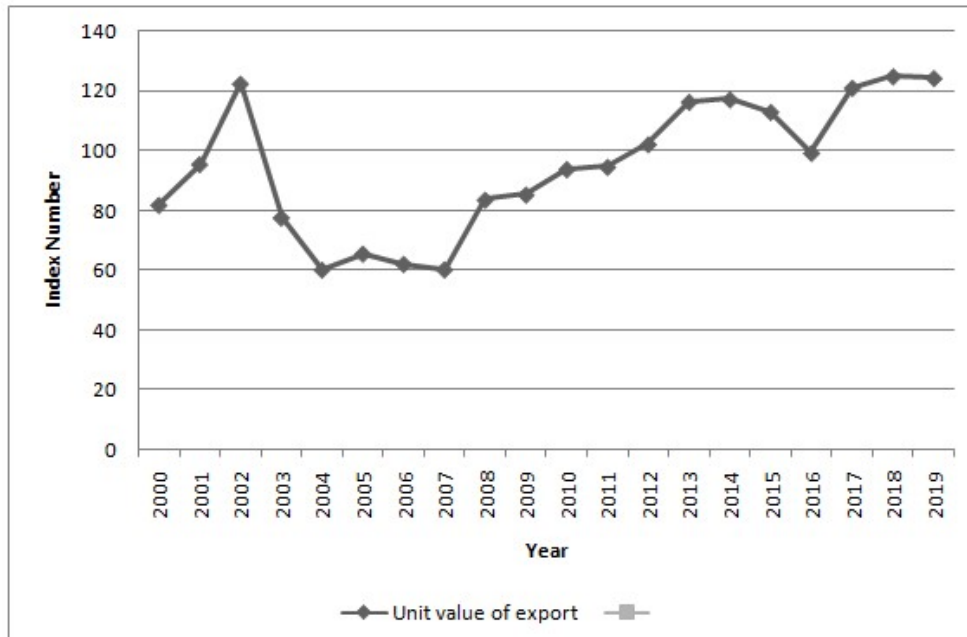**(Base year = Triennium ending average of 2000)**

Figure 5: Index Number for Export of Eggs in World and India
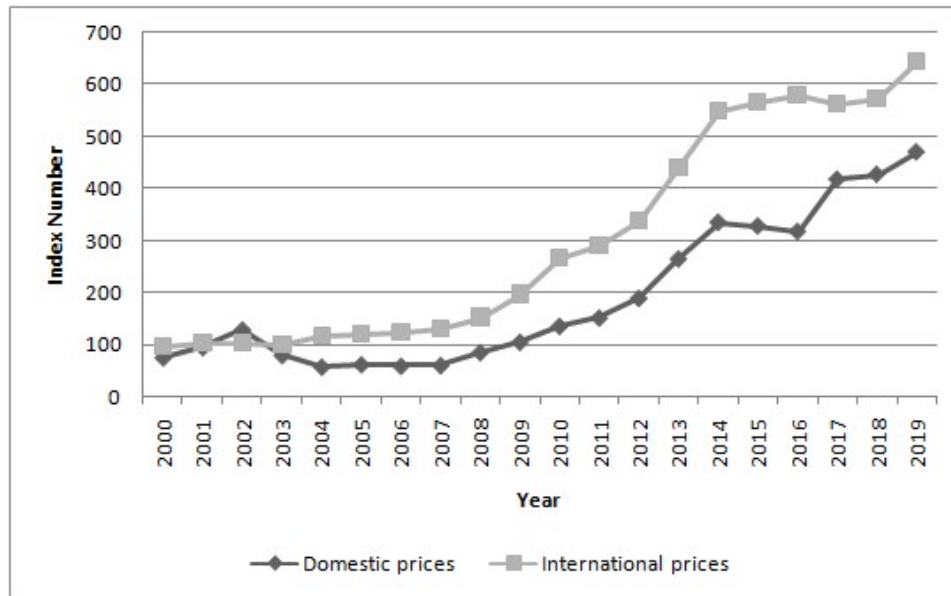
(Base year = Triennium ending average of 2000)

Figure 5 shows the comparison between the index numbers of world export and India's export. It can be observed that the index number for export from India is not stable.
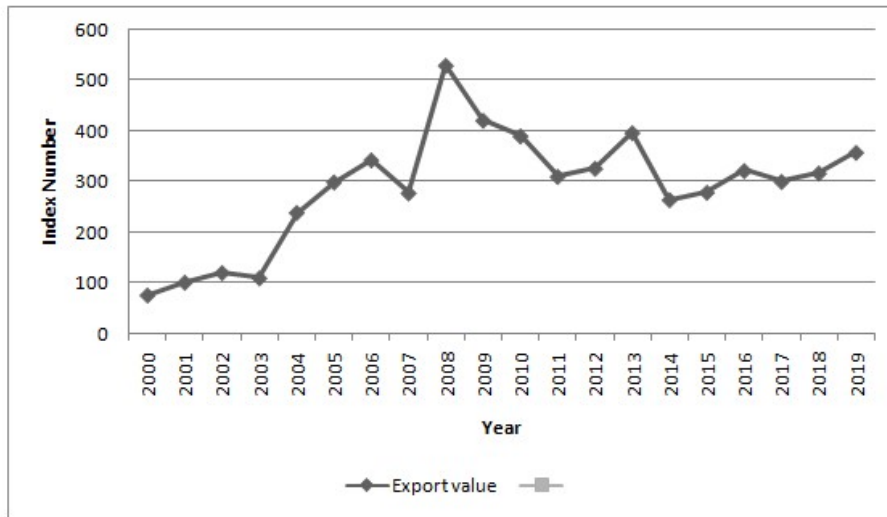
Figure 6: Index Number for Export Value of Eggs in India
(Base year = Triennium ending average of 2000)

Figure 7: Index Number for Unit Value of Export of Eggs in India
(Base year = Triennium ending average of 2000)

Figure 8: Index Number for Domestic Prices and International Prices of Eggs in India
(Base year = Triennium ending average of 2000)

V. CONCLUSION

The growth of production, export quantity, export value and unit value of export of eggs in India was positive and significant at one per cent level in all the periods of study. The CDVI revealed stability in production, quantity exported and export value in Period II compared to period I. The CV and CDVI for production of eggs were reported very low as compared to export quantity and export value in Period I and II. On the other hand, export quantity reported low CV with low degree of instability in Period II. During the overall Period, unit value of export reported the highest coefficient of variation. However, export quantity reported the highest instability and export value reported the lowest instability. The index number for the production, India's export, world export, value of export, unit value of export, domestic price and international price of eggs in displayed gradual increase in almost all the periods. Mostly the highest index number was seen for the last year and the lowest was seen for the first year.

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