LIVESTOCK SECTOR IN INDIA- A CRITICAL ANALYSIS

Abstract

India has the world's largest livestock population accounting for over 37.28 per cent of cattle, 21.23 per cent of buffalo, 26.40 per cent of goats and 12.17 per cent of sheep of the world's population. As far as livestock population is concerned, India's livestock population (512.1 million heads) constitutes majorly of cattle (190.90 million), goats (135.17 million), buffaloes (108.70 million), and sheep (65.07 million). The study examined the growth and export dimension of livestock sector of India, the factors affecting livestock output and the trends, performance and determinants of livestock production. Secondary data for years (1951 to 2016-17) were collected. Besides, Regression analysis, the Markov Chain analysis and Coppock's Index were computed to achieve the stipulated objectives. The results revealed that India's total livestock population increased from 289.4 million in 1951 to 529.70 million in 2007 but plummeted to 512.06 million in 2012, while total poultry population increased consistently from 73.5 million in 1951 to 729.21 million in 2012.

In livestock composition bovine share was increased but bovine share was decreased. Buffalo, goat and pig share was also increased but cow, cattle and sheep share to total livestock population was decreased. The instability was observed the highest in poultry and remaining livestock animals also shows the instability in its population growth. India's milk, meat, egg and wool production increased at the rate of 4.18, 2.74, 6.02 and 0.81 per cent per annum respectively during the study period. Production of milk, meat and egg increased rapidly after 1970, 1980 and 1980, respectively. India's trade balance for livestock and livestock products shifted from deficient condition to positive balance.

Comment [L1]: contracdictory

Keywords: Trends in livestock population, Growth and instability of livestock and livestock production

Introduction

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The livestock wealth in the world comprises about 195 million buffaloes, 1,482 million cattle, 1,006 million goats, 1,209 million sheep, 58.9 million horses, 10 million mules, and 27.8 million camels (Anonymous, 2016). The distribution of the livestock population across the globe shows that the ruminants, cattle and sheep dominate the animal population in Asia, Africa and Oceania. The proportion of cattle, sheep and goat population is almostv ~~same~~similar in Europe (Ref). In North, Central and South America cattle dominates, while goats are primarily found in Asia (59%) and Africa (34%). Asia accounts for 41 per cent of sheep and 58 per cent of swine population. About 97 per cent of world's total livestock population is in Asia (Philipson *et al*. 2011). India has the world's largest livestock population accounting for over 37.28 per cent of cattle, 21.23 per cent of buffalo, 26.40 per cent of goats and 12.17 per cent of sheep of the world's population (ref). As far as livestock population is concerned, India's livestock population (512.1 million heads) constitutes majorly of cattle (190.90 million), goats (135.17 million), buffaloes (108.70 million),

and sheep (65.07 million ref?). The country also exhibited a tremendous increase in the poultry population in the last three decades and rose from 207.74 million birds in 1982 to 729.21 million birds by 2012 census why no recent data!!. In order to study the scenario of livestock following objectives were framed.

- To estimate the trends and changes in composition of livestock population of India.
- To work out the overall impact and changes in production and productivity of livestock.
- To estimate the instability of major livestock and livestock products of India.

Research Methodology

The study is based on the time series data obtained from various published sources *viz*; Department of Animal Husbandry, Dairying and Fisheries, Annual reports, Commission published by government of India, Report on export of products by APEDA. The secondary data on livestock population of India for the selected decade years ~~covering the period~~ from 1951 to 2015 ~~in respect of India~~ were ~~obtained~~ collected by referring the livestock census reports published by the Department of Animal Husbandry, Dairying and Fisheries, India. Some other reports *viz*., Annual reports, Agriculture and Processed Food Products Export Development Authority (APEDA) reports on exports, Food and Agriculture Organisation (FAO) were also useful for getting relevant information.

This information became useful for studying the changes in livestock population, growth rates in livestock products (milk, meat and egg, etc.), export of livestock products during the period from 1960-61 to 2016-2017.The information is also useful for identifying the important factors influencing the livestock production in India.

Analysis of data

The analysis of data was done keeping in view of the objectives of the study. It was proposed to use both tabular and statistical method of analysis. For the study total period was divided into sub periods as per availability of data.

Percentage change over the base year

The per cent change over base year for t^{th} year was calculated as,

$$\text{Per cent change} = (Xt - Xt\text{-}1/\ Xt\text{-}1) \times 100$$

Where, Xt-1 and Xt-1 represents the quantity in t^{th} and (t-1)th year, respectively.

Compound growth rate

In estimation of growth of livestock population and production (Milk, Meat, Egg, Wool etc.). Exponential function of the following type to the data for three periods explained as below,

$$Y = ab^t$$

Where,

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Comment [L8]: This is not at all related to methodology, rather it may justify objective

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Y= Livestock production (milk, meat, egg in tonnes)/livestock population/export of livestock product/import of livestock product

a = Intercept

b = Regression coefficient, t = Time period in years

Finally, the annual rate of the compound growth in the livestock products, population, export and import will be and their exports was worked out by using the formula,

$$CGR\ \% = (Antilog\ b\text{-}l) \times 100$$

The significance of the estimated compound growth rates was examined with the help of student "t" test.

Instability analysis

Coefficient of variation

Coefficient of variation of livestock population and livestock products will be estimated for examining the growth and instability of livestock population and livestock products.

$$C\ V = (S.D/Mean)\ X100$$

Coppock index

Coppock index was estimated for examining the instability. It is calculated as the antilog of the square root of the logarithmic variance using the following formula (Coppock, 1962)

$$\text{Coppock Index} = (\text{Antilog})\ \sqrt{(V\log -1)} * 100\ V\ \log = 1/\ (N-1)\ ) \sum (\log pt+1 - \log pt - M)2$$

$$M = 1\ /(N-1) + \sum (logpt+1 - \log pt)$$

Results and Discussion

The results of the study are presented and discussed in this chapter in line with objective and methodology of the study under the following sub-headings.

1. Trends in livestock population of India
2. Changes in composition of livestock population of India.
3. Growth and instability of livestock and livestock production in India.
4. Export and import value of livestock products and livestock

Comment [L10]: !!!, look at formulations

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1) Trends in livestock population of India

Under present investigation, table 1 gives the growth trends in livestock population of India. The census period growth rate of total Livestock population depicted a continuously increasing trend were 4.77 per cent in 1956 to 26.54 per cent in 1977 then to 82.33 per cent in 2007 before decline to 76.27 per cent in 2012 (declined means that its less than the previous census but not less than the base census). The total bovine population recorded similar trend of growth and increased continuously from 198.7 million in 1951 to 304.42 million in 2007 and declined to 299.6 million in 2012 (declined means that its less than the previous census but not less than the base census). The cattle population increased continuously from 155.3 million in 1951 to 180 million in 1977 then to 204.58 million in 1992. After 1992 cattle population declined continuously in the census 1997 and 2003 by having population 198.88 million ,185.18 million respectively then its increased with the population 199.68 million in 2007 but it further declined to 190.08 million in 2012–. Decline in cattle population mainly due to the reduction of bullock population, reasons for bullock population reductions are (i) increased use of farm machinery in agriculture enhanced by subsidized credit from the central and state governments (Sserunjogi and Lokesh, 2014).

On the other hand, the buffalo population registered a consistently strong increase in its absolute population during the study period. It increased continuously, from 43.4 million in 1951 to 62 million in 1977 then to 108.7 million in 2012. The census period growth rate of buffalo population ~~depicted~~ depicting a continuously increasing trend ~~were~~ was 3.45 per cent in 1956 to 42.86 per cent in 1977 and ~~then to~~ 150.46 per cent in 2012 over base census 1951. The highest growth rate observed during 2012.

As far as small ruminants were concerned, the total bovine population in India increased from 86.3 million in 1951 to 116.6 million in 1977 then to 185.83 million in 2003. It further rose to 212.1 million in 2007 before it slumped to 200.24 million in 2012.

The sheep population growth was registered fluctuation. In the beginning of study period observed that increase of population from 39.1 million in 1951 to 42.4 million in 1966 before declining to 40 million in 1972 ,after this its population drastically increased to

48.76 in 1982 but it again declined to 45.7 million in 1987. Thereafter it taken increasing trend with 57.49 million in 1997, 61.47 in 2003 and it peaked at 70.60 million in 2007 before it declined to 63.90 million in the 2012 census. The census period the change in sheep depicted a continuous fluctuation, the changes were 4.86 per cent in 1977 then to 83.2 per cent in 2007 and declined to 66.42 per cent in 2012 over base census 1951.

The pig population on the other hand registered that lowest population among the livestock population under the study. The pig population marginally increased from 4.49 million in 1951 to 4.9 million in 1956 and 5.2 million in 1961 however; afterwards it declined to 5 million in 1966. As far as poultry population is concerned, India registered a rapid and consistent rise in poultry population during the study period. The poultry population in India increased tenfold, from 73.5 million birds in 1951 to 729.21 million birds by the 2012 census. In

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census period the growth of poultry population depicted a continuously increasing trend and changes were 28.98 per cent in 1956 to 159.2 per cent in 1977 then to 892.12 per cent in 2012 over the base census.

Comment [L16]: Merely narrating history is not good; rather take the whole scenario in consideration and describe the population to relate with product growth

It could be inferred from the above discussion that in the last six decades, India experienced an impressive growth in poultry population which could have emanated from increased uptake of improved chickens for poultry farming across Indian states. Among the bovine animals, buffaloes registered consistently increasing population, on the basis of higher consumer preference for buffalo milk due to it high fat content and ease in maintaining the stock. On the other hand, the cattle population registered a consistent decline after the 1992 due to increased use of machines for agricultural operations in Indian agriculture which decreased the demand for bullocks for draught purpose. The bovine population depicted decrease in growth in various inter-census periods resulting from continuous degradation of common grazing lands across Indian states.

2) Changes in composition of livestock population of India

To study the changes in composition of livestock the census wise composition of livestock was examined. The livestock involves bovine *viz.*, cattle and buffalo, bovine *viz.*, sheep and goat, pig. Changes in composition mean that variation of livestock animal in each census and their shares in total population.

Table 2 Changes in composition of livestock population of India.

This study revealed that bovine population share ~~to~~ in total livestock population was maximum (68.66%) in 1951 census but its share was continuously declined from 68.66 per cent in 1951 to 58.73 per cent in 2012.With some marginal fluctuations across the census. The decline of bovine share due was mainly due to continuously decrease of cattle population share. Cattle population share was 53.7 per cent in 1951 but decreased to 37.4 per cent in 2012.Cow population share was also continuously decreasing from 18.80 per cent in 1951 to 15.25 per cent in 1972 then it further declined 15.04 per cent in 2012. Reason for decrease of cattle and cow population share was slow growth rate of it population as compared to other livestock animal's population growth rate. Buffalo population share in total livestock population was continuously increasing from 15.0 per cent in 1951 to 16.9 in 1977 then to 21.3 per cent in 2012.

In case of bovine population, its share in total livestock population was fluctuating across the census and its share lies between 30 to 40 per cent in each census to total livestock population. Bovine population growth rate was moderately increasing so its population share had continuously increased. The main reason for increase of bovine population was rapid increase of goat population share. Goat population share was continuously increasing from

16.31 per cent in 1951 to 20.64 per cent in 1977 then it further increased to 26.64 per cent in 2007 before decline to 26.50 per cent in 2012.In case of sheep population its share was 13.51 per cent in 1951 but decreased to 11.20 per cent 1977 then it further declined to 10.86 per cent in 1992 before increased of its share to 13.56 per cent in 2007.But in 2012 it further declined to 12.76 per cent.

In case of pig population share in total livestock population was continuously increasing from 1.55 per cent in 1951 to 2.80 per cent in 2003 before declined to 2.02 per cent in 2012.The reason for increase of its share in each census was increase of its population to the total livestock population.

It could be inferred from the above discussion that in the last six decades, India experienced a decrease of bovine share in total livestock composition due to cattle and cow"s slow growth rate. On other hand bovine share was balanced by buffalo's moderate growth rate. The bovine population share was continuously increasing due to rapid growth rate of goat population but sheep share was declining. Pig population share in each census was increased due to consistent increase of pig population to the total livestock population of related census.

3) Growth and instability of livestock and livestock production in India

In the previous section, an attempt has been made to study the livestock development, in terms of absolute changes in its composition of livestock population in India during the last sixty one years in India.

A detailed analysis was done for compound growth rate and instability of livestock population, total milk, meat, egg, wool production at all India level. Moreover, the growth rates were worked out separately for the sub-periods: period I (1960-61 to1969-70), period II (1970- 71 to 1979-80), period III (1980-81 to 1989-90), period IV (1990-91 to 1999-00), period V (2000-01 to2009-10), period VI (2010-11 to 2016-17) and for the overall period (1960-61 to 2016-17). Coppock"s Index was also computed to examine whether there was any significant shift in growth function between the sub-periods.

Table 3 - Compound growth rate of livestock population of India

The compound growth rate of livestock population and it reveals that fluctuation in the growth rate of livestock population between inter periods. Highest growth rate of livestock population was observed during second period (1970-71 to 1979-80) with 1.3 per cent per annum and lowest growth rate was observed during sixth period (2010-11 to 2016-17) with negative growth rate of 0.32 per cent per annum. For the entire period (1960-61 to 2016-17) total livestock growth rate was 0.93 per cent per annum. Highest growth rate of cattle observed during third period with 0.74 per cent per annum and lowest growth rate observed during fourth and sixth period with negative 0.68 per cent annually in both periods. This means that cattle population decreased during fourth and sixth period. For the entire period growth rate of cattle was highly significant with increase by 0.18 per cent per annum.

On the other hand buffalo population growth rate was also showing fluctuation. Highest growth rate of buffalo observed during third period with 1.83 per cent annually and lowest growth rate observed during sixth period with 0.8 per cent annually. The population of buffalo has significantly increased in all the periods and for entire period also, In case of sheep population growth rate, it is also showing fluctuation. In first and third periods it growth was non-significant. Sheep population growth increased in rapidly in fourth period that's why its shows 2.1 per cent growth rate per annum. In sixth period the sheep population declined by 0.74 per cent per annum. At the entire period the sheep population was significantly

Comment [L17]: Pl. justify the changes bringing rural socioeconomic changes in the discussion, data presentation is not enough to justify changes

Comment [L18]: Periods are not justified; why certain periods are considered, why not whole period will be considered

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increased by 1.12 per cent per annum. On the other hand goat population growth rate also in fluctuation mode. Highest significant growth rate of goat population was observed during second period with 2.88 per cent per annum. It was lowest in sixth period with negative growth rate (-0.74 per cent).The overall period growth rate was 1.7 per cent per annum which was highly significant.

In case pig population growth rate, it also showed fluctuation. Highest growth rate observed during second period with 3.37 per cent per annum and lowest in fifth and sixth period with negative growth rates of -3.09 and -2.81 per cent per annum respectively. The entire period growth rate was 1.52 per cent annum and it was significant.

As far as poultry population is concerned the population of poultry was significantly (p???) increased in all periods. It was highest (5.84 per cent) in fifth and lowest (2.14 per cent) in first period. Entire period growth rate of poultry was significantly increased with 3.92 per cent per annum.

It could be inferred from the above discussion that in the last six decades, highest growth rate was observed in poultry and fallowed by goat population due to increase in demand for meat and eggs. Cattle population growth rate was decreased due to decrease of bullock population. Buffalo and goat achieved moderate growth rate. Sheep and pig also had good growth rate of population.

Table 4 - Instability of livestock population of India

The coefficient of variation used as instability and ~~coppock~~ Coppock index as instability index. Table 4 depicts that instability and instability index of livestock population. That indicates that the total livestock population and individual component of livestock i.e. cattle, buffalo, sheep, goat , pig and poultry population was consistent across all the period .It indicates that there was much variation population growth of all the livestock population as such .However for the overall period the population is not consistent. Especially, poultry population was more fluctuated as compared to the different periods.

The same trend was observed in instability index. The total livestock population and different categories of livestock *viz*., cattle, buffalo, sheep, goat, pig, and poultry population was most stable across all periods and entire period.

It could be inferred from the above discussion that in the last six decades, highest instability observed in poultry population than other livestock.it was followed by goat and pig. Instability was less in cattle due to its slow growth rate. In Buffalo and sheep population also observed instability due to moderate growth rate.

Table 5 - Growth, Variation and Instability Index in Milk Production of India

In India overall production of milk increasing significantly at 4.18 per cent per annum. The highest significant growth observed during third period with 5.41 per cent per annum .In all the period the growth was significant except non-significant in period I with 0.58 per cent per annum. The instability indices for total milk production was 3.77 per cent, 12.64 per cent and15.69 per cent,13.39 per cent ,13.49 per cent,11.06 per cent

respectively for period I, II , III, IV, V, VI. The instability was high during period III. The overall period instability was 3.39 per cent. This showed that milk production was more instable during overall period.

Table 6 - Growth, Variation and Instability Index in Meat Production of India

In India at overall period the production of meat increasing significantly at 2.74 per cent per annum. The highest significant growth was observed in meat production during fifth period with3.39 per cent per annum. The results of instability analysis indicates that the meat production was very stable during all the period i.e. Period I to VI (0.091 to 0.371). The meat production was very much consistent in all the period. However, at overall the meat production was not consisted with 44.35 per cent variation. This showed that meat production was more consistent during the period under study.

Table 7 - Growth, variation and instability index in egg production of India

In India overall production of egg showed that was increasing, significantly at 6.02 per cent per annum. The highest positive significant growth observed during third period with 8.16 per cent per annum .It shows that fluctuation in the growth rate between the inter periods. The egg production was more consistent during period IV, V, VI (12.57, 16.6 and 11.36 per cent, respectively) as compared to period I, II, III (19.13, 18.81 and 23.43 per cent, respectively). The variation was high during period III. The overall period instability was 86.2. This showed that egg production was not consistent during the study period. The coppock index showed the same trend.

Table 8 - Growth, variation and instability index of wool production in India

In India overall production of wool showed that increased, significantly at 0.81 per cent per annum. As compared other livestock product production more fluctuation observed in wool production .In first period its growth was non-significant with 1.17 per cent per annum. The negative growth observed during second and fifth period (-1.5 NS and -1.76) .The highest positive significant growth observed during third period with 3.04 per cent per annum. It registered that fluctuation in the growth rate between the inter periods. The wool production was consistent during all periods under study. The same trend was observed in coppock index. Coppock index revealed that the wool production was more stable in all the period and for entire period also.

4) Export and import value of livestock products and livestock

In this section export and imports of milk products, meat, eggs, live animals and their value is given.

Table 9 - Export and Import milk products of India

Table 9 revealed that the India imported more milk products at beginning decades of after independence as trade balance of milk product was negative up to 1980-81 for both quantity and value. White revolution made India self-sufficient in milk production and that's why India started exporting milk products after 1990-91 at large quantity hence India's trade balance was positive with large amount after 1990-91.In the year 2016-17, India's trade balance of milk products was positive and highest as compared to other periods under study.

Table 10 - Export and import of total meat

Table 10 revealed that India was all time exporter of meat product. India's meat trade balance was positive and increasing in all decades except in decadal year 1970-71, where India's trade balance was positive but drastically declined.

Table 11 - Export and import of eggs

Table 11 revealed that India was all time exporter of eggs. India's export was always increasing but only declined during the year 1970-71.India"s export in quantity and value more than import in all years. It was highest in quantity for the year 2010-11(40598 tonnes) and in value for the year 2016-17 (77851, 000 $).

Table 12 - Export and import of livestock

Table 12 depicts the trade balance of live animals in both quantity and value. Table12 revealed that, the trade balance of live animals was positive for all decadal year except in the year 1970-71 and 2000-01.Whereas in the year 1990-91 the trade balance was negative for quantity but positive in value. However it concludes that the export and import of live animals both in quantity and value was fluctuating over a period under study.

Table 13 - Export and import value of livestock products and livestock

Table 13 presented the export and import value of livestock products and livestock in value. Table 13 shows that India's export was lean at the beginning of three decade years,those were 1960-61,1970-71and 1980-81 with the values 1.423m$,0.587$ and 71.401m$, respectively and these were less than the import values at same years. The import values were 14.053 m$, 16.339 m$ and 92.283 m$ for beginning three points of time respectively. There after India's import decreased and export increased after 1990-91 and export values were 113.114 m$, 408.314 m$, 2933.185 m$ and 4397.835 m$ for 1990-1991, 2000-01, 2010-11, 2016-17, respectively. Trade balance was deficient during 1960-61, 1970-

71, 1980-81with the values 12.630m$, 15.752$, 20.884 m$, respectively. India gain trade balance positive after the 1990-91 and the values were 106.588 m$, 408.519 m$, 2840.976 m$, 4423.561 m$ for 1990-91, 2000-01,2010-11, 2016-17.

Summary and Conclusions

1. In case of bovine population, its share in total livestock population was fluctuating across the census and its share lies between 30 to 40 per cent in each census to total livestock population. Bovine population growth rate was moderately increasing so its population share had continuously increased. The main reason for increase of bovine population was rapid increase of goat population share. Goat population share was continuously increasing.

2. In the last six decades, India experienced a decrease of bovine share in total livestock composition due to cattle and cow's slow growth rate. On other hand bovine share was balanced by buffalo's moderate growth rate. The bovine population share was continuously increasing due to rapid growth rate of goat population but sheep share was declining. Pig population share in each census was increased due to consistent increase of pig population to the total livestock population of related census.

3. In Livestock population of India, highest instability observed in poultry population than other livestock.it was followed by goat and pig. Instability was less in cattle due to its slow growth rate. In Buffalo and sheep population also observed instability due to moderate growth rate.

4. In India overall production of milk increasing significantly at 4.18 per cent per annum. The highest significant growth observed during third period with 5.41 per cent per annum .In all the period the growth was significant except non-significant in period I with 0.58 per cent per annum.

5. The meat and wool production was consistent during all periods under study, expect egg production.

6. India's trade balance of milk products was positive and highest as compared to other periods under study.

7. The trade balance of live animals was positive for all decadal year except in the year 1970-71 and 2000-01.Whereas in the year 1990-91 the trade balance was negative for quantity but positive in value. However it concludes that the export and import of live animals both in quantity and value was fluctuating over a period under study.

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TABLES

Table 1: Trends in livestock population of India **(Number in million)**

Year	Cow	Cattle	Buffalo	Total Bovine Population	Sheep	Goat	Total ovine population	Pig	Total livestock population	Poultry
1951	54.4 (100)	155.3 (100)	43.4 (100)	198.7 (100)	39.1 (100)	47.2 (100)	86.3 (100)	4.49 (100)	289.4 (100)	73.5 (100)
1956	47.3 (-13.05)	158.7 (2.19)	44.9 (3.45)	203.6 (2.47)	39.3 (0.51)	55.4 (17.4)	94.7 (9.73)	4.9 (11.36)	303.2 (4.77)	94.8 (28.98)
1961	*51 (-6.25)*	175.6 (13.07)	51.2 (17.97)	226.8 (14.14)	40.2 (2.81)	60.9 (29.0)	101.1 (17.15)	5.2 (18.8)	333.1 (15.10)	114.2 (55.37)
1966	51.8 (-4.78)	176.2 (13.46)	53 (22.11)	229.2 (15.35)	42.4 (8.44)	64.6 (36.9)	107 (23.99)	5 (13.64)	341.2 (17.90)	115.4 (57.01)
1972	53.4 (-1.84)	178.3 (14.81)	57.4 (32.25)	235.7 (18.62)	40 (2.30)	67.5 (43.0)	107.5 (24.57)	6.9 (56.82)	350.1 (20.97)	138.5 (88.44)
1977	54.6 (0.37)	180 (15.9)	62 (42.86)	242 (21.79)	41 (4.86)	75.6 (60.2)	116.6 (35.11)	7.6 (72.73)	366.2 (26.54)	159.2 (116.60)
1982	59.2 (8.82)	192.45 (23.92)	69.78 (60.78)	262.23 (31.97)	48.76 (24.71)	95.25 (101.1)	144.01 (66.87)	10.07 (128.86)	416.31 (43.85)	207.74 (182.64)
1987	62.1 (14.5)	199.69 (28.58)	75.97 (75.14)	275.66 (38.73)	45.7 (16.88)	110.21 (133.5)	155.91 (80.66)	10.63 (141.59)	442.2 (52.80)	275.32 (274.59)
1992	64.4 (18.38)	204.58 (31.73)	84.21 (94.03)	288.79 (45.34)	50.78 (29.87)	115.28 (144.2)	166.06 (92.42)	12.79 (190.68)	467.64 (61.59)	307.07 (317.94)
1997	64.4 (18.38)	198.88 (28.06)	89.92 (107.19)	288.8 (45.34)	57.49 (47.03)	122.72 (160.0)	180.21 (108.82)	13.29 (202.05)	482.3 (66.66)	347.61 (372.94)
2003	64.5 (18.57)	185.18 (19.24)	97.92 (125.62)	283.1 (42.48)	61.47 (57.21)	124.36 (163.5)	185.83 (115.33)	13.52 (207.27)	482.45 (66.71)	489.01 (565.32)

Comment [L21]: Table 1 and Table 2 may be combined in one; compound growth is presented in Table 3; they are not at all required here to present and to shown year wise. Data repetition must be avioded. Trend in population change and in the composition of national herd like, large ruminant (cattle, buffalo, cows/bulls) or small ruminant herd (goat/sheep/dairy goat etc) or poultry flocks (commercial/scavenging/duck over a period of 1951 to 2016 would be more demanding to readers; year to year data or period to period data is not at all respond to the need of the objective of the article.

Comment [L22]: What is justification

Comment [L23]: ???

2007	73 (34.19)	199.08 (28.19)	105.34 (142.72)	304.42 (53.21)	71.56 (83.2)	140.54 (197.8)	212.1 (145.77)	11.13 (152.95)	527.65 (82.33)	648.83 (782.76)
2012	76.7 (40.99)	190.9 (22.92)	108.7 (150.46)	299.6 (50.78)	65.07 (66.42)	135.17 (186.4)	200.24 (132.03)	10.29 (133.86)	510.13 (76.27)	729.21 (892.12)

Comment [L24]: data may be updated to recent times 2017/18?

(Figures in the parentheses indicate percentage change over the base year census) („-‟) Sign indicates decline over the base year census Source: Integrated Sample Survey, Department of Animal Husbandry, Dairying and Fisheries, Govt. of India, 2014.

Table 2: Changes in composition of livestock population of India **(Number in million)**

Year	Total livestock population	Cow	Cattle	Buffalo	Bovine population	Sheep	Goat	Ovine Population	Pig
1951	289.4 (100)	54.4 (18.80)	155.3 (53.7)	43.4 (15.0)	198.7 (68.66)	39.1 (13.51)	47.2 (16.31)	86.3 (29.82)	4.49 (1.55)
1956	303.2 (100)	47.3 (15.60)	158.7 (52.3)	44.9 (14.8)	203.6 (67.15)	39.3 (12.96)	55.4 (18.27)	94.7 (31.23)	4.9 (1.62)
1961	333.1 (100)	51 (15.31)	175.6 (52.7)	51.2 (15.4)	226.8 (68.09)	40.2 (12.07)	60.9 (18.28)	101.1 (30.35)	5.2 (1.56)
1966	341.2 (100)	51.8 (15.18)	176.2 (51.6)	53 (15.5)	229.2 (67.17)	42.4 (12.43)	64.6 (18.93)	107 (31.36)	5 (1.47)
1972	350.1 (100)	53.4 (15.25)	178.3 (50.9)	57.4 (16.4)	235.7 (67.32)	40 (11.43)	67.5 (19.28)	107.5 (30.71)	6.9 (1.97)
1977	366.2 (100)	54.6 (14.91)	180 (49.2)	62 (16.9)	242 (66.08)	41 (11.20)	75.6 (20.64)	116.6 (31.84)	7.6 (2.08)
1982	416.31	59.2 (14.22	192.45	69.78 (16.8)	262.23 (62.99)	48.76 (11.71	95.25 (22.88)	144.01 (34.59)	10.07 (2.42)

	(100)	)	(46.2)			)			
1987	442.2 (100)	62.1 (14.05)	199.6 9 (45.2)	75.97 (17.2)	275.66 (62.34)	45.7 (10.33)	110.21 (24.92)	155.91 (35.26)	10.63 (2.40)
1992	467.6 4 (100)	64.4 (13.77)	204.5 8 (43.7)	84.21 (18.0)	288.79 (59.88)	50.78 (10.86)	115.28 (24.65)	166.06 (35.51)	12.79 (2.74)
1997	482.3 (100)	64.4 (13.35)	198.8 8 (41.2)	89.92 (18.6)	288.8 (59.88)	57.49 (11.92)	122.72 (25.44)	180.21 (37.36)	13.29 (2.76)
2003	482.4 5 (100)	64.5 (13.37)	185.1 8 (38.4)	97.92 (20.3)	283.1 (58.68)	61.47 (12.74)	124.36 (25.78)	185.83 (38.52)	13.52 (2.80)
2007	527.6 5 (100)	73 (13.83)	199.0 8 (37.7)	105.3 4 (20.0)	304.42 (57.69)	71.56 (13.56)	140.54 (26.64)	212.1 (40.20)	11.13 (2.11)
2012	510.1 3 (100)	76.7 (15.04)	190.9 (37.4)	108.7 (21.3)	299.6 (58.73)	65.07 (12.76)	135.17 (26.50)	200.24 (39.25)	10.29 (2.02)

(Figures in the parentheses indicate percentage to total)

Source: Integrated Sample Survey, Department of Animal Husbandry, Dairying and Fisheries, Govt. of India, 2014.

Comment [L25]: It is simply repetitions of what is presented in Table 1

Table 3: Compound growth rate of livestock population of India (Per cent)

Sr. No.	Periods	Cattle	Buffalo	Sheep	Goat	Pig	Poultry	Total Livestock
I	1960-61 to1969-70	0.19***	1.06***	0.15NS	1 ***	1.63***	2.14***	0.5 ***
II	1970-71 to1979-80	0.48***	1.65***	1.17***	2.88***	3.37***	4.07***	1.3 ***
III	1980-81 to1989-90	0.74***	1.83***	-0.01 NS	2.5 ***	2 ***	3.97***	1.29 ***
IV	1990-91 to1999-00	-0.68***	1.42***	2.1 ***	0.95***	0.8 ***	3.29***	0.47 ***
V	2000-01 to2009-10	0.62***	1.44***	1.84***	1.57***	-3.09 ***	5.84***	1.1 ***
VI	2010-11 to2016-17	-0.68***	0.8 ***	-0.74 *	-0.34*	-2.81 ***	2.32***	-0.32 *
Over all	1960-61 to2016-17	0.18***	1.6 ***	1.12***	1.7 ***	1.52***	3.92***	0.93***

(„ *** " and „*" indicates significance at 1 and 5 per cent level, NS is Non-Significant)

Comment [L26]: What is the justification of making these periods and how this is related to objective?

Table 4: Instability of livestock population of India

Statistics	Farm Animals						Significance	
	Cattle	Buffalo	Sheep	Goat	Pig	Poultry	LSD	Level
Compound growth rate, %								
Coefficient of Variation (per cent)								
Coppock Index (per cent)								

Sr. No.	Periods	Cattle	Buffalo	Sheep	Goat	Pig	Poultry	Total Livestock
	Coefficient of Variation (per cent)							
I	1960-61 to1969-70	0.67	3.27	1.36	3.02	6.51	7.23	1.51

Comment [L27]: Table 3 and Table 4 may be combined together into a revised Table shown in the text

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II	1970-71 to1979-80	1.59	5.02	4.08	8.95	10.53	13.45	4.1
III	1980-81 to1989-90	2.25	5.57	2.22	7.62	6.34	12.39	3.9
IV	1990-91 to1999-00	2.17	4.26	6.29	2.93	2.6	10.08	1.52
V	2000-01 to2009-10	2.41	4.37	6.32	5.14	9.77	16.9	3.66
VI	2010-11 to2016-17	1.57	1.77	2.27	1.04	6.38	5.01	0.93
Over all	1960-61 to2016-17	5.01	25.67	19.81	26.89	28.96	63.2	15.4
	Coppock Index (per cent)							
I	1960-61 to1969-70	0	0.032	0	0.03	0.083	0.118	0.006
II	1970-71 to1979-80	0.009	0.086	0.05	0.257	0.392	0.482	0.057
III	1980-81 to1989-90	0.019	0.12	0.009	0.182	0.176	0.368	0.06
IV	1990-91 to1999-00	0.013	0.067	0.121	0.024	0.028	0.37	1.52
V	2000-01 to2009-10	0.002	0.055	0.054	0.041	0.208	0.881	3.66
VI	2010-11 to2016-17	0.008	0.011	0.014	0.002	0.154	0.086	0.002
Over all	1960-61 to2016-17	0.002	0.473	0.151	0.461	0.211	2.88	0.128

Comment [L28]: How do you justify this classification??

Products	Farm Product				Significance	
	Milk	Meat	Eggs	Wool	LSD	Level
CGR						
CV						
CI						
Wool						

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Table 5: Growth and instability in milk production of India

Sr. No.	Periods	CGR (%)	CV (%)	Coppock Index (%)
I	1960-61 to1969-70	0.58 NS	3.77	0.023
II	1970-71 to1979-80	4.23***	12.64	0.551
III	1980-81 to1989-90	5.41***	15.69	0.906
IV	1990-91 to1999-00	4.47***	13.39	0.531
V	2000-01 to2009-10	4.45***	13.49	0.55
VI	2010-11 to2016-17	5.16***	11.06	0.472
Over all	1960-61 to2016-17	4.18***	67.54	3.395

(„***" and NS indicates significance at 1 per cent level and Non-Significant)

Comment [L29]: Table 5, 6, 7, & 8 may be combined and presented following a Table given in the text; any trend may be shown in graphics

Table 6: Growth and instability in meat production of India

Sr. No.	Periods	CGR (%)	CV (%)	Coppock Index (%)
I	1960-61 to1969-70	1.91 ***	5.85	0.091
II	1970-71 to1979-80	2.63 ***	7.85	0.213
III	1980-81 to1989-90	3.18 ***	10.65	0.371
IV	1990-91 to1999-00	1.45 ***	4.68	0.092
V	2000-01 to2009-10	3.39 ***	10.31	0.341
VI	2010-11 to2016-17	2.32 ***	9.44	0.362
Over all	1960-61 to2016-17	2.74 ***	44.35	1.606

(„***" Indicate significance at 1 per cent level)

Table 7: Growth and instability in egg production of India

Sr. No.	Periods	CGR (%)	CV (%)	Coppock Index (%)
I	1960-61 to1969-70	6.5 ***	19.13	1.698
II	1970-71 to1979-80	6.46 ***	18.81	0.942
III	1980-81 to1989-90	8.16 ***	23.43	1.599
IV	1990-91 to1999-00	4.27 ***	12.57	0.514
V	2000-01 to2009-10	5.57 ***	16.6	0.853
VI	2010-11 to2016-17	5.34 ***	11.36	0.454
Over all	1960-61 to2016-17	6.02 ***	86.2	8.812

(„***" indicates significance at 1 per cent level)

Table 8: Growth and instability of wool production of India

Sr. No.	Periods	CGR (%)	CV (%)	Coppock Index (%)
I	1960-61 to1969-70	1.17 NS	7.35	0.15
II	1970-71 to1979-80	-1.5 NS	8.64	0.089
III	1980-81 to1989-90	3.04 ***	9.09	0.268

IV	1990-91 to1999-00	2.06 ***	7.22	0.087
V	2000-01 to2009-10	-1.76 ***	6.03	0.049
VI	2010-11 to2016-17	0.1 NS	4.18	0.001
Over all	1960-61 to2016-17	0.81 ***	15.3	0.129

(„***" and NS indicates significance at 1 per cent level and Non-Significant)

Table 9: Export and import of milk products

Year	Export		Import		Trade balance	
	Quantity (tonnes)	Value (1000$)	Quantity (tonnes)	Value (1000$)	Quantity (tonnes)	Value (1000$)
1960-61	63	24	41890	-13620	-41827	-13620
1970-71	1940	532	54003	-15683	-52063	-15683
1980-81	2728	2214	54484	-89747	-51756	-89747
1990-91	22639	10484	1466	7184	21173	7184
2000-01	197179	114182	1261	112355	195918	112355
2010-11	155461	160897	46864	98795	108597	98795
2016-17	276878	312157	11240	292365	265638	292365

Comment [L30]: Similarly Table 9, 10, 11 & 12 may be combined together

Table 10: Export and import of total meat

			Trade balance

Year	Export		Import		Quantity (tonnes)	Value (1000$)
	Quantity (tonnes)	Value (1000$)	Quantity (tonnes)	Value (1000$)		
1960-61	510	278	0	0	510	278
1970-71	17	8	0	0	17	8
1980-81	47191	57686	0	0	47191	57686
1990-91	91703	94155	0	0	91703	94155
2000-01	247178	261668	5	43	247173	261625
2010-11	977777	2687569	137	1222	977640	2686347
2016-17	1331263	3971238	408	2346	1330855	3968892

Table 11: Export and import of eggs

Year	Export		Import		Trade balance	
	Quantity (tonnes)	Value (1000$)	Quantity (tonnes)	Value (1000$)	Quantity (tonnes)	Value (1000$)
1960-61	1375	858	1016	407	359	451
1970-71	3	2	1	1	2	1
1980-81	6015	4963	14	20	6001	4943
1990-91	5802	3689	0	0	5802	3689
2000-01	21185	32183	8	15	21177	32168
2010-11	40598	70688	316	1249	40282	69439
2016-17	37233	77851	34	893	37199	76958

Table 12: Export and import of livestock

Year	Export		Import		Trade balance	
	Heads (No.)	Value (1000$)	Heads (No.)	Value (1000$)	Heads (No.)	Value (1000$)
1960-61	22700	263	5	2	22965	**261**
1970-71	4781	45	7351	123	-2570	**-78**
1980-81	75872	6538	9296	302	66576	6236
1990-91	47309	4786	218574	3226	-171265	1560
2000-01	1234	281	43803	379	-42569	-98
2010-11	343336	14031	19678	2388	323658	11643
2016-17	719360	36589	59487	20894	659873	15695

Table 13: Export and import value of livestock products and livestock (Value in '1000' $)

Year	Grand total of export and import value of livestock products and livestock		
	Export	Import	Trade Balance
1960-61	1423	14053	-12630
1970-71	587	16339	-15752
1980-81	71401	92283	-20884
1990-91	113114	6526	106588
2000-01	408314	2264	408519

2010-11	2933185	166961	2840976
2016-17	4397835	43925	4423561