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Livestock Sector in India: A Critical Analysis

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Authors' contributions

This work was carried out in collaboration among all authors. Author KPS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MRS and MMK have managed the analyses, research framework features of the study. Author VGP has managed the statistical tools outlook and literature searches. All authors read and approved the final manuscript.

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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. The study examined the growth and export dimension of livestock sector in India, the factors affecting livestock output and the trends, performance and determinants of the livestock sector in India. 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, the ovine share was increased but the bovine share was decreased. Buffalo, goat and pig share in livestock population was increased but the cow, cattle and sheep share to total livestock population was decreased. The instability was observed to be highest in poultry, remaining livestock animals also shows instability in its population growth. India's milk,

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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. In India production of milk increased rapidly after the year 1970 while production of meat and egg increased rapidly after the year 1980. In past India's trade balance for livestock and livestock products was deficient, now it has been shifted to a positive balance.

Keywords: Trends in livestock population; growth and instability of livestock and livestock production.

1. INTRODUCTION

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 [1,2].

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 almost the same in Europe. In North, Central and South America cattle dominate, 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 [3-5].

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) [6,7]. 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. (Anonymous, 2017).

The present study has the following objectives.

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

2. RESEARCH METHODOLOGY

The study was based on the time-series data obtained from various published sources *viz*; Department of Animal Husbandry, Dairying and Fisheries, Annual reports, Commission published by the government of India, Report on the export of products by APEDA. The data on livestock population for the selected decade years covering the period from 1951 to 2015 in respect of India was obtained by referring the livestock census reports published by the Department of Animal Husbandry, Dairying and Fisheries, India [8-10]. 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.), the export of livestock products during the period from 1960-61 to 2016-2017. The information is also useful for identifying the important factors influencing livestock production in India.

2.1 Analysis of Data

The analysis of data was done keeping in view 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.

2.2 Percentage Change Over the Base Year

The per cent change over the 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.

2.3 Compound Growth Rate

In the estimation of the growth of livestock population and production (Milk, Meat, Egg, Wool etc.). The exponential function of the following

type to the data for three periods explained as,

$$Y = ab^t$$

Where,

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

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

CGR % = (Antilog b-l) x 100

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

2.4 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

CV = (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)

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

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

3. RESULTS AND DISCUSSION

3.1 Trends in Livestock Population of India

Table 1 gives the growth trends in the livestock population in India. The 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 a decline to 76.27 per cent in 2012 (decline means that it's less than the previous census but not less than the base census). The total bovine population recorded a similar trend of growth and increased progressively from 198.7 million in 1951 to 304.42 million in 2007 and declined to 299.6 million in 2012 (decline means that it's less than the previous census but not less than the base census). The cattle population increased progressively from 155.3 million in 1951 to 180 million in 1977 then to 204.58 million in 1992. After 1992 cattle population decreased in the census 1997 and 2003 then increased in 2007. It further declined to 190.08 million in 2012. The decline in cattle population was mainly due to a reduction in the 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 [1].

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

The total ovine 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. At the beginning of the study, the 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 took an 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 sheep population depicted a continuous fluctuation, the changes were 4.86 per cent in 1977, then to 83.2 per cent in 2007, 66.42 per cent in 2012 over the base census of 1951.

The pig recorded the lowest population among the livestock populations under 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; it declined to 5 million in 1966. India registered a rapid and consistent rise in the 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 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.

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 the increased introduction of improved chickens for poultry farming across Indian states. Among the bovine animals, buffaloes registered consistently increasing population, based on higher consumer preference for buffalo milk due to its high-fat content and ease of maintaining the stock. On the other hand, the cattle population registered a consistent decline after 1992 due to increased use of machines for agricultural operations in Indian agriculture which decreased the demand for bullocks for draught purpose. The ovine population depicted a decrease in growth in various inter-census periods resulting from continuous degradation of common grazing lands across Indian states.

3.2 Changes in the Composition of Livestock Population of India

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

This study revealed that bovine population share to total livestock population was maximum (68.66%) in the 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 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 by 15.04 per cent in 2012. Reason for a decrease of cattle and cow population share was the slow growth rate of its 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 ovine 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. The ovine population growth rate was moderately increasing so its population share had continuously increased. The main reason for the increase of bovine population was the 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 a 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 the case of pig population share in the total livestock, the population was continuously increasing from 1.55 per cent in 1951 to 2.80 per cent in 2003 before declining to 2.02 per cent in 2012. The reason for the increase of its share in each census was an increase in 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 the other hand, the bovine share was balanced by buffalo's moderate growth rate. The bovine population share was continuously increasing due to the rapid growth rate of goat population but sheep share was declining. Pig population share in each census was increased due to the consistent increase of pig population to the total livestock population of the related census.

3.3 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.

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)
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)

(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(100)	59.2(14.22)	192.45(46.2)	69.78(16.8)	262.23(62.99)	48.76(11.71)	95.25(22.88)	144.01(34.59)	10.07(2.42)
1987	442.2(100)	62.1(14.05)	199.69(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	467.64(100)	64.4(13.77)	204.58(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)	198.88(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	482.45(100)	64.5(13.37)	185.18(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	527.65(100)	73(13.83)	199.08(37.7)	105.34(20.0)	304.42(57.69)	71.56(13.56)	140.54(26.64)	212.1(40.20)	11.13(2.11)
2012	510.13(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

Table 3. Compound growth rate of livestock population of India (Percent)

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 *
Overall	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)*

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.

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

On the other hand buffalo, the population growth rate was also showing fluctuation. The highest growth rate of buffalo observed during the third period with 1.83 per cent annually and the lowest growth rate observed during the sixth period with 0.8 per cent annually. The population of buffalo has significantly increased in all the periods and for the entire period also, In case of sheep population growth rate, it is showing fluctuation. In the first and third periods it growth was non-significant. Sheep population growth increased in rapidly in the fourth period that's why it shows a 2.1 per cent growth rate per annum. In the sixth period, the sheep population declined by 0.74 per cent per annum. At the entire period, the sheep population was significantly increased by 1.12 per cent per annum. On the other hand goat population growth rate also in fluctuation mode. The highest significant growth rate of goat population was observed during the second period with 2.88 per cent per annum. It was lowest in the sixth period with a negative growth rate (-0.74 per cent). The overall period growth rate was 1.7 per cent per annum which was highly significant.

In the case of the pig population growth rate, it also showed fluctuation. Highest growth rate observed during the 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.

Table 4. Instability of livestock population of India

Sr. no.	Periods	Cattle	Buffalo	Sheep	Goat	Pig	Poultry	Total livestock
				Coefficient of variation (Percent)				
I	1960 to1970	0.67	3.27	1.36	3.02	6.51	7.23	1.51
II	1970 to1980	1.59	5.02	4.08	8.95	10.53	13.45	4.1
III	1981 to1990	2.25	5.57	2.22	7.62	6.34	12.39	3.9
IV	1991 to 2000	2.17	4.26	6.29	2.93	2.6	10.08	1.52
V	2001 to2010	2.41	4.37	6.32	5.14	9.77	16.9	3.66
VI	2011 to2017	1.57	1.77	2.27	1.04	6.38	5.01	0.93
Overall	1961 to 2017	5.01	25.67	19.81	26.89	28.96	63.2	15.4
				Coppock index (Percent)				
I	1960 to 1970	0	0.032	0	0.03	0.083	0.118	0.006
II	1970 to 1980	0.009	0.086	0.05	0.257	0.392	0.482	0.057
III	1981 to 1990	0.019	0.12	0.009	0.182	0.176	0.368	0.06
IV	1991 to 2000	0.013	0.067	0.121	0.024	0.028	0.37	1.52
V	2001 to 2010	0.002	0.055	0.054	0.041	0.208	0.881	3.66
VI	2011 to 2017	0.008	0.011	0.014	0.002	0.154	0.086	0.002
Overall	1961 to 2017	0.002	0.473	0.151	0.461	0.211	2.88	0.128

Table 5. Growth, variation and instability index 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)*

Table 6. Growth, variation and instability index 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, variation and instability index 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, variation and instability index of wool production in 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)*

As far as poultry population is concern the population of poultry was significantly increased in all periods. It was highest (5.84 per cent) in fifth and lowest (2.14 per cent) in the first period. The 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, the highest growth rate was observed in poultry and fallowed by goat population due to the increase in demand for meat and eggs. Cattle population growth rate was decreased due to the decrease of bullock population. Buffalo and goat achieved moderate growth rate. Sheep and pig also had a good growth rate of population.

The coefficient of variation used as instability in livestock population and Coppock index used as

instability index. Table 4 depicts that instability with instability index of livestock population. That indicates that the total livestock population and the 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 in the population growth of all the livestock populations. However, for the overall period, the population was not consistent.

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

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

In India overall production of milk increasing at the rate of 4.18 per cent per annum. The highest growth observed during the third period with 5.41 per cent per annum. In all the period the growth was good except in the 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 the 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 unstable during the overall period.

In India, the production of meat increased at 2.74 per cent per annum. The highest growth was observed in meat production during fifth period with 3.39 per cent per annum. The results of instability analysis indicate 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, the overall meat production was not consistent with the 44.35 per cent variation. This showed that meat production was more consistent during the period under study.

In India, the overall production of egg showed that was increasing at 6.02 per cent per annum. The highest positive growth observed during the 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 the period I, II, III (19.13, 18.81 and 23.43 per cent, respectively). The variation was high during period III. The overall period of instability was 86.2. This showed that egg production was not consistent during the study period. The Coppock index showed the same trend.

In India, the overall production of wool increased at 0.81 per cent per annum. As compared to other livestock product production more fluctuation was observed in wool production. In the first period, its growth was not good with 1.17 per cent per annum. The negative growth observed during the second and fifth period (-1.5 NS and -1.76). The highest positive growth observed during the 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 the entire period also.

3.4 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

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

Table 10. Export and import of total meat

Year	Export		Import		Trade balance	
	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

Table 9 revealed that India imported more milk products at the beginning decades of after independence as the trade balance of milk product was negative up to 1980-81 for both quantity and value. The 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 the 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 revealed that India was all-time exporter of meat product. India's meat trade balance was positive and increasing in all decades except in the decadal year 1970-71, where India's trade balance was positive but drastically declined.

Table 11 revealed that India was an 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 value for the year 2016-17 (77851, 000 $).

Table 12 depicts the trade balance of live animals in both quantity and value. The trade balance of live animals was positive for all decadal year except in the year 1970-71 and 2000-01. In the year 1990-91, the trade balance of import & export of livestock 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 presents the exported and imported values of livestock products and livestock in value. At the beginning of three-decade years, 1960-61,1970-71 and 1980-81 with the values 1.423 m$, 0.587 $ and 71.401 m$, respectively and these were less than the import values at same years. The import values were 14.053 m$, 16.339 m$ and 92.283 m$ for beginning three points of time respectively. Thereafter 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. The trade balance was deficient during 1960-61, 1970-71, 1980-81with the values 12.630 m$, 15.752$, 20.884 m$, respectively. India gains trade balance positive after the 1990-91 and the values were 106.588 m$, 408.519 m$, 2840.976 m$, 4423.561 m$ for 1990-91, 2000-01, 2010-11, 2016-17.

4. SUMMARY AND CONCLUSIONS

1. In case of ovine 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. The ovine population growth rate was moderately increasing so its population share had continuously increased. The main reason for the increase of bovine population was the 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 the other hand, the bovine share was balanced by buffalo's moderate growth rate. The bovine population share was continuously increasing due to the rapid growth rate of goat population but sheep share was declining. Pig population share in each census was increased due to the consistent increase of pig population to the total livestock population of the related census.
3. In Livestock population of India, the highest instability observed in the 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, the overall production of milk increased at 4.18 per cent per annum. The highest growth observed during the 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ramachandra VA. An economic analysis of growth in cattle and buffalo population of Karnataka. Karnataka Journal of Agricultural Science. 2014;27 (4):536-538.
2. Senthilkumar G, Selvakumar KN, Prabu M, Serma A, Valli C, Thilakar P. Factors influencing draught cattle population in Tamil Nadu. Indian Veternary Journal. 2016;93:22-24.
3. Verma MR, Mandal S. Dynamics of milch bovine population in Meghalaya. Indian Journal of Animal Science. 2011;81(5): 521-524.
4. Vijay K, Singh BP, Triveni D, Rajesh K. Perceived constraints and suggestions in adoption of goat husbandry technologies: A study in semi-arid zone of Uttar Pradesh. Indian Journal of Animal Science. 2014;84: 897–902.
5. Raju SS, Anandan S, Prasad CS. Assessment of animal feed resource availability in Southern Karnataka region. Indian Journal of Animal Science. 2002;72 (12):1137-1140.
6. Sserunjogi B, Lokesh H. Structural growth and development of the livestock sector in North-Eastern Karnataka-An economic analysis. Agricultural Economics Research Review. 2014;27:319-25.
7. Thorton PK. Livestock production: Recent trends, future prospects. Philosophical Transactions of the Royal Society. 2010; 365:2853-2867.
8. Rao PP, Birthal PS. Review on raising livestock productivity in crop livestock system in India: Challenges and implications for research. Indian Journal of Animal Science. 2005;75:123337.
9. Birthal PS, Parthasarathy R. Intensification of livestock production in India: Patterns, trends and determinants. Indian Journal of Agricultural Economics. 2004;59(3):555-565.
10. Ramachandra VA. Growth and export dimensions of livestock sector in Karnataka-An Econometric analysis. Agricultural Economics Research Review. 2012;6:458-464.

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