



Secular Analysis of Domestic Animals Composition in Indian Context: Recent Evidence

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ABSTRACT

India is a developing country, where livestock sector is highly dynamic due to rapidly increasing demand for animal products in various sectors. Livestock sector contributes about 37 and 4.1 percent in agriculture and gross domestic product (GDP) respectively, of the country. It contributes in the socio-economic development of rural livelihoods. It is revealed from the investigation that in India, about 50 per cent of bovine (buffalo and cattle) population is maintained by the marginal farming households. We have argued that women have predominant responsibility for animal rearing. The productions of milk, meat and wool have increased tremendously with the increase in livestock composition. Despite the fact that exports of livestock sector have expanded in numerous times over the study period. India held strong position in exports of livestock products as poultry and dairy produce and buffalo's meat. Study purposes that the Central Government of India should recognize and agree to implement the new programmes to expand the production behaviour of livestock products particularly in drought areas.

HIGHLIGHTS

- India's exports of livestock products were moderately volatile.
- The total livestock population in India has positive expanding trend by 5.05 per cent.

Keywords: Livestock Composition, Forecasting, Trade, Instability, Growth

Livestock sector is major contributor in the social and economic development of rural households in India. This sector contributes approximately 36 percent to the total agricultural gross domestic product and 4 per cent to the complete gross domestic product. It is moreover indicated as one of the dominant sectors for foreign earning. This sector put forward its impending to emerge as an instrument for agricultural growth in the next decades. It supports to crop farming in the form of manure cake, organic manure and draught power, supplies hides, bones, blood, fibers and skin to the livestock industries and provides food, nutritional security and transportation facilities

to rural livelihood. In Indian context, animal husbandry and crop cultivation are interlinked like a pair of wheels in bullock cart. Livestock production is thus likely to be undergoing significant change in the forms of efficient production, populace adjustment, production efficiency, industrialization, profit oriented and augmentation to respond to the expanding requirement for farm animal-based food products (Rae and Nayga, 2010). More than 70

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per cent of rural people depend upon Animal Husbandry activity for their daily income. Hence, Animal Husbandry works as the backbone of rural economy especially when there is uncertainty of monsoon. The significance of farm animals goes away from its food creation utility as it is major contributor in the wellbeing of 63 per cent of rural households in the country (Brithal *et al.*, 2002). About 8-10 percent labour force are engaged in livestock sector, particularly women workforce and generates 15-40 percent income in the farming community income in diversified states of the country. Pastoral labour women are directly involved in lot of the functions related to health care, feeding, breeding and management of domestic animals. Therefore, they are noteworthy actor in rearing of animals. This sector reduced the weather-based living standard of rural poor by creating a steady employment and income (Brithal and Ali, 2005). Livestock is being raised predominantly on agricultural by-product and crop residues in India. Beyond of its identified significant, the cultivated area under fodder crops is constraint to only 5-6 percent of the entire cultivated area in 2015-16 (Anonymous).

A lot of studies was carried out by various scientists and researchers to understand the chronological and spatial alters in the farm animal population at national height (Patel, 1993; Pandey, 1995; Pandey; Gangwar, 1995, Sharma, 2004; Bairwa *et al.*, 2013); also in some states like Haryana (Goyal, 1995; Tomer and Singh, 1995; Elumalai and Panday, 2003; Raj and Gupta, 2015), Himachal Pradesh (Chand, 1995; Kumar *et al.*, 2004; Chauhan, 2008), Rajasthan, (Yadav, 1995; Soju and Meena, 2017), Uttarakhand (Bardhan *et al.*, 2010), Jammu and Kashmir (Baba *et al.*, 2011) and Punjab (Kaur and Bhullar, 2012; Subhashand Kaur, 2013). Nevertheless, no such current described studies are available in Indian context. This study is undertaken to appraise farm animal sector in India along with unambiguous objectives- (1) to analyze the growth performance and changes in composition of domestic animal population in India, (2) to measure the contribution of livestock sector in agricultural as well as allied pursuits and (3) to estimate the trade behaviour of farm animal sector in the country.

MATERIALS AND METHODS

This study is carried out on published secondary data on trader behaviour, output and populace of farm animal

sector in India. The required time series data on population and products of livestock sector were compiled from various journals and e-resources such as Department of Animal Husbandry and Dairying, Government of India, Agricultural and Processed Food Products Export Development Authority (APEDA), Ministry of Commerce, Livestock Population Census, Agricultural Statistics at a Glance and National Dairy Development Board (NDDB), Anand, Gujarat. The study period pertained to 1951-52 to 2019-20 for livestock population and 1998-99 to 2017-18 for milk, wool and meat value of output and trade performance of the economy.

Analytical tools

The collected time series data was computed by using various statistical methods to achieve the findings of stated objectives such as:

Compound annual growth rate

A well familiar compound annual growth rate method is used to measure growth performance of selected parameters. The compound annual growth rate was computed by using the following formula given as:

$$y = y_0(1+i)^t \quad \dots(1)$$

Where;

y_0 and y_t are the chronological values of particular variable(s), and i is the compound annual growth rate of given time series variable (s) in percentage.

Further, keeping $A = (1 + r)$, in above mathematical equation after that taking natural logarithm of the above eq. 1.

$$Y = Y_0 A^t$$

Annual growth rate

The yearly growth rate was worked out with the help of general annual growth rate formula as:

$$AGR = \frac{(X_t - X_{t-1})}{X_{t-1}} \times 100 \quad \dots(2)$$

Where;

AGR is annual growth rate in percentage, X_t is livestock

population/quantity or value of output at the end of selected period, X_{t-1} is livestock population/quantity or value of output at the starting of selected period.

Note: When the data on livestock population has been given at specific interval of period, then value of calculated annual growth rate should be divided by length of period (or the number of years).

Instability index

To measure the variability in export quantity of livestock outputs was computed with the help of Cuddy-Della Valle instability index. Cuddy and Della Valle (1978) initially introduced the index for calculating the instability in time series data. The original formula of Cuddy-Della Valle index is given below as:

$$Ix = \frac{SEE}{\bar{Y}} \times 100$$

Where;

Ix is instability index; SEE is Standard error of the trend line estimates; \bar{Y} is mean value of the time series quantity of export data

Correlation analysis

The correlation analysis is used to estimate the linear alters in magnitude of one variable connected to changes in magnitude of another variable. The degree of linear association between factor of product export and total farm animal export is computed through Karl Pearson's correlation co-efficient (r). it is computed by using the following formula:

$$r = \frac{\sum xy}{N\sigma_x\sigma_y} = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$$

Where;

X = Value of product associated to particular livestock product viz., meat of buffalo, sheep and goat, processed, product of dairy and poultry in latest seventeen years.

Y = Value of product associated to complete livestock industry in latest seventeen years.

$$x = X_i - \bar{X}$$

$$y = Y_i - \bar{Y}$$

\bar{Y} = Arithmetic mean value of whole livestock products

\bar{X} = Arithmetic mean value of individual animal produce

σ_x = Standard deviation of series X, i.e. $\sigma_x = \frac{\sqrt{\sum x^2}}{N}$

σ_y = Standard deviation of series Y, i.e. $\sigma_y = \frac{\sqrt{\sum y^2}}{N}$

N = Number of pairs of both attributes (X and Y).

Forecasting growth of total exported livestock products

The prediction of exported quantity of total domestic animal products from the country is worked out through very popular Ordinary Least Square (OLS) method. It was predicted for five years by using the formula given as:

$$a_0 = \frac{\sum X^2 \sum Y - \sum X \sum XY}{n \sum X^2 - (\sum X)^2} b_0 = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

RESULTS AND DISCUSSION

Trend in composition of livestock population

The temporal variation in the population of total livestock and different species like cattle, buffalo, sheep, goat and other animals like camel, pig, horse and ponies, mules and donkeys have been shown in table 1. A fluctuating trend was observed in cattle population but an absolute value of population was increased from 155.3 million in 1951 to 193.46 million in 2019. At the same time, the contribution of cattle in whole livestock inhabitants was reduced from 53.02 per cent to 36.04 percent.

The compound annual growth rate of cattle was 1.61 per cent during the study period. The affirmative growth rate in farm cattle populace may be because cattle products are having more nutritional value in terms of vitamins and proteins. Even cow's by-products are also keeping medicinal value for soil health. Sonavale *et al.* (2020) also reported positive pattern of growth rate. On the other hand, buffalo population registered a consistent increasing pattern during the study period. It was increased progressively from 155.3 million in 1951 to 109.85 million in 2019. As far as concerned the buffalo's contribution to total farm-animals populace, it was found in the analysis that buffalo

Table 1: Trends of Livestock Population in India (Million Nos.)

Species	Cattle	Buffalo	Sheep	Goat	Others	Total Livestock
1951	155.3 (53.02)	43.4 (14.82)	39.1 (13.35)	47.2 (16.11)	7.9 (2.70)	292.9 (100.00)
1956	158.7	44.9	39.3	55.4	8.3	306.6
1961	175.6	51.2	40.2	60.9	8.6	336.5
1966	176.2	53.0	42.4	64.6	8.3	344.5
1972	178.3	57.4	40.0	67.5	10.0	353.2
1977	180.0	62.0	41.0	75.6	10.8	369.4
1982	192.5	69.8	48.8	95.3	13.2	419.6
1987	199.7	76.0	45.7	110.2	13.6	445.2
1992	204.6	84.2	50.8	115.3	16.0	470.9
1997	198.9	89.9	57.5	122.7	16.4	485.4
2003	185.2	97.9	61.5	124.4	16.0	485.0
2007	198.9	105.1	69.5	140.5	15.69	529.69
2012	190.0	108.7	65.07	135.17	13.12	512.06
2019	193.46 (36.04)	109.85 (20.47)	74.26 (13.83)	148.88 (27.74)	10.31 (1.92)	536.76 (100.00)
CAGR (%)	1.61	8.19	5.37	9.49	5.00	5.04

Source: Compiles and computed by author from various Livestock Census issues of India

Note: Figure in parentheses is percentage share of species in total livestock population.

contribution has augmented from 14.82 per cent in 1951 to 20.47 in 2019 with 8.19 per cent compound annual growth rate. Prabu *et al.* (2012) also reported an increasing trend in buffalo population at national level. For the aim of milk and by-products, the substitution of cow with buffalo might be a reason for an expand in population of buffalo. The sheep population depicted fluctuations throughout the study period.

The number of sheep population was increased from 39.1 million in 1951 to 74.26 million in 2019. The contribution of sheep in total domestic animals has augmented a little bit from 13.35 per cent in 1951 to 13.83 per cent in 2019. The sheep's population was increased at 5.37 per cent per annum. Sonavale *et al.* (2020) also reported similar pattern of fluctuation in sheep population. The trend in goat population has shown a radical change with 9.49 per cent compound annual growth rate. During the same period, goat population has increased from 47.2 million to 148.88 million. The share of goat in total domestic animals has amplified from 16.11 per cent in 1951 to 27.74 per cent in 2019. Soju and Meena (2017) also reported increasing trend in goat population in Rajasthan. The temporal

composition of various species of domestic livestock had changed noticeably during 1951 to 2019, as presented in table 1. The whole population of livestock in India has amplified by 4.69 per cent over the previous census. The highest population of livestock was recorded in 2019. The total livestock population has increased by 5.05 per cent per annum during the study period. Islam *et al.* (2016) had reported similar trend in total livestock population at national level.

Annual growth rate in livestock population

The pattern of growth in population of cattle, buffalo, goat, sheep and other species over the year have been analyzed and reported in table 2. It was found in the study that growth in cattle population has turned down from 0.44 per cent during 1951-56 to 0.36 per cent during 2012-19. Similarly, the growth rate of buffalo has also decreased from 0.66 per cent in 1951-56 to 0.21 per cent in 2012-19. The growth of cattle population shows many fluctuations throughout the study period. The highest annual growth rate (3.47%) was found in goat population during 1951-56. The goat population has seen more than 1.22 per cent

Table 2: Annual Growth Rate in Livestock Population of Major Species in India

Species	Year						
	1951-56	1961-66	1972-77	1982-87	1992-97	2003-07	2012-19
Cattle	0.44	0.07	0.19	0.75	-0.56	1.48	0.36
Buffalo	0.69	0.7	1.6	1.78	1.35	1.47	0.21
Sheep	0.1	1.09	0.5	-1.27	2.64	2.60	2.82
Goat	3.47	1.22	2.4	3.13	1.28	2.59	2.03
Others	1.01	-0.7	1.6	0.61	0.5	-0.39	-4.28
Total Livestock	0.94	0.48	0.92	1.22	0.62	1.84	0.96

Source: Calculated by author from various issues of Livestock Census of India.

Table 3: Distribution of Cattle and Buffalo across Different Land Holding Sizes in India (Percentage Share)

Year	1991-92		2006-07		2011-12	
	Cattle	Buffalo	Cattle	Buffalo	Cattle	Buffalo
Marginal	35.12	34.48	50.44	44.79	54.65	49.50
Small	24.13	22.40	22.22	21.50	22.30	22.18
Semi medium	21.08	21.46	16.05	18.30	14.29	16.74
Medium	15.26	16.67	9.12	12.55	7.24	9.48
Large	4.41	5.00	2.17	2.86	1.52	2.11
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Calculated by author.

annual growth rate in the same period. The growth in sheep population has been drastically changed from 0.1 per cent in 1951-56 to 2.82 per cent in 2012-19. On the whole, the growth rate of complete livestock populace is almost stagnant during the period of 1951 to 2019, excluding for a noticeable increase during 1982-87 and 2003-07. Earlier, Bairwa *et al.* (2013) reported a similar pattern of growth rate in cow and buffalo at national level.

The distribution of cattle and buffalo among different landholding sizes is presented in table 3. It shows that marginal farmers were maintaining largest proportion of cattle and buffalo population followed by small, medium, semi-medium, large sizes land holding cultivators during the study period. From 1991-92 to 2011-12, their allocation among different land holding sizes was changed drastically. While the share of small holdings has remained stagnant in buffalo population, the share in holding cattle and buffalo by large size farmers has steadily decreased

from 4.41 and 5 per cent in 1991-92 to 1.52 and 2.11 per cent in 2011-12 respectively. However, the share of marginal size holdings has increased from 35.12 and 34.48 per cent in 1991-92 to 54.65 and 49.50 per cent in 2011-12, respectively. Bairwa *et al.* (2013) also examined the eagerness shown by marginal cultivators to maintain a large livestock exposes and it plays most important role in keep going their livelihood.

Production performance of livestock sector

Trends in production performance of milk, meat and wools in India has been presented in table 4 and fig. 1. It reveals from the table that milk production has increased gradually from 75.4 million tones in 1998 to 176.3 million tones in 2017 to declare India as leading producer on the earth. The share of cattle population has increased from 40.4 percent to 47.4 per cent (Fig. 2) since involvement of new crossbreeds. The milch buffaloes are still a significant

contributor in the production of total milk, nevertheless their shares have been reduced from 55.1 per cent to 48.9 per cent. Meat production which was only 1.9 million tones in 1998 has increased steadily over the years and reached 7.7 million tones in 2017-18. Poultry is the major contributor at 49.2 per cent followed by buffalo, goat, sheep and pig (Fig. 3).

Table 4: Trends in Production of Livestock Products in India

Year	Meat (Million tones)	Wool (Million Kg)	Milk (Million tones)
1998	1.9	46.9	75.4
1999	1.9	47.9	78.3
2000	1.9	48.4	80.6
2001	1.9	49.5	84.4
2002	2.1	50.5	86.2
2003	2.1	48.5	88.1
2004	2.2	44.6	92.5
2005	2.3	44.9	97.1
2006	2.3	45.1	102.6
2007	4.0	43.9	107.9
2008	4.2	42.8	112.2
2009	4.5	43.1	116.4
2010	4.9	43.0	121.8
2011	5.5	44.7	127.9
2012	5.9	46.1	132.4
2013	6.2	47.9	137.7
2014	6.7	48.1	146.3
2015	7.0	43.6	155.5
2016	7.4	43.5	165.4
2017	7.7	41.5	176.3
CAGR	-0.55	4.50	9.37

Source: Compiled and calculated by author from Basic Animal Husbandry Statistics.

Ironically, wool production has been declined from 47 million kg. in 1998 to 41.5 million kg in 2017, it could be due to the reducing population of camel and sheep in the country. There were limitations on access to common grazing lands; therefore, animal rearers move their livelihood towards crop farming and other activities in dry land areas. Further, India's woollen industry is shifting their focus to markets such as Kazakhstan, Germany, China and Australia as it faces decline in export to the USA and Europe due to warmer winters. On the consumption side, imported garments substituted tastes and introduced new standards. The maximum share of wool is being

contributed by ewes at 68 per cent followed by castrated ram (Fig. 4).

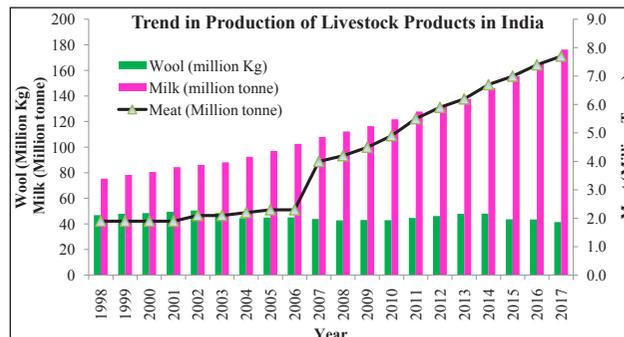


Fig. 1: Trends in Livestock Products in India

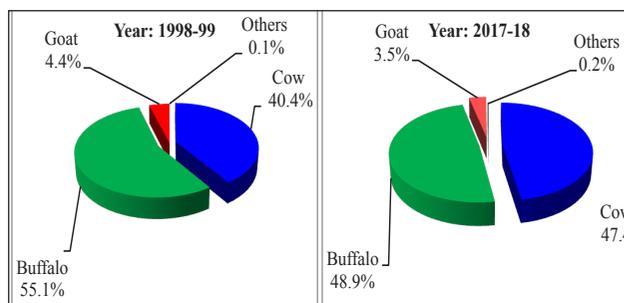


Fig. 2: Contribution of Species in Total Milk production in India (1998 to 2017)

The growth rate of milk, meat and wool fluctuates from year to year. During the era of study, the annually compound growth rate of milk, wool and meat were 9.37, 4.5 and -0.55 percent, respectively. Reddy and Ramappa (2016) also reported the positive pattern of growth rates of milk production in different periods.

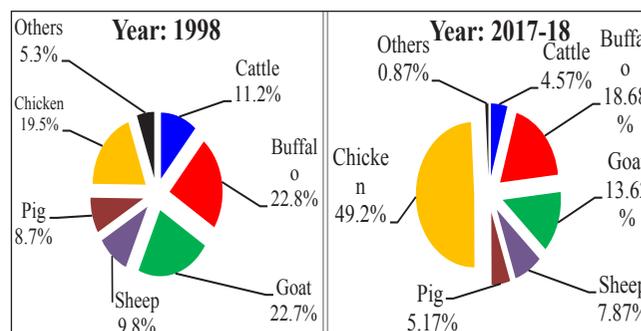


Fig. 3: Contribution of Species in Total Meat Production in India (1998 to 2017)

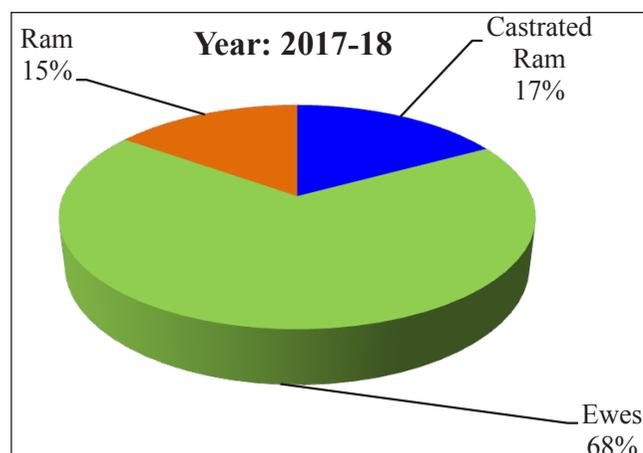


Fig. 4: Contribution of Species in India's Wool Production (1998 to 2017)

The livestock sector's contribution in value of agriculture along with allied activities of India at current prices from 1998 to 2017 is indicated in table 5. Based on its share in value of agriculture plus allied activities, we can understand the significance of this sector in Indian economy. The value of livestock sector has almost sextupled from 1.18 lakh crore in 1998 to 7.58 lakh crore in 2017. At the same time, the value of agricultural plus allied activities has more than quadrupled from 4.89 lakh crore to 20.70 lakh crore. Over the period, the contribution of livestock sector in total value of agriculture plus allied activities has been balancing near a noticeable 25 per cent. The estimated annual compound growth rate in value of livestock sector registered the higher growth rate (10.05 per cent) than agriculture and allied activities (9.87 per cent) during the period from 1998 to 2017.

Table 5: Share of Domestic Animal Sector in amount of Agricultural and Allied Activities in India (at Current Price)

Year	Value of Agriculture and Allied activities (₹ Lakh crore)	Value of Livestock (₹ Lakh crore)	%Share of Livestock Sector
1998	4.89	1.18	24.22
1999	5.27	1.31	24.81
2000	5.30	1.41	26.70
2001	5.67	1.52	26.75
2002	5.56	1.58	28.33
2003	6.25	1.62	25.99

2004	6.48	1.73	26.75
2005	7.17	1.93	26.99
2006	8.01	2.15	26.87
2007	9.29	2.47	26.61
2008	10.49	2.92	27.85
2009	12.00	3.41	28.46
2010	14.16	3.88	27.42
2011	15.06	3.24	21.52
2012	16.69	3.67	22.01
2013	18.81	4.06	21.58
2014	20.69	5.10	24.65
2015	22.28	5.82	26.15
2016	24.96	6.73	26.95
2017	20.70	7.58	36.64
CAGR	9.87	10.05	

Source: Computed and compiled by author from various issues of BAHS, Government of India.

Amid the various components of livestock sector, major part of value contributes by the milk group as it has recorded about 67 per cent of whole livestock values during all the five-year chunk periods since 1998 (table 6). Further, second highest contributor of value is the meat group (19 per cent) comprising meat, their products, hides and skins, etc. Apart from milk and meat group, dung, wools, eggs and hair give slight components of livestock value.

Table 6: Share in Value of Different Livestock Product (Five Year Ending Average) (₹ Crore at Current Price)

Livestock Product	1998-02	2003-07	2008-12	2013-17
Milk Group	94099.4 (67.3)	135190 (67.7)	277289.4 (66.4)	508624 (66.6)
Meat Group	24997.8 (17.9)	35936 (18.0)	81669.6 (19.6)	161692 (21.2)
Eggs	4361.4 (3.1)	6691.4 (3.4)	14966 (3.6)	24959.4 (3.3)
Wool and Hair	328.4 (0.2)	348.4 (0.2)	464 (0.1)	551.4 (0.1)
Dung	11235.2 (8.0)	16719.8 (8.4)	29531 (7.1)	44845.4 (5.7)

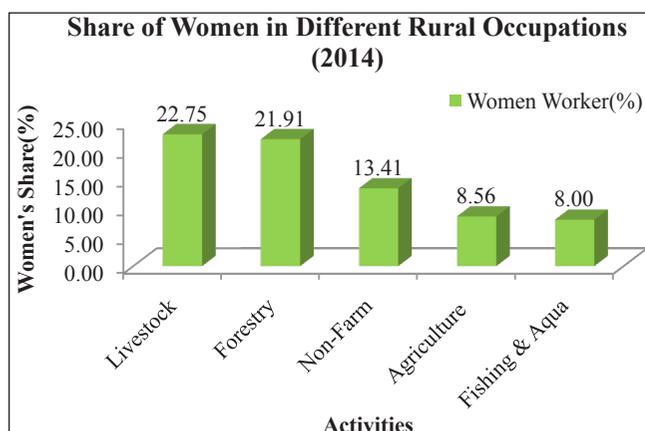
Others	4895.4 (3.5)	4814.4 (2.3)	13577 (3.2)	23330.2 (3.1)
Total	139917.6 (100.0)	199700 (100.0)	417497 (100.0)	764002 (100.0)

Note: Figures in parenthesis are percentage share in total.

Source: Computed and compiled by author from issues of Basic Animal Husbandry Statistics.

Role of women in livestock sector

Animal rearing in rural India is primarily a household based activity, and involves family labour for caring animals. There are various rural occupations that have wide range of opportunities for women participation in India.



Source: Statistical compilation of gender related indicators in India, Central Statistics Office, GoI

Fig. 5: Women's contribution in various occupations

Livestock sector is primarily deals under the supervision of women as marked in the Fig. 5 that about 23 per cent women constituted the primary work force in rearing of domestic animals followed by crop farming or agriculture (22 per cent). This is evident from the data that rural women are straightly involved in livestock operational management activities related to feeding, milking, breeding and health care of the domestic animals.

Export performance of livestock products

Table 7 present the export values of various livestock products during the period 1998-2017. The results are

based on comparison among the five year average *i.e.*, 1998-02, 2003-07, 2008-12 and 2013-17. India exports livestock products namely buffalo meat, goat and sheep meat, poultry produce, dairy product, animal casings and processed flesh to the world. Export of these products from India has acquired an extensive impetus since the untimely nineties chiefly due to trade liberalization and numerous international business policy variations, joined with competition in world market prices of various farm-animal products. It is revealed from the table that trends in export of livestock products *viz.*, buffalo-meat and poultry products have presented a tremendous augmentation since the millennial.

The export of buffalo meat which was 2230.11 thousand tones during the five-year ending average 1998-02 has increased to 1383.38 thousand tones by the five-year ending 2013-17. It has upheld its prime place to the products of poultry as their exports have boost up by leap and many fold from a only 1383.38 thousand tones during the same period. During the whole study period under investigation, the highest compound annual growth rate was observed in poultry products (24.13 per cent) followed by buffalo meat (13.02 per cent), dairy product (11.63 per cent). In case of total livestock export value, it was 13.89 per cent during the same period.

Instability in livestock exports

We have estimated the degree of variability in exported quantity of livestock production *viz.*, dairy produce, buffalo meat, poultry product, animal casing, sheep and goat meat and last but not least processed flesh from India. A brief perusal of the data presented in table 8 shows that during the period under investigation, instability in buffalo meat is quite low at 12.26 percent, when compared to sheet and goat meat in the country. Even though, the instability in export of processed meat, dairy and poultry products has altered moderately at 59.91, 66.17 and 67.34 per cent respectively. Further, the instability in export of animal casing has increased drastically about 179 per cent. While the export of animal products augmented in many-fold during the entire study period, the performance of these products has been observed to be highly unstable. Ohlan (2014) examined declined instability in dairy product (milk) of India.

Table 7: Export (Value) of Livestock Products from India (Five-year average value of commodity) Quantity in “000” tones)

Products	1998-2002	2003-07	2008-12	2008-12	2013-17	CAGR (%)
Buffalo Meat	230.11 (85.32)	383.14 (35.92)	756.17 (47.27)	756.17 (47.27)	1383.38 (69.563)	13.02
Sheep and Goat meat	8.37 (3.10)	10.48 (0.98)	25.58 (1.60)	25.58 (1.60)	21.76 (1.094)	6.44
Poultry Products	15.58 (5.78)	617.09 (57.85)	758.52 (47.42)	758.52 (47.42)	511.27 (25.709)	24.13
Dairy Products	13.2 (4.89)	48.91 (4.59)	51.09 (3.19)	51.09 (3.19)	69.26 (3.483)	11.63
Animal Casings	2.01 (0.75)	0.62 (0.06)	1.44 (0.09)	1.44 (0.09)	2.68 (0.135)	0.65
Processed Meat	0.44 (0.16)	0.63 (0.06)	0.77 (0.05)	0.77 (0.05)	0.32 (0.016)	-0.18
Total Livestock Products	269.71 (100.00)	1066.7 (100.00)	1599.73 (100.00)	1599.73 (100.00)	1988.68 (100.00)	13.89

Source: Compiled and computed by author from APEDA statistics, Government of India.

Table 8: Instability in Export of Livestock Products (1998-2017)

Product	Instability (%)
Buffalo Meat	12.26
Sheep and Goat Meat	35.10
Poultry Products	67.34
Dairy Products	66.17
Animal Casings	178.96
Processed Meat	59.91
Total Live Stock Products	21.77

Source: Author’s own calculation based on data available in APEDA statistics.

Forecasting and correlation in livestock exports

The Karl Pearson analysis of correlation is applied to find out the linear alters in the value of one variable due to dissent in second variable. The degree of linear relationship between the export quantities of every selected domestic animal products along with total exports quantity of livestock has been worked out for 1998 to 2017 which is shown in table 9. The result indicates that the buffalo flesh, dairy output and poultry materials have a dominant grip on exports of animal products from India with a correlation degree of 0.73, 0.60 and 0.54, respectively whereas goat and sheep flesh is not in burly footing along with total exports as observe from its low correlation coefficient. In case of processed meat, a negative relationship shows that demand for processed meat has decreased in international market.

Table 9: Correlation between Exports of Each Livestock Product with Total Livestock Exports (1998 to 2017)

Correlation Factor	Value of Karl Pearson Coefficient (r)
Buffalo Meat : Total Livestock Export	0.73
Dairy Product : Total Livestock Export	0.60
Poultry Product : Total Livestock Export	0.54
Sheep and Goat Meat : Total Livestock Export	0.39
Other Product : Total Livestock Export	0.31
Processed Meat : Total Livestock Export	-0.28

Source: Author’s own calculation based on data available in APEDA statistics.

The method of Ordinary Least Square has been used to project the exports of livestock products from India up to 2022-23 as shown in table 10.

Table 10: Total Livestock Products Export Forecast for India (2018-2022)

Year	Equation is $Y = 13.20 + 0.96X$		Quantity in lakh tones	
	<i>a</i>	<i>b</i>	<i>X</i>	<i>Y</i>
2018-19	13.20	0.96	21	33.29
2019-20	13.20	0.96	22	34.25
2020-21	13.20	0.96	23	35.21
2021-22	13.20	0.96	24	36.16
2022-23	13.20	0.96	25	37.12

Source: Author’s own calculation based on data available in APEDA statistics.



It is revealed from the table that in next half decade the exports of livestock products from India would expand from 33.29 lakh tones in 2018-19 to 37.12 lakh tones at the end of 2022-23.

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REFERENCES

- Baba, S.H., Wani, M.H. and Zargar, B.A. 2011. Dynamics and sustainability of livestock sector in Jammu and Kashmir. *Agric. Econ. Res. Rev.*, **24**: 119-132.
- Bairwa, K.C., Varadan, R.J., Jhahria, A. and Meena, D.K. 2013. An economic appraisal of livestock sector in India. *Indian J. Anim. Res.*, **47**(2): 105-112.
- Bardhan, D., Sharma, M.L. and Saxena, R. 2010. Livestock in Uttarakhand: Growth pattern and determinants of composition and intensity. *Indian J. Anim. Sci.*, **80**(6): 584-589.
- Brithal, P.S. and Ali, J. 2005. Potential of livestock sector in rural transformation. In R. Nayyar and Sharma, A.N. (eds.) Rural transformation in India. The role of non-farm sector. New Delhi: Institute of Human Development and Manohar Publishers and Distributors.
- Brithal, P.S., Joshi, P.K. and Kumar, A. 2002. Assessment of research priorities for livestock sector in India. *Policy Paper-15*, National Centre for Agricultural Economics and Policy Research, New Delhi.
- Chand, R. 1995. Livestock in Himachal Pradesh: Factors affecting growth, composition and intensity. *Indian J. Agric. Econ.*, **50**(3): 299-310.
- Chauhan, S. K. 2008. Socio-economic dimensions of equine-rearing in Himachal Pradesh. *Agric. Econ. Res. Rev.*, **21**(2): 211-220.
- Cuddy, J.D. and Valle, P.A.D. 1978. Measuring the instability of time series data. *Oxf. Bull. Econ. Stat.*, **40**: 53-78.
- Elumalai, K. and Panday, U. K. 2003. Growth and density scenario of livestock and poultry in Haryana. *Indian J. Anim. Sci.*, **73**(10): 1168-1173.
- Goyal, S.K. 1995. Temporal changes in size and composition of milch animals in Haryana. *Indian J. Anim. Sci.*, **50**(3): 394.
- Islam, M.M., Anjum, S., Modil, R.J. and Wadhvani, K.N. 2016. Scenario of livestock and poultry in India and their contribution to national economy. *Int. J. Environ. Sci.*, **5**(3): 956-965.
- Kaur, P. and Bhullar, A.S. 2012. Structure of milk production in Punjab-an analysis of trend and sources of growth. *Indian J. Dairy Sci.*, **65**(6): 514-519.
- Kumar, V., Sharma, H.R. and Sharma, R.K. 2004. Livestock economy of Himachal Pradesh: Growth pattern, ecological implications and state policy. *Agric. Econ. Res. Rev.*, **17**(1): 57-76.
- Ohlan, R. 2014. Growth and instability in dairy production and trade: A global analysis. *Inter. J. tr. & Glo. Mkt.*, **7**(2): 145-172.
- Pandey, R.N. and Gangwar, A.C. 1995. Changes in population of farm livestock over time in India. *Indian J. Agric. Econ.*, **3**: 274-375.
- Pandey, U.K. 1995. The livestock economy of India: A profile. *Indian J. Agric. Econ.*, **3**: 264-282.
- Patel, R.K. 1993. Present status and promise of dairying in India. *Indian J. Agric. Econ.*, **48**(1): 1-33.
- Prabu, M., Kumar, G.S. Pandian, A.S.S., Selvakumar, K.N. and Varathan, B.J. 2012. Dynamics of livestock population-India vis-à-vis Tamil Nadu. *T.N.J. Veter. Ani .Sci.*, **8**(5): 266-270.
- Rae, A. and Nayga, R. 2010. Trends in consumption, production and trade in livestock and livestock products. Book Chapter in: Livestock in changing landscape, drivers, consequence and responses. Editors: Steinfeld, H.; Mooney, H.A.; Schneider, F.; Neville, L.E.:13-15. *Island press*. Washington, D.C., U.S.A.
- Raj, R. and Gupta, S.K. 2015. Relative share of livestock population of Haryana. *Int. J. Adv. Res.*, **3**(4): 790-796.
- Reddy, B.S. and Ramappa, R. 2016. Performance of livestock sector in India with reference to bovine population. *Curr. Agri. Res. J.*, **4**(1): 108-113.
- Sharma, V. P. 2004. Livestock economy of India: Current status, emerging issues and long term prospects. *Indian J. Agric. Econ.*, **9**(3): 512-544.
- Soju, S. and Meena, G.L. 2017. Dynamics of livestock population and output in Rajasthan: A temporal analysis. *J. Anim. Res.*, **7**(2): 345-354.
- Sonavale, K.P., Shaikh, M.R. and Kadam, M.M. and Pokharkar, V.G. 2020. Livestock sector in India: A critical analysis. *Asi. J. Agril. Ext., Econ. Socio.*, **38**(1): 51-62.

Subhash, S.P. and Kaur, P. 2013. Livestock population in Punjab: Factors determining growth, composition and density. *J. Agril. Develop. Policy*, **23**(2): 79-91.

Tomer, B.S. and Singh, B. 1995. Livestock composition and trend in Haryana. *Indian J. Agric. Econ.*, **3**: 375-376.

Yadav, S.S. 1995. Dynamics of milch animal stock in Rajasthan and its implication for state economy. *Indian J. Agric. Econ.*, **3**: 329-330.

