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Status of Livestock Diversification in Rajasthan for Period from 1997 to 2019

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ABSTRACT

Background: Livestock is the backbone of agriculture GDP which contribute around 25 per cent in Indian agriculture GDP and approx. 30 per cent of Rajasthan Agriculture GDP. The contribution of GDP in agriculture GDP can be increased by switching with profitable innovation or improved breeds that is profitable for the particular region. In another words a shift from less sustainable or profitable livestock to a more profitable and sustainable or ensuring livelihood security is livestock diversification.

Methods: The study is based on 33 district of Rajasthan's secondary data of livestock census for period from 1997 to 2019 and from 2012 to 2019, which is conducted in year 2024-25. The segment of periods provides valuable insights into the role of animal husbandry in supporting rural livelihoods and the mixed farming systems prevalent in the region. The proposed study is confined to indigenous cattle, cross bread cattle and buffalo. Herfindhal Index used to identify the livestock diversification index (Lower value indicate higher diversification) and proportional method was employed to find out the real diversified number in to the indigenous cattle, cross bread cattle and buffalo livestock.

Result: The result of the study revealed that the index has been going down steadily in Ajmer, Bhilwara, Churu and Udaipur from 1997 to 2019. This shows that the distribution of indigenous cattle, crossbreeds and buffaloes is becoming more balanced. The Hanumangarh and Ganganagar district of Rajasthan stands on first and second position respectively in higher diversification means, in Hanumangarh district the population of buffalo decrease by 0.138 proportion (-117115 is real number change) and crossbreed cattle and indigenous cattle increase by 0.155 and 0.003 proportion and 131504 and 2711 real number changes respectively from period 1997 to 2019. Jaisalmer (0.89) and Dholpur (0.72) district have higher diversification index for year 2019 which indicate lower diversification for these districts. Jaisalmer district have decrease in indigenous cattle (21408) and increase in cross bread (18154) and buffalo (48) in real number changes.

Key words: Districts, Diversification, Index, Livestock, Proportion.

INTRODUCTION

Diversification is crucial for ensuring sustainable livelihoods due to its ability to mitigate risks and enhance resilience. Diversification in agriculture' has tremendous impact on the agro-socio-economic upliftment of resource-poor farming communities (Deogharia, 2018). In India, crop and livestock production systems are practiced by 86 per cent of smallholders. However, the choices available to farmers are limited by the availability of resources such as land, labor and capital. Livestock is the backbone of agriculture GDP which contribute around 25 per cent in Indian agriculture GDP and approx. 30 per cent of Rajasthan agriculture GDP. The contribution of GDP in agriculture GDP can be increased by switching with profitable innovation or improved breeds that is profitable for the particular region. In another words a shift from less sustainable or profitable livestock to a more profitable and sustainable or ensuring livelihood security is livestock diversification.

Livestock diversification refers to the practice of integrating multiple livestock species or combining livestock with crop systems to increase farm resilience, optimize resource use and enhance income stability. It is a key strategy in smallholder and mixed farming systems to manage climatic, economic and disease-related risks (FAO, 2021; Thornton *et al.,* 2022).

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Traditionally, many rural households have depended on a narrow range of livestock species, making them vulnerable to shocks such as droughts, disease outbreaks and market volatility. By diversifying their livestock holdings-through poultry, goats, sheep, cattle, pigs, fisheries, or even beekeeping-farmers can access multiple income streams, food sources and insurance mechanisms (Reddy *et al.*, 2020). In India, Jammu and Kashmir is home to diverse cattle genetic resources, including native breeds adapted to harsh environments. The region has a rich history of cattle introduction, with various breeds brought in by different cultures, such as the Aryans, Pathans and

Sikhs (Anonymous, 2021). Local breeds, like the Gurezi cattle, remain uncharacterized but possess distinct features, such as a prominent hump and small stature (Lawrence, 2002; Sarma *et al.,* 2025).

Livestock diversification not only improves economic returns but also contributes to ecological sustainability. Integrating livestock with crops enhances nutrient recycling, reduces reliance on external inputs and promotes sustainable land management practices (Steinfeld *et al.,* 2019). Moreover, it plays a critical role in climate-smart agriculture by enhancing adaptation capacities and reducing greenhouse gas emissions per unit of output (Thornton and Herrero, 2021).

Recent studies have emphasized that livestock diversification contributes to food and nutrition security by improving household diets through access to varied animal-sourced foods (IFPRI, 2023). However, the benefits depend on enabling factors such as market access, extension services, institutional support, gender equity and local knowledge systems (Singh *et al.,* 2022).

Livestock diversification plays a critical role in smallholder farming systems, especially in developing countries, where it contributes significantly to livelihood security, nutritional improvement and employment generation (Kumar *et al.,* 2013). Additionally, integrating livestock with crops not only diversifies income but also enhances ecological sustainability by closing nutrient cycles and reducing reliance on external inputs. In addition to giving a lot of people access to affordable, wholesome food, this industry contributes significantly to the creation of job possibilities in rural areas (Al-Sharafat, 2013).

The strategy of diversification aligns with broader goals of climate-smart agriculture, sustainable rural development and food security. However, its success depends on access to veterinary services, market infrastructure, knowledge dissemination and policy support (Herrero *et al.,* 2010). As global agricultural systems face increasing pressure from climate change, resource degradation and population growth, livestock diversification emerges as a viable pathway toward sustainable rural development.

MATERIALS AND METHODS

The study is confined to 33 districts of Rajasthan for the 5 livestock census from 1997 to 2019. The present study is based on purely secondary data and conducted in the year 2024-25. Herfindhal Index was used to identify the livestock diversification index and proportional method was employed to find out the real diversified number in to the livestock.

Herfindhal index formula

$$H.I. = \sum_{i=1}^{N} P_i^2$$

$$P_i = \frac{A_i}{\sum_{i=1}^{N} A_i}$$

Where in reference to livestock P represents livestock proportion of i^{th} livestock and N denotes total number of livestocks. A_i represent, number under i^{th} livestock and $\sum_{i=1}^{N} A_i$ represent total livestock in number i is 1,2,3 ….n^{th} the number of livestock.

Herfindahl Index range varies from 0 to 1. Its value is 0 when there is perfect diversification and its value is 1 when there is complete specialization of particular livestock, both of these extreme values are in idea situations. HI is inversely propositional to diversification (Asante *et al.,* 2018; Thiel, 1967; Pal and Kar, 2012) means lower value indicates higher diversification level.

Proportional method

Proportion formula (for livestock category):

Proportion of livestock category =

$$\frac{\text{Number of livestock in category}}{\text{Total number of population}}$$

Proportional Method formula for calculating real number of livestock:

Real number of livestock (Category) =

Proportion of category × Total livestock population

RESULTS AND DISCUSSION

Livestock plays an important role in the sustainable livelihood of poor people because of inherent risk involved in the crop farming due to uncertainty of rainfall and occurrence of recurrent droughts. They provide income and increased economic stability of the households (Rani *et al.,* 2025). The present study calculates the diversification index Indigenous cattle, Cross bread cattle and Buffalo in different districts of Rajasthan for the years 1997, 2003, 2007, 2012 and 2019, shown in Table 1. The diversification index shows how many different kinds of cattle there in each area. A lower index value means greater diversity, which means that the three species of animals are more evenly mixed. On the other hand, a higher score means less variety, with one or two varieties of cattle being more common.

Most districts in the state show a general downward trend in the score, which means that the variety of cattle has become better over time. For example, the index has been going down steadily in Ajmer, Bhilwara, Churu and Udaipur from 1997 to 2019. This shows that the distribution of indigenous cattle, crossbreds and buffaloes is becoming more balanced. This tendency shows that livestock improvement programs could work and that farmers might be altering their minds about keeping a variety of diverse breeds.

Some districts, on the other hand, show patterns that are different from the others. For example, in 1997, Jaisalmer and Dungarpur had relatively high index values (0.994 and 0.990, respectively), which meant that there

Table 1: Diversification index of Indigenous cattle, cross bread cattle and buffalo in Rajasthan.

District	1997	2003	2007	2012	2019
Ajmer	0.503	0.479	0.476	0.457	0.452
Alwar	0.665	0.720	0.717	0.716	0.697
Banswara	0.596	0.592	0.572	0.550	0.510
Baran	0.575	0.533	0.518	0.503	0.496
Barmer	0.749	0.685	0.684	0.661	0.681
Bharatpur	0.727	0.767	0.662	0.714	0.644
Bhilwara	0.523	0.478	0.460	0.420	0.405
Bikaner	0.716	0.651	0.645	0.630	0.606
Bundi	0.510	0.492	0.493	0.488	0.507
Chittorgarh	0.530	0.510	0.487	0.464	0.473
Churu	0.521	0.489	0.477	0.454	0.436
Dausa	0.583	0.628	0.619	0.638	0.631
Dholpur	0.647	0.730	0.721	0.754	0.726
Dungarpur	0.990	0.548	0.541	0.522	0.499
Ganganagar	0.457	0.434	0.440	0.387	0.396
Hanumangarh	0.480	0.457	0.450	0.408	0.376
Jaipur	0.523	0.540	0.491	0.464	0.472
Jaisalmer	0.994	0.984	0.977	0.973	0.894
Jalore	0.501	0.516	0.514	0.524	0.546
Jhalawar	0.547	0.526	0.518	0.500	0.500
Jhunjhunu	0.609	0.604	0.512	0.484	0.432
Jodhpur	0.612	0.554	0.541	0.544	0.557
Karouli	0.575	0.649	0.644	0.707	0.779
Kota	0.513	0.499	0.492	0.482	0.485
Nagour	0.499	0.493	0.485	0.445	0.430
Pali	0.506	0.491	0.494	0.488	0.477
Pratapgarh	-	-	-	0.527	0.495
Rajsamand	0.494	0.472	0.459	0.451	0.434
S.Madhopur	0.506	0.514	0.563	0.616	0.669
Sikar	0.554	0.574	0.512	0.465	0.419
Sirohi	0.529	0.508	0.502	0.492	0.476
Tonk	0.508	0.498	0.501	0.525	0.587
Udaipur	0.552	0.531	0.525	0.496	0.454

Note: Lower value indicate higher diversification.

was very little variety at that time. However, both districts' index values steadily drop until 2019, which shows that they are making progress towards diversity. On the other hand, districts like Karouli and Tonk have index values that have been going higher over the years. This means that there is less variety and more of certain sorts of cattle.

Also, keep in mind that Pratapgarh was founded after 2007, hence there is no data for prior years. This is why there are no values for 1997, 2003 and 2007. Overall, the data gives us useful information about how the variety of livestock has evolved over time in Rajasthan's districts. Most places demonstrate a favourable trend towards balanced livestock management.

Table 2 indicates the percentage and numerical change in the numbers of three significant types of livestock in Rajasthan districts between 1997 and 2019: Indigenous cattle, Crossbred cattle and buffaloes. Relative change indicates how many more or less of each type of animal there are and numerical change indicates how many more or less there are each year.

Indigenous cattle

In all districts except two, the indigenous cattle decreased, both in absolute as well as relative terms. Dungarpur, for instance, had the highest decline, with percentage depletion of -0.437 and loss of over 3.3 lakh indigenous cattle. Jaipur (-338,630) and Udaipur (-206,474) also had huge declines. Ganganagar and Hanumangarh were the sole two districts where indigenous cattle were slightly higher in number. This also means that people in most of the state are leaving behind traditional breeds.

Crossbred cattle

On the other hand, the population of crossbred cattle increased mainly in Rajasthan, which shows that people are moving towards more productive cattle. Some of the districts that have experienced high proportionate growth include Jhunjhunu (0.303), Sikar (0.263) and Jaipur (0.177). The absolute numbers also went higher, which is in line with the trend. To give an example, Jaipur alone had more than 3.3 lakh crossbred cattle, which is an indication that crossbreeding is highly popular in this area.

Buffaloes

The buffaloes also grew in numbers, though not uniformly. The greatest proportionate growth was in the Tonk (0.332), Sawai Madhopur (0.325) and Karauli (0.287) districts, which had more than 2 lakh, 1.2 lakh and 1.6 lakh more buffaloes, respectively. But districts like Jhunjhunu (-0.232) and Sikar (-0.151) experienced a proportionate fall in buffaloes, which means that people in different areas have different propensities towards breeding buffaloes. This data shows a pattern in the state of fewer indigenous animals and more crossbred animals and buffaloes. This conforms to changes in agricultural and dairy farming practice with a view to raising productivity and economic output.

Table 3 presents information on the relative and absolute changes in population of three key livestock categories-Indigenous cattle, Crossbred cattle and buffaloes in the districts of Rajasthan from 2012 to 2019. The data indicates changing trends in animal husbandry that impact different animal groups and areas in diverse ways.

One of the most striking discoveries from the table is the overall decrease in Indigenous Cattle across most districts. Districts such as Udaipur (-0.076 proportion, -1,09,072 cattle), Jhalawar (-0.139, -82,562) and Ajmer (-0.093, -84,265) have experienced significant decreases both in proportion and in actual counts. This decrease has occurred due to a shift away from native breeds under the assumption that they produce less milk than crossbred animals. Moreover, issues such as inadequate fodder, low

Table 2: Proportional and Real number shift of animals from the period of 1997 to 2019 in Rajasthan.

Districts	Proportional change (1997-2019)			Number change (1997-2019)		
	Indigenous cattle	Crossbred cattle	Buffalo	Indigenous cattle	Crossbred cattle	Buffalo
Ajmer	-0.254	0.073	0.176	-230064	65765	159186
Alwar	-0.108	0.071	0.061	-149965	97779	84203
Banswara	-0.101	0.025	0.048	-102491	25397	48845
Baran	-0.172	0.003	0.131	-97026	1867	73694
Barmer	-0.052	0.001	0.017	-58522	1560	19619
Bharatpur	-0.023	0.074	-0.082	-22359	71318	-79575
Bhilwara	-0.161	0.095	0.049	-190353	111836	58158
Bikaner	-0.072	0.084	-0.004	-101098	117575	-5085
Bundi	-0.244	0.033	0.220	-126500	17369	113843
Chittorgarh	-0.227	0.034	0.177	-193319	28925	150858
Churu	-0.080	0.081	0.000	-57487	57829	-265
Dausa	-0.140	0.070	0.104	-95066	47752	70177
Dholpur	-0.115	0.043	0.115	-50459	19058	50751
Dungarpur	-0.437	0.006	0.187	-332240	4776	142585
Ganganagar	0.028	0.175	-0.138	23555	146477	-115874
Hanumangarh	0.003	0.155	-0.138	2711	131504	-117115
Jaipur	-0.178	0.177	0.001	-338630	336398	2842
Jaisalmer	-0.052	0.044	0.000	-21468	18154	48
Jalore	-0.150	0.010	0.166	-133331	8908	147446
Jhalawar	-0.246	0.015	0.214	-146458	8739	127460
Jhunjhunu	-0.125	0.303	-0.232	-76944	186475	-142867
Jodhpur	-0.038	0.047	-0.004	-52412	64694	-5739
Karouli	-0.201	0.018	0.287	-118853	10754	169726
Kota	-0.136	0.013	0.114	-62343	6125	52290
Nagour	-0.093	0.080	0.013	-103774	89213	13999
Pali	-0.071	0.020	0.046	-48771	13641	31763
Pratapgarh	-	-	-	-	-	-
Rajsamand	-0.130	0.059	0.064	-62163	28152	30853
S.Madhopur	-0.257	0.016	0.325	-97362	6057	123277
Sikar	-0.142	0.263	-0.151	-123532	229687	-131882
Sirohi	-0.157	0.023	0.118	-65372	9649	49051
Tonk	-0.303	0.013	0.332	-184563	8043	202366
Udaipur	-0.145	0.047	0.072	-206474	67187	102857

returns and limited veterinary services for Indigenous Cattle might have discouraged farmers from maintaining sizable herds of these animals.

Conversely, Crossbred Cattle have shown a growth trend in most of the districts. Hanumangarh (0.067 proportion, 56,861 cattle), Sikar (0.057, 49,710) and Bikaner (0.041, 57,411) have shown impressive growth. This indicates a growing trend of livestock owners towards high-yielding crossbreed cattle, which are going to be promoted through dairy development schemes and artificial insemination schemes. The relatively higher economic payback from crossbred cattle, especially in terms of milk yield, makes them a more viable option for farmers to increase household income.

Buffalo population shows mixed trends, with some districts showing increments and others showing decrement. Districts such as Jhalawar (0.128 proportion, 76,406 buffaloes), Udaipur (0.055, 78,479) and Chittorgarh (0.093, 79,195) showed significant increments, reflecting growing demand for milk from buffaloes and possibly greater adaptability of buffaloes to local climatic and fodder conditions. On the other hand, districts such as Sikar (-0.066 proportion, - 57,276 buffaloes), Hanumangarh (-0.080, -67,354) and Ganganagar (-0.059, -49,633) showed significant decrements. These modifications might indicate alterations in land utilization, water accessibility, or community requirements influencing the selection of livestock.

Interestingly, several districts displayed unique trends. One district that stood out was Barmer, which demonstrated a rise in Indigenous cattle despite overall negative trends for that category, while Jaipur saw relatively minor fluctuations across all three types of livestock. Nagour and Jhunjhunu districts experienced small

Table 3: Proportional and real number shift of animal from the period of 2012 to 2019 in Rajasthan.

Districts	Proportional change (2012-2019)			Number change (2012-2019)		
	Indigenous cattle	Crossbred cattle	Buffalo	Indigenous cattle	Crossbred cattle	Buffalo
Ajmer	-0.093	0.038	0.055	-84265	34441	49824
Alwar	-0.012	0.023	-0.011	-16276	31769	-15493
Banswara	-0.049	0.015	0.035	-50293	15104	35190
Baran	-0.047	-0.003	0.050	-26258	-1934	28192
Barmer	0.017	-0.001	-0.016	18859	-691	-18167
Bharatpur	0.005	0.042	-0.047	5240	40171	-45411
Bhilwara	-0.031	0.014	0.017	-37064	16696	20368
Bikaner	-0.014	0.041	-0.027	-19279	57411	-38132
Bundi	-0.073	0.012	0.061	-37792	6291	31501
Chittorgarh	-0.094	0.002	0.093	-80505	1310	79195
Churu	0.036	0.034	-0.070	25752	24665	-50417
Dausa	-0.017	0.020	-0.003	-11625	13691	-2065
Dholpur	-0.017	0.032	-0.015	-7430	14058	-6628
Dungarpur	-0.055	0.004	0.051	-41498	2908	38590
Ganganagar	0.026	0.033	-0.059	21719	27913	-49633
Hanumangarh	0.012	0.067	-0.080	10493	56861	-67354
Jaipur	-0.004	-0.005	0.009	-8007	-9025	17033
Jaisalmer	-0.042	0.040	0.002	-17165	16278	887
Jalore	-0.057	0.007	0.050	-50568	6589	43979
Jhalawar	-0.139	0.010	0.128	-82562	6156	76406
Jhunjhunu	0.040	0.021	-0.061	24603	12791	-37395
Jodhpur	0.020	0.015	-0.035	27987	21029	-49015
Karouli	-0.054	0.003	0.051	-31792	1539	30252
Kota	-0.011	-0.002	0.012	-4862	-809	5671
Nagour	0.026	0.013	-0.039	28930	14461	-43391
Pali	-0.021	0.010	0.010	-14339	7124	7215
Pratapgarh	-0.048	0.006	0.042	-27657	3420	24236
Rajsamand	-0.051	0.022	0.029	-24595	10486	14109
S.Madhopur	-0.064	0.011	0.052	-24171	4284	19887
Sikar	0.009	0.057	-0.066	7567	49710	-57276
Sirohi	-0.036	0.018	0.018	-14908	7577	7331
Tonk	-0.085	0.000	0.085	-51891	226	51666
Udaipur	-0.076	0.021	0.055	-109072	30593	78479

increases in Indigenous and Crossbred cattle but a decline in buffaloes, which reflects sub-regional variations in livestock priorities.

Overall, the trends show a gradual shift in livestock composition in Rajasthan. Decline in Indigenous Cattle shows the problems of traditional animal husbandry, while increase in Crossbred Cattle shows the shift towards commercialization and increased productivity. The buffaloes hold importance but display uneven growth, likely influenced by regional economic and environmental factors. The trends indicate the need for tailored livestock development in the region, focusing equally on productivity, sustainability and the preservation of local breeds.

CONCLUSION

The study conclude that the past two decades show a clear shift in Rajasthan's livestock sector toward more balanced and economically efficient compositions. Many districts, such as Ajmer, Bhilwara, and Udaipur, have moved toward greater livestock uniformity, reflecting improved awareness and adoption of diverse breeds supported by government initiatives. Conversely, areas like Karouli and Tonk show reduced diversity, possibly due to market preferences or breed adaptability. Despite a general decline in indigenous cattle, crossbred and buffalo populations have grown, indicating farmers' inclination toward higher-yielding and profitable breeds. Overall, these trends highlight a structural transformation in livestock management driven by economic, environmental, and policy factors.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

Since this is a review article so, there is no use of animal procedures for experiments.

Conflict of interest

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