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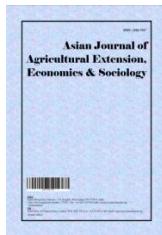
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Livestock Population Dynamics in Central India: A District-level Analysis of Madhya Pradesh and Chhattisgarh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In this study, we assessed the dynamics of district-level livestock population in two central states of India, viz. Madhya Pradesh and Chhattisgarh during the period 2012-19. The analytical tools comprised of simple descriptive statistics and fitting exponential trend equations. We found temporal variations in shares of different species to total district-wise livestock population. While population of cattle declined in Madhya Pradesh, the same registered a minor increase in Chhattisgarh. The reverse situation was observed in case of buffaloes. Dynamics of changes in small ruminant population pointed towards the increasing importance of goats as compared to sheep. Although, cattle is the livestock species on which the rural population mostly depend for their livelihood in both the states, economic dependence on sheep and pig is more in Chhattisgarh than Madhya Pradesh. Some policy suggestions have been given based on the findings of the study on leveraging the opportunities offered by livestock sector.

HIGHLIGHTS

- In the context of increasing population pressure and associated shrinking landholding size, diversification of agricultural activities becomes crucial.

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- The role of livestock, on account of more equitable distribution in favour of resource poor farmers, is important for sustainable livelihood security of farmers.
- For formulating appropriate policies for development of livestock sector, it is necessary to carry out disaggregated analyses to assess the district-level trends and dynamics of livestock population.

Keywords: *Chhattisgarh; growth; livestock; Madhya Pradesh; population; production.*

1. INTRODUCTION

With the relentless growth in human population, the number of holdings has increased progressively and as a consequence, the size of land holding in general has been shrinking steadily over the years, progressively making individual holdings unviable. Agricultural diversification has been considered as one of the major pillars for realizing the mandate of doubling farmers' income all throughout India. In this context, animal husbandry assumes significant importance as distribution of livestock is more equitable than that of land holding in the country. In fact in semi-arid and arid regions, among various livelihood options, livestock sector has emerged as one of the fastest-growing agricultural sub-sectors in India [1]. In fact the role of livestock in rural transformation in Indian context is well established in published literature [2-4].

Central India is agriculturally a frontline region in India, contributing significantly to the national food basket. Madhya Pradesh and Chhattisgarh states, in this region, are two most important states as agriculture contributes significant share to the state gross domestic product (SGDP). In fact the share (37%) of agriculture to SGDP in Madhya Pradesh is highest in the country. Even then, undulating topography, large proportion of waste lands, under developed irrigation potential, low ground water utilization, large proportion of rain-fed agriculture, moderate cropping intensity and high proportion of low value crops, are some of the constraints impeding agricultural sector in the two states. High proportion (29%) of landholdings being small (<2 ha) also has adverse implications for scaling up high-value crop production.

Livestock, on the other hand, plays important role for the rural households, in terms of not only providing food and livelihood security, but also acting as sources of insurance & investment and energy & power in agricultural operations. For formulating appropriate policies for development of livestock sector, it is necessary to assess the

trends and dynamics of livestock population in the two states. There have been earlier studies which have analyzed the trends in livestock population and production in specific states [5-9]. However, scant literature is available on the structural changes that have taken place in the two central states' livestock sector using the latest published official government data [10]. The present study aims to fill this gap and analyzes the district-level trends and dynamics in livestock population in the states of Madhya Pradesh and Chhattisgarh.

2. MATERIALS AND METHODS

2.1 Data

This study has assessed the changes in livestock population between the last inter-census period (2012-19) in the states of Madhya Pradesh and Chhattisgarh. Sources of data for this district-level study are Livestock Censuses [10,11], published by Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

2.2 Analytical Framework

Tabular and percentage analyses were carried out to ascertain the spatial, breeds/species-wise and temporal compositional changes in livestock population. The annual compound growth rates (ACGR) of population of different livestock breeds/species were estimated. Population data are available only for the Census years. As such, growth rates were calculated based on the inter-census period data and the same was used and extrapolated to generate continuous data. Exponential growth equation was fitted to compute the annual growth rates in livestock population.

3. RESULTS AND DISCUSSION

3.1 Trends in Livestock Population

Figs. 1 (panel a-e) and 2 (panel a-e) present the top ten districts in terms of highest population of

different species (as in 2019) and their corresponding annual compound growth rates during 2012-19, respectively, for Madhya Pradesh and Chhattisgarh. During the concerned period, a few districts in both the states were bifurcated. In this context, for maintaining comparability of figures on different parameters between the two points of time, the combined districts have been considered.

The total cattle and pig populations in the state of Madhya Pradesh have declined at the rate of -0.63 and -1.69 per cent per annum during 2012-19. The population of sheep increased marginally (0.38% per annum), while that of buffaloes and goats registered significant growth (2.74% and 4.11% per annum, respectively). In case of cattle, among the districts with high population, as in 2019, Rewa and Satna registered negative

growth rates, while the cattle population remained almost static in the districts of Sagar, Chhindwara and Singrauli. Rajgarh was the only district with negative growth rate per annum in case of buffalo population among the top-ten districts with highest buffalo population as per the latest census. In case of sheep, the top four districts (Shivpuri, Tikamgarh, Burhanpur and Rewa) with highest population registered negative or static growth during the last intercensus period. Chhattarpur and Datia were the districts with significantly high growth rates in sheep population during 2012-19. For goats, all the districts in the top-ten list registered significant and positive growth rates. Rewa, Sidhi, Satna and Dindori, were the districts among the top-ten list, in terms of highest pig population in 2019, which reported almost no or negative rates during the concerned period.

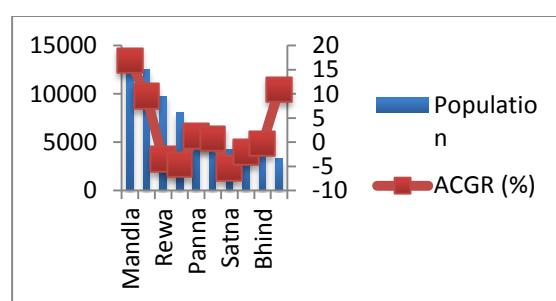
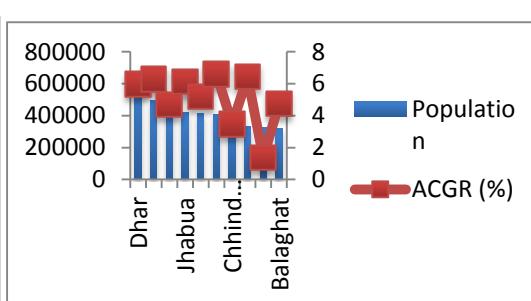
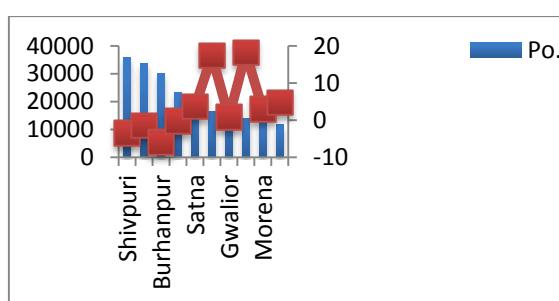
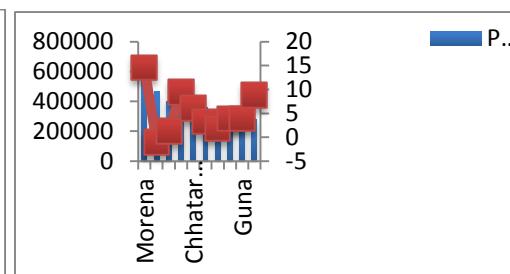
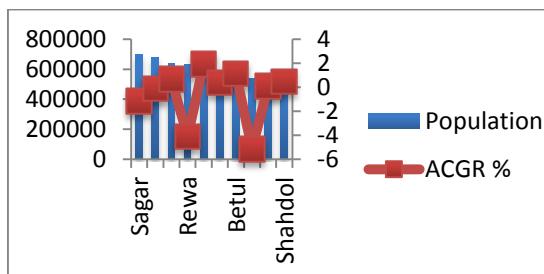


Fig. 1. Top 10 districts in Madhya Pradesh with highest species-wise livestock population in 2019 and their ACGR during 2012-19

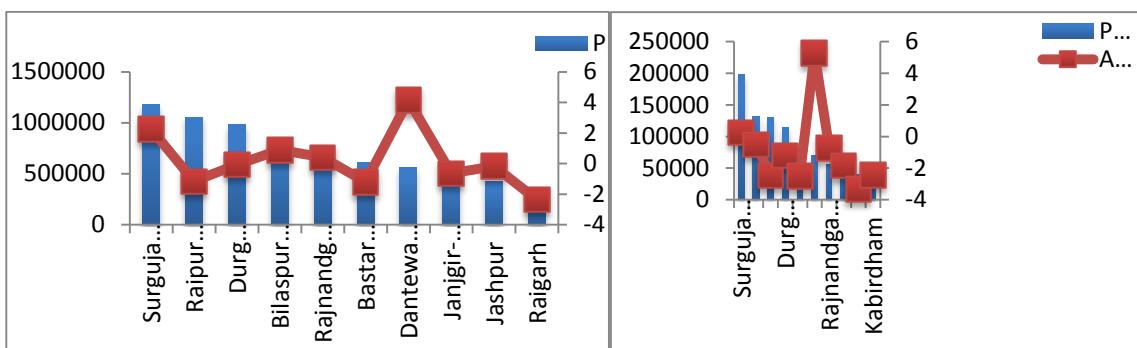


Fig. 2a. Cattle

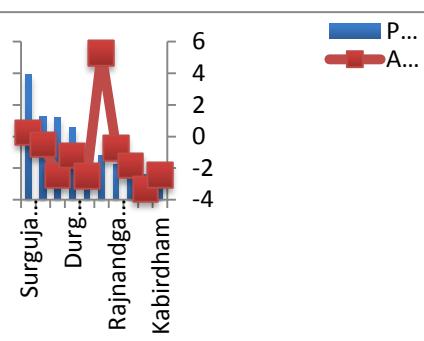


Fig. 2b. Buffalo

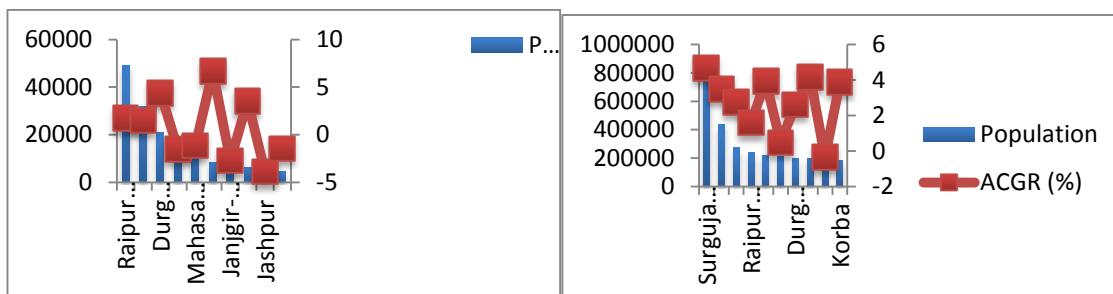


Fig. 2c. Sheep

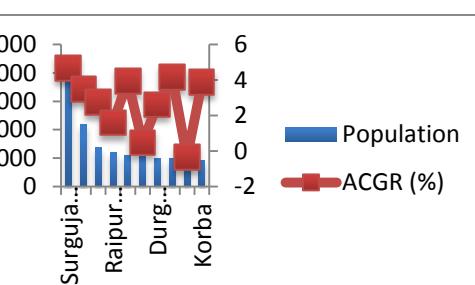


Fig. 2d. Goat

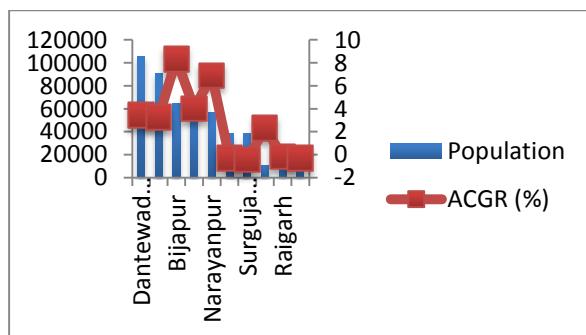


Fig. 2e. Pig

Fig. 2. Top 10 districts in Chhattisgarh with highest species-wise livestock population in 2019 and their ACGR during 2012-19

In Chhattisgarh, population of all livestock species increased during 2012-19, except buffaloes, whose population declined at a rate of 2 per cent per annum. Goat and pig population increased almost at the rate of 3 per cent per annum, each, during the same period. The population growth of cattle, however, was insignificant. In case of cattle, Dantewada registered the highest growth rates in population amongst the top-ten districts with highest population, as in 2019. On the other hand, Raipur, Bastar and Raigarh reported negative growth rate in cattle population during 2012-19. Dantewada, however, registered sharpest

decline in buffalo population during the last intercensus period among the districts with highest buffalo population, as in 2019. Other districts, from the top-ten list, with negative growth in buffalo population are Raipur, Durg, Bastar, Rajnandgaon and Kabirdham. Rajnandgaon, Durg and Surguja are the districts to register highest annual growth rate in sheep population during 2012-19, while Raigarh, Mahsamund, Bilaspur, Jangir-Champa, Jashpur and Bilaspur registered decline in sheep population during the same period. In case of goats almost all the districts in the top-ten list, in terms of population as in 2019, reported significant annual growth,

except Rajgarh (goat population remained static) and Bastar (reporting negative growth). Jashpur, Surguja, Rajgarh and Dhamtari are the districts with high pig population, where the pig population declined or almost remained static during 2012-19.

3.2 Category-wise Percentage Change in Livestock Population

Fig. 3 presents the sex and age-wise population of different livestock species in the two states considered in this study.

Madhya Pradesh, in case of adult indigenous male cattle, registered negative percentage change during 2012-19. This probably points towards declining demand for adult male indigenous cattle for draft purpose on account of increasing mechanization in agriculture. In Chhattisgarh, however, the opposite phenomenon was observed, as adult indigenous male cattle increased substantially during the same period. This might be due to the relatively lesser degree of mechanization of agricultural operations. Adult indigenous milch animals, on the other hand, increased in both the states, implying the preference for indigenous cows for

milch purpose. Young male stock declined in both districts, implying a negative replacement rate. Young female stock, on the other hand, increased in both the districts.

Crossbred cattle population of all sex and age group-wise categories increased during 2012-19 in Madhya Pradesh. In Chhattisgarh, however, adult male and young male populations declined, implying again their negative replacement rate and that crossbred young male cattle are mainly slaughtered for their meat. The percentage increase in crossbred adult milch cattle during the 2012-19 has been significantly higher as compared to that of indigenous milch cattle in both the states, implying shift in preference for crossbred cattle for milk purpose. The increase in crossbred milch cattle population is consistent with their higher productivity as compared to the indigenous cattle. It has been reported that in the developing country context, accelerated productivity growth in livestock activities brings about higher returns to land and similar returns to labour [12] which explains the shifting preference in favour of crossbred animals on account of higher yield potential.

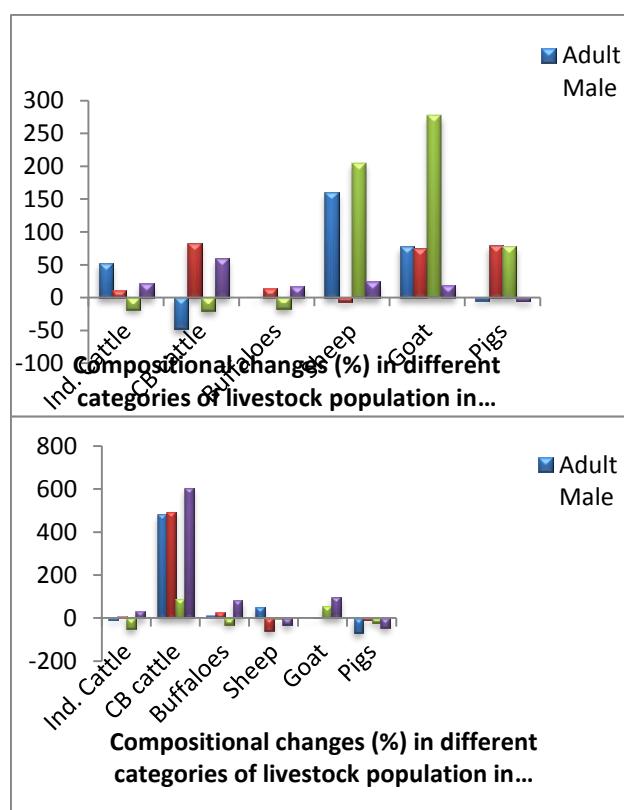


Fig. 3. Percentage changes in different categories of livestock population in Madhya Pradesh and Chhattisgarh

Population of young male buffalo stock declined during the concerned period in both the states. Cattle slaughter for meat (beef) purpose is banned in many states of India. As such, buffalo is the major source of bovine meat, i.e. carabeef, as slaughter of buffaloes in India is not banned. The decline in young male buffalo cattle population, most probably implies increasing trends in their slaughter to cater to the international market. Similar observations were reported by FICCI [13] and Bardhan et al. [14]. Adult milch buffalo and young female buffalo population increased in both the states during the last inter-census period.

In case of sheep adult female population declined in both the states, while the adult male population increased, implying that adult female sheep are mostly preferred for slaughtering. Goat population increased across all category-wise. This trend in goat population points towards the increasing demand for goat meat in the region. In recent past role of commercial goat farming as profitable enterprises has been highlighted [15]. However, constraints in upscaling goat farming exist in terms of lack of market infrastructure, selling of animals at market and matching irregular demand and supply were [16,17].

District-wise data in regard to category-wise changes in population of different livestock species in Madhya Pradesh and Chhattisgarh revealed that in Madhya Pradesh, adult male buffalo (> 2 years) population declined in nearly half of all the districts in the state. Young buffalo (< 2 years) population decreased in almost all the districts. The decline in young male buffalo population probably points towards the increasing trends towards their slaughter for meat purpose, on account of rising demand. Almost all the districts in the state reported a positive change in population of female buffalo calves, young female buffaloes and in-milk female buffaloes, pointing towards increasing demand for buffaloes for milch purpose. Young and adult male crossbred cattle population declined in almost 50 per cent of all districts in Madhya Pradesh. On the other hand, female crossbred cattle calves and young & in-milk crossbred cattle population increased in almost all the districts. Indigenous young and adult male cattle population declined during the period in vast majority of the districts. In more than 30 per cent of the districts in the state, adult female in-milk indigenous cattle population declined. The percentage increase in population in this category, in the states which registered positive

growth, was significantly lower than the same for in-milk female crossbred cattle. The above trends regarding male population imply the declining importance of male population for draft purpose on account of increasing mechanization. The trends in female population, across the breeds/species, on the other hand suggest shift in preference from indigenous cattle to crossbred cattle and buffaloes for milch purpose.

In Chhattisgarh, practically all the districts registered negative growth in young and adult male buffalo population. Adult in-milk female buffalo population also decreased in majority of the districts. On the other hand female crossbred cattle population, across all categories, increased in practically all the districts in the state. In case of indigenous cattle population, while female calves and young female population increased in all the districts, the same for adult in-milk indigenous cattle population increased in half of the total number of districts in the state. The above trends indicate that even though there are definite trends in shift in preference for milch purpose in favour of crossbred cattle, the importance of indigenous female stock for the same purpose is relatively higher in this state than the same for Madhya Pradesh.

3.3 Share of Different Species to Total District-wise Livestock Population

Figs. 4 and 5 present the top-ten districts in Madhya Pradesh and Chhattisgarh, respectively, in terms of shares of different livestock species to total livestock population in the respective districts.

As in 2019, cattle accounts for the highest share (46%) of livestock population in the state of Madhya Pradesh, followed by goats (27%) and buffaloes (25%). Sheep and pigs have negligible share in the state's livestock population. While this share declined for cattle during 2012-19, the same has increased for goats and buffaloes during the same period. For sheep and pigs, this share has remained almost static during the above period. Cattle is, by a fair margin, the most prominent species in the districts of Dindori, Anuppur, Mandla and Umaria, as in 2019. The shares in these districts have not changed significantly during 2012-19. The share of buffaloes in total livestock population is highest in the district of Morena, followed by Bhind, Rajgarh and Datia. The shares in all these three districts, have increased since 2012, the most significant increase having taken place in Morena. Goat is

the major species in the districts of Alirajpur, Barwani and Jhabua, as in 2019, with the share of goats increasing significantly in all the three districts, significantly, since 2012. Sheep and pig account meagre shares of total livestock population in almost all the districts. Only in the

states of Burhanpur and Mandla, sheep and pig population contributed any substantial shares, respectively. The shares of these two species in the total livestock population have declined during 2012-19 in, practically, all the districts.

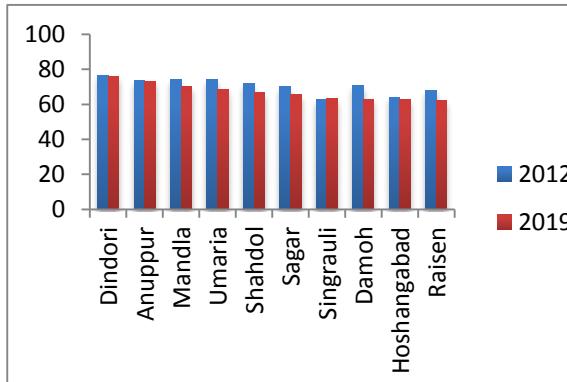


Fig. 4a. Cattle

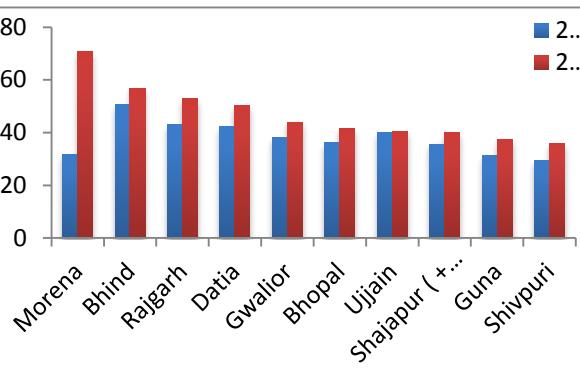


Fig. 4b. Buffalo

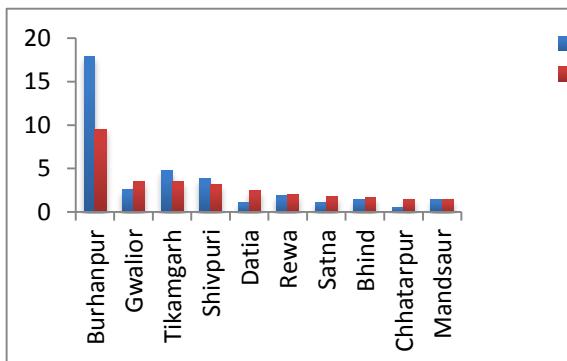


Fig. 4c. Sheep

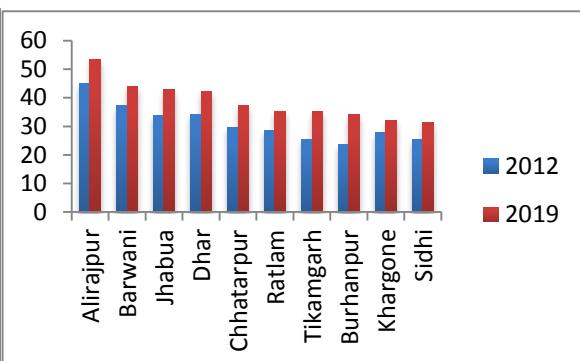


Fig. 4d. Goat

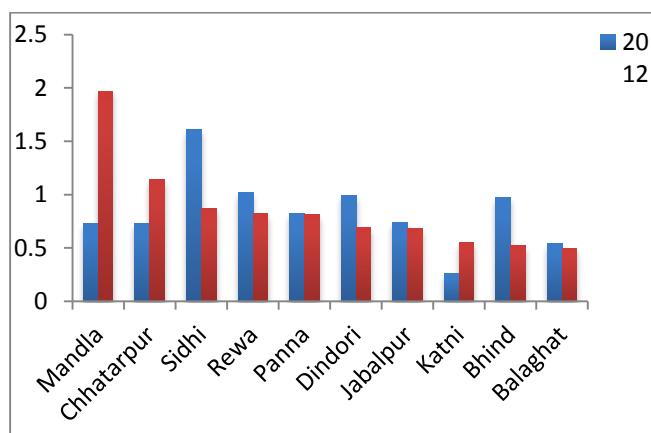


Fig. 4e. Pig

Fig. 4. Top 10 districts in terms of species-wise shares to total district-wise livestock population in Madhya Pradesh

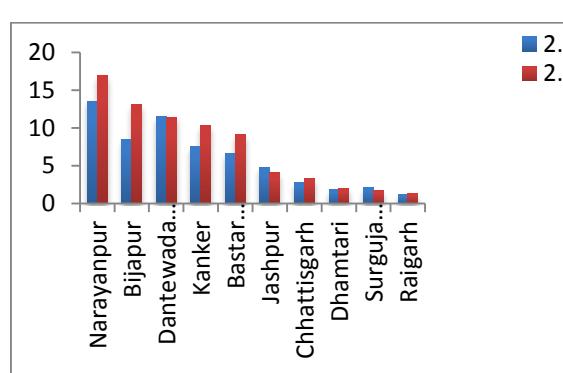
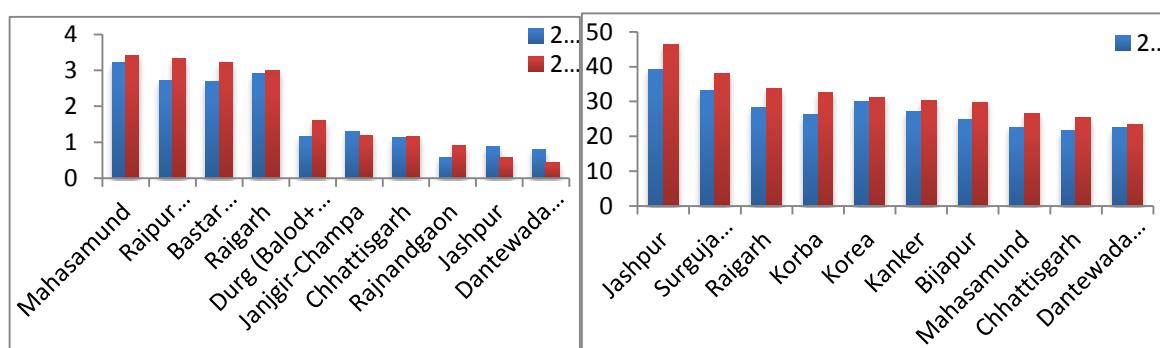
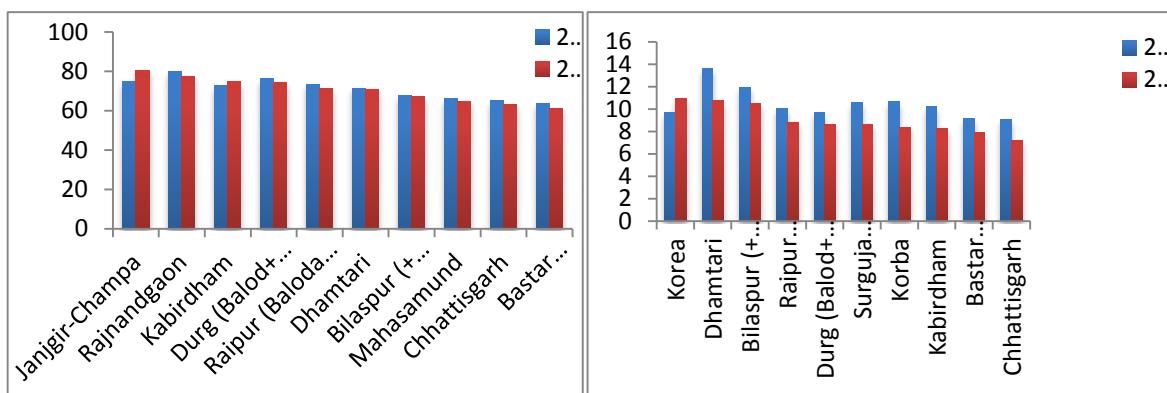


Fig. 5e. Pig

Fig. 5. Top 10 districts in terms of species-wise shares to total district-wise livestock population in Chhattisgarh

In Chhattisgarh, as in Madhya Pradesh, cattle is the most prominent species with a share of 63 per cent to total population, as in 2019. Goat ranks second with a share of 25 per cent, followed by buffaloes (7%). Shares of sheep (1%) and pigs (3%), although meagre, are however higher than the same for Madhya Pradesh. Share of cattle, across all species, is the highest in all the districts, the most prominent districts in this regard being Jangir-Champa,

Rajnandgaon and Raipur. Buffalo is the most prominent, amongst all districts, in Bilaspur, Dhamtari and Korea. However, this share has declined in these districts during 2012-19, with the exception of Korea. Share of goats in highest in Jashpur, followed by Surguja, Raigarh and Korba. Pig is the most dominant species, amongst all districts, in Narayanpur district, followed by Bijapur, Dantewada and Kanker. Share of pig, in almost all major districts in terms

of pig population, has increased during the last inter-census period. On the other hand, share of sheep to total livestock population, in all the districts, has remained static during the same period.

3.4 Share of Different Districts to States' Total Species-wise Livestock Population

Figs. 6 and 7 present the shares of top ranked districts in terms of their shares to total population for different livestock species for Madhya Pradesh and Chhattisgarh, respectively.

In Madhya Pradesh, which is a large state with 50 districts, not much significant variations were observed in the shares of different districts to the state's total population for most species. In case of cattle, Sagar, Chhindwara, Dhar, Khargone and Balaghat accounted for larger shares of the state's cattle population. Greater shares of the state's buffalo population, on the other hand, are in the districts of Morena, Rajgarh, Shivpuri and

Bhind. Highest share of the state's sheep population, by a far margin, is accounted for by the district of Shivpuri, followed by Burhanpur and Satna. Dhar, Alirajpur, Barwani and Jhabua accounted for higher shares of the state's goat population. Mandla and Chhatarpur are the two districts which have the highest shares of pig population in the state.

In Chhattisgarh, the highest shares of total cattle population of the state are accounted for by the districts of Surguja, Raipur and Durg. Surguja, is also the district with the highest share in the state's buffalo population, followed by Bilaspur, Raipur and Durg. The overwhelming share of Chhattisgarh's sheep population is accounted for by the district of Raipur, followed distantly by Bastar, Durg and Narayanpur. Surguja district also has the highest share in the state's goat population, followed distantly by Jashpur. In case of pigs, the prominent districts, in terms of their shares in the state's total population, are Dantewada, Bastar and Bijapur.

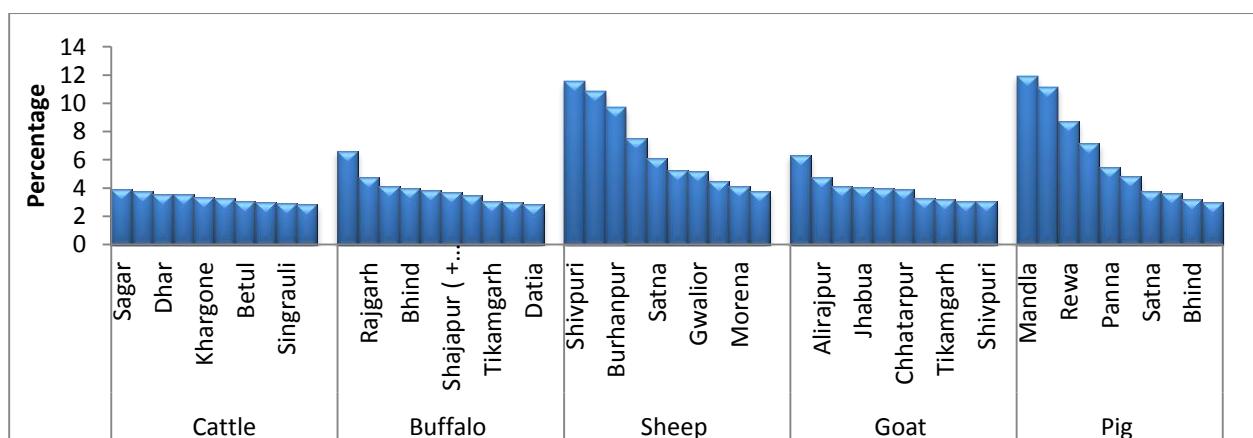


Fig. 6. Share of top 10 districts to state's total species-wise livestock population in Madhya Pradesh

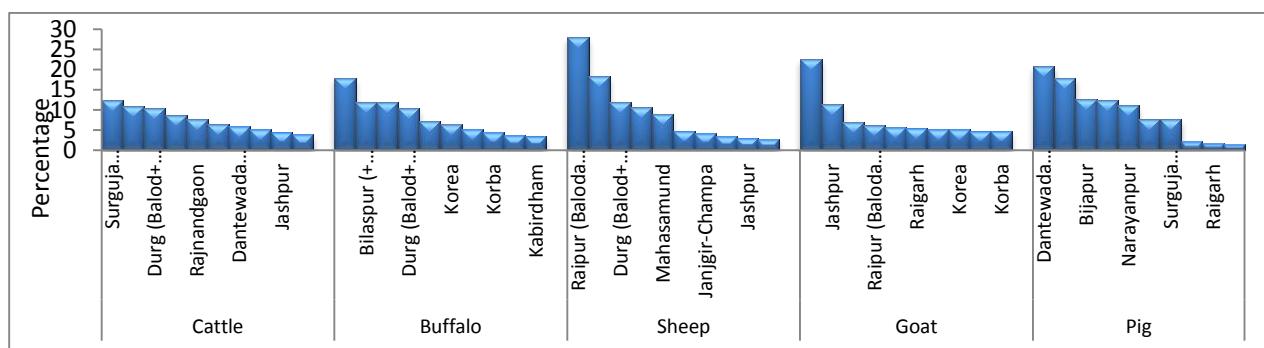


Fig. 7. Share of top 10 districts to state's total species-wise livestock population in Chhattisgarh

3.5 Livestock Density

Figs. 8 and 9 elicit the district-wise population density per 1000 rural population for different species for the year 2019 for Madhya Pradesh and Chhattisgarh, respectively. Livestock population per 1000 rural population gives some indication towards economic dependence of rural people on the particular livestock species. In Madhya Pradesh, the density of cattle is highest amongst all species, followed by goats and buffaloes. In comparison, the densities of sheep and pigs are insignificant. In case of cattle, the highest density is observed in the districts of Anuppur and Dindori. This implies the economic importance of this species in these districts. In terms of buffalo population density per 1000 rural population, Morena, Datia and Rajgarh are the two top ranked districts, pointing towards the rural people's high dependence on this species for their livelihood. The goat population density is highest in Alirajpur district, by a significant margin, followed distantly by Jhabua. Among all

districts, economic dependence on sheep is the highest in Burhanpur district. Density of pig is the lowest across all species; the highest density being in the district of Mandla.

In Chhattisgarh, as in Madhya Pradesh, the density per 1000 rural people is highest for cattle, followed distantly by goats and buffaloes. However, in case of pigs, the density in Chhattisgarh is significantly higher than that in Madhya Pradesh. Narayanpur, Dantewada and Bijapur are the top-ranked districts in terms of cattle density. Korea and Narayanpur districts have the highest buffalo densities. Economic dependence, in terms of density per 1000 rural population, on goats is highest in Narayanpur district, followed by Bijapur and Jashpur. Narayanpur has the highest density per 1000 rural population for pigs, by a significant margin, followed by Bijapur. It is thus evident, that the economic dependence on practically all livestock species is highest in the district of Narayanpur [18].

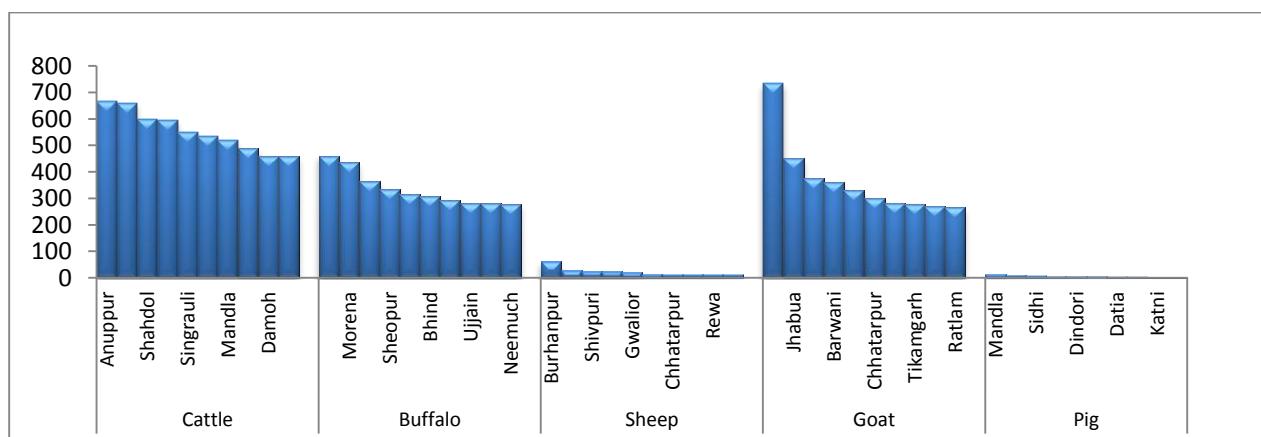


Fig. 8. Livestock density per 1000 rural population in Madhya Pradesh

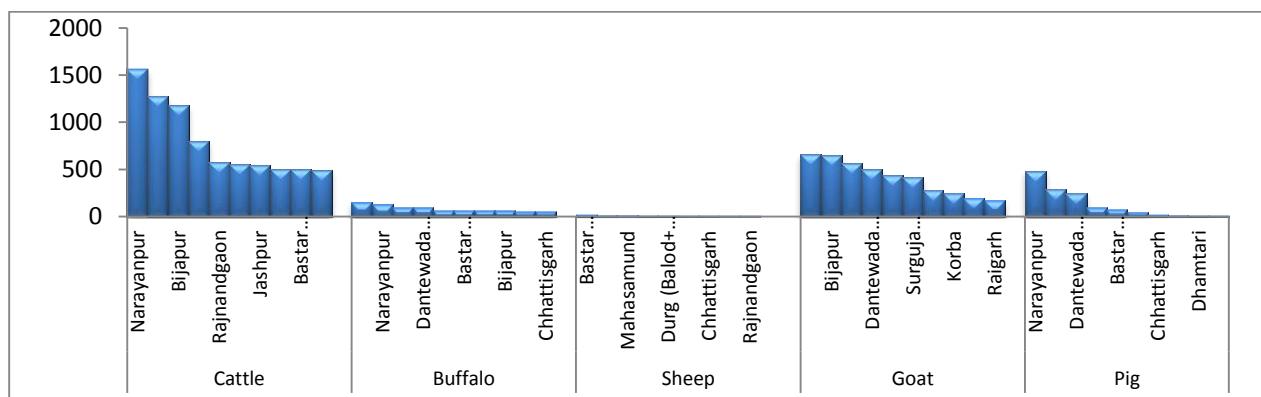


Fig. 9. Livestock density per 1000 rural population in Chhattisgarh

4. CONCLUSION

The study has assessed the district-wise dynamics of livestock population in two central states of India, viz. Madhya Pradesh and Chhattisgarh during 2012-19. Widespread disparities were observed in the distribution of different livestock species across various districts. While population of cattle declined in Madhya Pradesh, the same registered a minor increase in Chhattisgarh. The reverse situation was observed in case of buffaloes. Dynamics of changes in small ruminant population pointed towards the increasing importance of goats as compared to sheep. Although, cattle is the livestock species on which the rural population mostly depend for their livelihood in both the states, economic dependence on sheep and pig is more in Chhattisgarh than Madhya Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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