Livestock population dynamics in Banni grasslands of Gujarat

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Received: 14 August 2018; Accepted: 13 September 2018

ABSTRACT

Banni grasslands in Gujarat are home to migratory pastoralists (Maldharis) for more than 500 years. Maldharis are landless and dependent on livestock for their livelihood. The study was conducted to measure the long-term growth and instability of different livestock species in Banni grasslands from 1977 to 2012. Pastoralists (280) were personally interviewed during 2015 to 2017 to prioritize the factors affecting trends in livestock population using Garrett ranking technique. The Compound Annual Growth Rate (CAGR) in population was highest for Banni buffaloes (5.89%) followed by Kankrej cattle (1.78%) and it was negative for goat (-0.28%) and sheep (-0.29%) population. Cuddy Della Valle Instability Index was very high for goat (89%) and sheep population (78%) whereas it was low for buffaloes (31%) and cattle (23%). The severity and duration of drought significantly affected the decline in population of goat and sheep. However, the shift in population of buffaloes and cattle was affected by complex of technological and policy factors. Decline in demand of Kankrej bullocks for agriculture use, low milk productivity of cows, and detrimental impact of regular feeding on Prosopis juliflora pods (weakening and dislocation of jaws and gradual death of cows) led to significant increase in population of Banni buffaloes when compared to Kankrej cattle. The population growth rate of Banni buffaloes (457%) was six times higher than the Kankrej cows (70%) from 1977 to 2012. This trend is most likely to continue in the following years as the migratory pastoralism is being gradually replaced by semi-migratory and sedentary pastoralism and establishment of organized dairy industry. Establishment of dairy units/Milk Collection Centres and improved road connectivity of villages in Banni have further facilitated in promotion of Banni buffalo based pastoralism as the primary source of livelihood. Composition of different livestock species in 2012 (Buffaloes: 72%, Cattle: 16%, Goat: 7% and Sheep: 6%) indicated the dominance of Banni buffalo both in terms of number and contribution to livelihood of pastoralists and overall economy of Banni grasslands.

Key words: Banni buffalo, Banni grassland, Kankrej cattle, Livestock, Maldharis

Banni grassland in Bhuj taluka in Kachchh district of Gujarat is spread in about 2600 km² area and is the largest natural tropical grassland in Indian subcontinent (Banni 2018, Ramble 2018). Banni region experiences arid climate with an average annual rainfall of 317 mm received by southwest monsoon between June–September. Recurrent droughts are a common phenomenon in Banni and Kachchh region. Maldhari is a collective term for the livestock-dependent social groups of Gujarat and pastoralism is especially prevalent in the district of Kutch (Tambs-Lythe 1997). Banni grassland is home to migratory pastoralists (known as Maldharis) for more than 500 years. Hence, Maldharis do not have either individual/private land ownership rights or (legally sanctioned) community grazing rights over Banni grasslands. High salinity, low permeability, poor organic matter and poor soil moisture regime also make soil in Banni grasslands less suitable for agriculture (Geevan et al. 2003). The invasion of Prosopis juliflora and ingression of salinity are other rising problems of the region, where Maldharis are residing in the region without occupancy right (Chaudhary and Singh 2013). Since the 1950s, the Banni has experienced major changes that have largely degraded the quantity, composition and productive potential of its plant populations, having serious repercussions on livestock production.

Banni area comprises 48 hamlets/villages organized into 19 Panchayats with a population of 21,338 people in 2011–12 (Directorate of Animal Husbandry 2016). The nomadic pastoralist communities are generally known as Maldharis comprising 22 ethnic communities. Maldhari panchayats have united at a regional level as the Banni Panchayat Parishad, which is the regional body addressing various issues concerned with Banni grasslands and Maldharis. Banni Pashu Uchherak Maldhari Sangathan (Banni Breeders’ Association), formed in 2008 is a registered
society which is also working to address various socio-economic and livelihood issues of Maldharis in Banni area such as conservation and improvement of grasslands and native livestock breeds, recognition of community grazing and land use rights over Banni region, developing organized dairy market in the region and other issues (The Biocultural Community Protocol of Maldharis of Banni 2010). Maldharis are landless, and migratory pastoralism is the main source of livelihood. They are dependent on gauchars (village commons) for their livestock rearing. Banni buffaloes, Kankrej cows, Pathanwadi and Duma/Marwari sheep, Kachchhi goat, Kachchhi and Tari camel and Sindhi horse are the domesticated animals. Banni buffalo was recognized as the distinct buffalo breed of the country in 2010 (NBAGR 2018). Livestock constitute as the predominant source of employment and income for Maldharis in Banni grasslands even to this date. In this context, it was of immense importance to explore the nature and extent of different livestock species in Banni grasslands over a period of time. The specific objectives of this research paper were to measure the long-term growth and instability trends in livestock population in Banni grasslands and delineate the factors behind such a growth and instability.

MATERIALS AND METHODS

The study was conducted in Banni grasslands in Bhuj taluka of Gujarat’s Kachchh district using both primary and secondary data. The secondary data on population of different livestock species in Banni grasslands from 1977 to 2012 were collected from different sources (Vijay Kumar et al. 2011, Directorate of Animal Husbandry 2016, MoA 2012). The data on livestock population as per 19th Livestock Census 2012 (MoA 2012) was available in published form for district level. Livestock data (census 2012) pertaining to 48 villages under Banni grassland was personally collected by the researchers from the office of the Animal Husbandry Department in Bhuj specifically for this study. This data was not in any published form. The Compound Annual Growth Rate (CAGR) method was used to measure the population growth rate of various livestock species. It gives year-over-year growth rate of a variable under study (population) over a specified period of time. The CAGR is calculated by taking the n th root of the total percentage growth rate, where n is the number of years in the period being considered. It was calculated using the following formula:

\[
CAGR (t_0, t_n) = \left( \frac{V(t_n)}{V(t_0)} \right)^{\frac{1}{n}} - 1
\]

where, \( V(t_0) \), Start value (value at the beginning of the year); \( V(t_n) \), Finish value (value at the end of the year); and \( t_n - t_0 \), Number of years.

The Cuddy-Della Valle Instability Index (Cuddy and Della Valle 1978) was used to measure the instability in population growth of different livestock species in Banni grasslands using the following formula:

\[
CD = CV(1-R^2)^{0.5}
\]

where CD, Cuddy-Della Valle Instability Index; CV, Coefficient of Variation in population (%); and \( R^2 \), Coefficient of Determination adjusted for number of degrees of freedom obtained from trend regression in equation.

The exhaustive list of factors affecting changes in livestock population and composition was prepared based on extensive review of literature and discussion with key pastoralists, experts and stakeholders during a pilot study conducted in January 2015. The primary data was collected from 280 pastoralist households (sample size) from 12 villages in Banni grasslands (Dhordo, Hodko, Patag, Uddo, Varli, Sadai, Burkhal, Mehar Aliwand, Madhavnagar, Udai, Sargu Nava and Bhirandiyara) between January 2015 and June 2017 by personal interview method using a structured interview schedule. An ex-post facto and survey research design was adopted for the study. Respondents were asked to rank various factors affecting the change in population of different livestock species using Garrett ranking technique. The outcome of such ranking was converted into score value with the help of the following formula:

\[
\text{Per cent position} = \frac{100(R_{ij} - 0.5)}{N_j}
\]

where \( R_{ij} \), Rank given for the \( i^{\text{th}} \) variable by \( j^{\text{th}} \) respondent; and \( N_j \), Number of variables ranked by \( j^{\text{th}} \) respondent. In the study \( N_j = 5 \).

With the help of Garrett’s table, the % position estimated is converted into scores. For each factor, the scores of each individual are added and total value of scores and mean values of score is calculated. The factor having highest mean value is considered most important.

Focussed group discussions were held with other stakeholders such as representatives of Banni region, researchers/academicians and NGOs/CSOs working in Banni grasslands to validate the primary data. The published secondary sources were also used to supplement the primary data.

RESULTS AND DISCUSSION

Growth and instability in population of different livestock species in Banni area: It is estimated that there were approximately 50,000 Kankrej cattle in Banni grasslands in late 1960’s. It could be seen that population of all livestock species has seen a great decline in the period between 1982 and 1992 (Table 1). This was mainly attributed to severe and consecutive droughts experienced by the region in this period as there were severe and very severe droughts (<50% of average rainfall) during 1982, 1985, 1986, 1987 and 1991 and mild and moderate droughts (50–75% of average rainfall) during 1984 and 1990 (Vijay Kumar et al. 2011). The decline in population was severe in case of sheep and goat due to large scale deaths, out migration and distress sale to cope with severe and successive droughts. The decline in cattle population was higher than the buffaloes. Other than this period, the
The instability in population growth was highest for goat (89%) and sheep (78%) indicating that their numbers varied drastically depending on absence or presence of drought and its severity. Goat and sheep herders either sold these animals or migrated outside the region during severe droughts. Around 400 camels were reported to be present in Banni grasslands in 2007 but their population has marginally declined during this period (Table 2).

In good rainfall years, it has been estimated that over 20,000 small ruminants, principally sheep, are brought into this region from Rajasthan to graze. During four consecutive years of regional drought, from 1986–89, large numbers of cattle and migrating small ruminants virtually eliminated many of the scattered pockets of vegetation that remained in Banni. However, the prolonged length of the drought finally resulted in massive livestock die-offs and a general out-migration of cattle during that period often to South Gujarat covering distances up to 800 km (Bharara 1987; Bharara 1993). Rathore (1993) in his study on livestock population dynamics between 1951 and 1988 in Rajasthan reported that intensity of droughts was the factor that influenced the differential growth rates of various types of ruminants. As seen in the study, even at the national level, the number of cattle and buffaloes has increased from 77.04 million to 80.52 million between 2007 and 2012 showing a growth of 4.51%. There is a decline in the population of sheep and goat by 9.07% and 3.82% respectively (MoA 2012).

The instability in population growth was highest for goat (89%) and sheep (78%) indicating that their numbers varied drastically depending on absence or presence of drought and its severity. Goat and sheep herders either sold these animals or migrated outside the region during severe droughts. Around 400 camels were reported to be present in Banni grasslands in 2007 but their population has marginally declined after this period. In 2012, around 950 horses were reported in the region. The Human:Livestock population ratio in Banni grasslands in 2012 was 2.73 indicating that there were approximately three livestock heads for every human being.

The livestock population in Banni grasslands as per 2011–12 household survey data (Directorate of Animal Husbandry 2016): Buffaloes (48,982) constituted 72% of livestock population in Banni grasslands followed by cattle (10681) at 16%. The goat (4746) and sheep (4022) together contributed 13% of livestock population. Further, buffaloes constituted 82% among major ruminants (buffaloes and cattle). Shah et al. (2010) in their study conducted in three villages in Bhitara panchayat in Banni grassland reported that population of buffaloes, cattle, goat and sheep ranged from 77–82%, 10–21%, 3–7% and 0–1%, respectively.

Breeding of Kankrej bullocks for draught purpose was the traditional occupation of Maldharis until 1970’s. They bred and sold these animals to farmers in Gujarat and other parts of the country. Until 1970’s, Banni buffaloes were domesticated mainly for meeting household requirements of milk and milk products. However, since late 1970’s there has been a gradual shift in livestock population in favour of Banni buffaloes over Kankrej cows. It was evident from table 2 that the growth rate of Banni buffalo (457%) between 1977 and 2012 was more than six times the Kankrej cattle (70%).

Change in vegetation pattern, especially invasion of Prosopis juliflora is unanimously attributed by pastoralists as one of the main reasons for this occupational shift. Feeding on P. juliflora pods (containing hard seeds) over a period of time leads to weakening and dislocation of jaws in cows gradually leading to their death. Pastoralists expressed that Banni buffaloes do not prefer to feed on P. juliflora pods whereas cows prefer them. Even when buffaloes feed on P. juliflora pods, they are less susceptible to its ill effects compared to cows.

Forest department introduced P. juliflora in 1960–61 on 31,500 ha to stop the advancement of Rann. However, P. juliflora soon spread throughout Kachchh via the ingestion of its fruit (pod) by cattle, and the distribution of its scarified seed in faeces (Shukla et al. 1984). P. juliflora occupied 33% of Banni in 2009 and would cover 57% area by 2020 (SAC 2002). Rapid expansion of P. juliflora resulted in loss of natural habitats, degradation of natural resources and significant loss of native biodiversity (Shah et al. 2010; Deepa 2009).

Mechanization of agriculture in Kachchh and other parts of Gujarat has led to reduction in use of bullocks for draught purpose. Consequently, the demand for Kankrej bullocks has also reduced drastically. Establishment of milk

### Table 1. Absolute change in population of livestock species in Banni grasslands (1977–2012)

| Species | 1977 | 1982 | 1992 | 2007 | 2012 |
|---------|------|------|------|------|------|
| Buffalo | 8789 | 21957 | 16776 | 27262 | 48982 |
| Cattle  | 6295 | 9640 | 6065 | 11006 | 10681 |
| Goat    | 5173 | 3726 | 1006 | 12537 | 4746  |
| Sheep   | 4379 | 12791| 1399 | 5892 | 4022  |

### Table 2. Growth rate and instability in population of livestock species in Banni grasslands (1977–2012)

| Species | % Growth | CAGR | CDV Instability Index |
|---------|----------|------|-----------------------|
|         | 1977–1982| 1982–1992| 1992–2007| 2007–2012| 1977–2012|
| Buffalo | 149.82 | −23.60 | 64.68 | 77.30 | 457.31 | 5.89 | 31.29 |
| Cattle  | 53.14 | −37.09 | 81.47 | −2.95 | 69.67 | 1.78 | 22.87 |
| Goat    | −27.97 | −73.00 | 1146.22 | −62.14 | −8.25 | −0.29 | 89.48 |
| Sheep   | 192.10 | −89.06 | 321.16 | −31.74 | −8.15 | −0.28 | 77.67 |
collection centres/dairy units in the region has played a vital role in growth and development of Banni buffalo based dairy enterprise. The productivity of Banni buffaloes (more milk with high fat content) is higher and hence they are more preferred over cows. Hence, number of Banni buffaloes has increased drastically since 1980’s when compared to Kankrej cows (Table 3). Improved road connectivity of villages in Banni area to Bhuj city and other towns and supply of Narmada canal water for drinking purpose have further acted as facilitating factors. These push and pull factors have led to a shift in occupational structure of pastoralists in Banni region. These factors have together contributed in development of organized dairy industry in Banni area. The frequency and duration of migration has also reduced resulting in gradual sedentarization of pastoralists. Sedentarization of pastoralists is now widespread, both because of active government policies and because of lack of support for migratory pastoralism (Sharma et al. 2003). Presently, rearing of Banni buffaloes for production and sale of milk and milk products is more predominant economic activity in the region.

Table 3. Factors that affected shift in population from Kankrej cattle to Banni buffaloes (n=280)

| Factor | Mean Score | Rank |
|--------|------------|------|
| Decline in demand of Kankrej bullocks for agriculture purpose | 89.11 | I |
| Invasion of *Prosopis juliflora* in Banni grasslands | 81.23 | II |
| Milk productivity of Banni buffaloes is higher than Kankrej cattle | 71.54 | III |
| Establishment of dairy units/Milk collection centres in Banni area | 63.89 | IV |
| Policy interventions in favour of developing organized dairy industry (Better road connectivity, establishment of grass depots, etc.) | 62.76 | V |

It is evident from tables 1 and 2 that population of goat and sheep between 1977 and 2012 has decreased marginally. There was a consensus among the pastoralists and other stakeholders that the main factor behind differential growth of goat and sheep was severity of drought and its duration. Gradual sedentarization of pastoralists has also contributed to decline in number of migratory pastoralists owning small ruminants. Studies by Rathore (1993) and Casimir (1996) also support these findings. Sheep and goat rearing was a primary occupation for only 3% households at present in Banni grasslands.

The Kankrej cattle are basically dual purpose (milch and draft) breed. However, the use of bullocks of this breed in agriculture has reduced drastically due to mechanization. Hence, domestication of Kankrej breed only for milk production is less economical when compared to Banni buffalo as evident in Table 4. The characteristics of Banni buffalo as milch animal such as age at first calving, calving interval, lactation yield, lactation length and fat content in milk are superior to Kankrej cattle (NBAGR 2018).

The significance of *Banni* buffaloes in livelihood of pastoralists in particular and the economy of Banni region in general become much more profound when it is noted that *Banni* buffaloes constituted 82% among major ruminants. *Banni* buffalo based pastoralism and *P. juliflora* based charcoal preparation were the major primary occupations for 70 and 20% households respectively at present. Further, charcoal preparation was the predominant secondary occupation for 60% households. Banni buffalo based pastoralism was found to be the most sustainable livelihood option in *Banni* grasslands from ecological, economic and socio-cultural parameters. Goat and sheep rearing was found to be more sustainable in the long run than charcoal production. It is to be noted that goat and sheep rearing is the primary occupation for only 3% households at present whereas charcoal preparation employs 20% households (Manjunatha 2015). Management of *P. juliflora* and rejuvenation of native grasses and shrubs is critical both for the sustainability of livelihoods and grassland ecosystem.

The pre-existing pasture rights of Maldharis over *Banni* grasslands have to be recognized. Granting Community Rights to Maldharis over *Banni* would help them to develop village level plan for conservation, development and management of grassland to enhance their livestock based livelihood. The management of *Banni* grassland as a Protected Forest needs to be amended transferring it into a joint management framework involving pastoral communities and Forest Department (Geevan, Dixit and Silori 2003; The Biocultural Community Protocol of Maldharis of *Banni* 2010; Joshi et al. 2015). Maldharis’ demand for community grazing rights over *Banni* grasslands is approved in-principle by the government but requires speedy implementation.

The study found that population growth rate between 1977 and 2012 was 457% for Banni buffaloes, 70% for Kankrej cattle and negative for sheep and goat (–8%). The population of goat and sheep was more sensitive to severity and duration of drought. Since late 1970’s, there was a gradual shift in population in favour of Banni buffaloes over Kankrej cattle. Decrease in demand of Kankrej bullocks...
livelihood of pastoralists. Scientific management of buffalo both in terms of number and contribution to Goat: 7% and Sheep: 6%) indicated the dominance of Banni livestock species in 2012 (Buffaloes: 72%, Cattle: 16%, Goat: 7% and Sheep: 6%) indicated the dominance of Banni buffalo both in terms of number and contribution to livelihood of pastoralists. Scientific management of P. juliflora is required to improve the livelihoods and ecological sustainability of grassland.

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