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Research article

Historical changes affecting pastoralism in *Banni* grasslands and contemporary priorities of the pastoralists

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Abstract

Pastoralism in *Banni* grasslands has evolved and adapted to significant ecological, geo-political, socio-economic and policy changes. This article critically examined the historical changes affecting pastoralism in *Banni* grasslands and identified the contemporary priorities of pastoralists concerning their livelihood. A socio-economic investigation was undertaken in *Banni* grasslands from 2014 to 2019 using primary, secondary and historical data. Traditionally, the pastoralists of *Banni*, mainly represented by the *Maldhari* community, have been amongst the finest cattle breeders and suppliers of the superior Kankrej bullocks for draught purposes in the region. The designation of *Banni* as a Protected Forest (1955) and the planting of *Prosopis juliflora* (1960s) by the Forest Department of Gujarat State are significant milestones in *Banni* after India's independence. Pastoralists perceived that their livelihood is mainly constrained by successive and severe droughts, rapid invasion of *P. juliflora*, lack of access to dairy cooperatives, overgrazing and overall degradation in that order of severity. However, the community adapted to these ecological and policy changes by gradually replacing pastoralism with semi-migratory and sedentary animal husbandry/ dairy enterprise. Since the production potential of *Banni* grasslands has decreased, the cost of livestock rearing has increased as purchases from the market are compensating for the fodder shortage. Further, pastoralist households have diversified their livelihoods through charcoal production (20% of households), handicrafts (3%), services (2%) and tourism/ trade (2%). Still, >93% of households in *Banni* are engaged in pastoralism/ dairy enterprise contributing 82% to the economy of the grasslands. Granting of community rights for use, conservation and management of *Banni;* increasing the carrying capacity of the grasslands; management of droughts; and access to dairy cooperatives in interior parts are the contemporary priorities perceived by the pastoralists.

Keywords: *Banni* buffalo; *Banni* grassland; Desertification; Pastoralism; *Prosopis juliflora*

Introduction

The *Banni* grassland spreads over an area of about 2617 $Km^2$of Bhuj taluka in the Kachchh district of Gujarat in India ($23^0$19′–$23^0$52′ N latitude to $68^0$56′–$70^0$32′ E longitude) and is the largest natural tropical grassland in the Indian subcontinent. It belongs to the *Dichanthium-Cenchrus-Lasiurus* type of grass cover (Dabadghao and Shankarnarayanan, 1973). The average annual rainfall is 317 mm, with only 10 to 13 rainy days (Banni, 2024; RAMBLE, 2024). Droughts are frequent in the region. Between 1932 and 2013, Kachchh district faced a total of 48 drought years, with 26 years falling under the severe to very severe category (Vijaykumar *et al*., 2011; Vijaykumar *et al*., 2015). Despite the harsh climatic conditions and inherent salinity of its alluvial sandy soils, it was once rated as Asia's finest grassland endowed with rich biodiversity (GUIDE, 1998; GUIDE, 2011; Joshi *et al*., 2009). However, it is considered as degraded remnant grassland at present (Dayal *et al*., 2015). Severe limitations of soil i.e. poor soil moisture, poor organic matter, low permeability and high salinity make it not suitable for crop cultivation (Geevan *et al*., 2003).

This has led to the evolution of nomadic communities that reared livestock mainly through extensive pastoralism. The nomadic pastoralists, generally known as *Maldharis*, do not have land ownership rights. *Banni* area consists of 48 villages under the jurisdiction of 19 Panchayats with a population of 38,408 people in 2021-22, mainly dominated by *Maldharis* (Projected by Manjunatha *et al*., 2019a; Directorate of Animal Husbandry, 2016). *Maldharis* are livestock herders and superior cattle and buffalo breeders and hence, traditionally, this region is a renowned livestock breeding tract of Gujarat (Joshi *et al*., 2009; Mahajan and Bharwada, 2011). They mainly

domesticate *Banni/ Kundi* buffaloes, *Kankrej* cow, *Kachchhi* goat, *Pathanwadi* and *Duma/Marwari* sheep, *Kachchhi* and *Tari* camel and *Sindhi* horses (Manjunatha *et al.,* 2019a).
Pastoralism/ animal husbandry is the chief livelihood activity for pastoralists even to this date (Manjunatha *et al.,* 2019b; Manjunatha *et al.,* 2022). *Banni* grassland underwent substantial changes after India's independence in 1947, such as its declaration as a Protected Forest in 1955 (this means *Maldharis* do not have occupancy rights), the rapid spread of *P. juliflora,* the shift in livestock composition, better road connectivity and access to the organized dairy industry. These driving factors have changed the pastoralists course of life from nomadic to semi-nomadic and sedentary animal husbandry/ dairy keepers. Belgacem *et al.* (2023) reported that there has been a major shift in the attitudes of pastoralists towards an increasing interest in settling down to benefit from social services such as education for their children. Severe degradation of *Banni* grassland due to prevailing arid conditions, the impact of climate change, increasing soil salinity and overgrazing affected the ecosystem of *Banni* grasslands, its carrying capacity and consequently the livelihoods of the pastoralists. In this context, the present study was undertaken to document the impact of historical milestones shaping pastoralism in *Banni* grasslands and to assess the contemporary priorities of pastoralists concerning their livelihood.

Materials and Methods

A combination of research methods was used to achieve the objectives of this article. Historical changes affecting the pastoralism in *Banni* grasslands, especially after India's independence in 1947, were critically analyzed through an extensive review of the literature (published articles, reports and secondary data). Content analysis was undertaken to identify the impact of these changes on pastoralism in terms of (i) a shift from nomadic pastoralism to semi-nomadic pastoralism and sedentary animal husbandry; (ii) promotion of/ access to the organized dairy industry; (iii) occupational shift; (iv) shifting livestock composition; (v) diversification of livelihood; (vi) land degradation and (vii) loss of biodiversity.
A combination of primary and secondary data was used to identify the contemporary priorities of pastoralists. Primary data was generated as follows:

Research design: Ex-post facto and survey research designs were adopted for the study.

Locale of the study, sample and sampling procedure: *Banni* grasslands situated in Bhuj taluka in Kachchh district of Gujarat was selected purposively for this socio-economic investigation. Out of the 48 villages in the administrative jurisdiction *of Banni* grasslands, twelve villages (Bhirandiyara, Hodko, Uddo, Patgar, Varli, Madhavnagar, Mehar Aliwand, Dhordo, Sargu Nava Sadai, Udai and Burkhal) were selected through stratified sampling technique to represent different parts of *Banni*.

Data collection tools and analysis: The exhaustive list of priorities of the pastoralists was developed through a comprehensive review of literature and group discussions with key pastoralists, experts and stakeholders during a pilot study undertaken from January to March 2015. These priorities were grouped into five major themes. The primary data was collected from 280 households from the 12 selected villages from April 2015 to June 2017 using the personal interview method with the assistance of a structured interview schedule. Respondents were asked to rank these priorities concerning their livelihood using the Garrett ranking technique. The result of the ranking was transformed into score value using the following formula:

$$Percent\ Position\ = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where R_{ij} = Rank given for the ith priority by jth respondent; and N_j = number of priorities ranked by jth respondent. In the study N_j = 5.
The primary data was aided by focussed group discussions involving elderly key pastoralists in each village and other stakeholders such as representatives of *Banni* region, scholars and institutes working on *Banni* grasslands. Field visits were undertaken to *Banni* grasslands, pastoralists' livestock yards, charcoal production units, households engaged in embroidery and leather work products and Rann Utsavex hibition stalls to acquaint with diverse livelihood options in the region.

Estimation of livestock population: The growth rate of livestock population in *Banni* grasslands from 1977 to 2012 (using actual data) was estimated using the CAGR method (Manjunatha *et al.,* 2019a). These growth rates were used as the benchmark to estimate the livestock population growth rates from 2012 to 2022. These growth rates were then moderated in consultation with officials of the livestock department in Bhuj, the district headquarters of Kachchh district. Finally, the population growth rate of buffaloes, cattle, goats and sheep during 2002-2012 was estimated to be 6, 2, 1 and 1% per annum, respectively and the livestock population in *Banni* grasslands corresponding to the year 2022 was estimated.

Results and Discussion

Evolution of pastoralism in the Banni grasslands vis-à-vis historical changes: A historical timeline of pastoralism in *Banni* grassland dating back to 500 years was recorded (Table 1). Trading and grazing routes existed through the Rann into the Sindh, as evidenced by archival

Table 1. Historical timeline of pastoralism in *Banni* grasslands

Period/year	Event	Key change/impact affecting pastoralism
Before India's independence		
Before 500 years (Before 1500AD)	Camel pastoralists migrated from Sindh, Balochistan, Afghanistan and Central Asia.	Pastoralism promoted
1526 to 1760s (Mughal period)	Free and unrestricted access to common property resources (CPRs). No taxes on grazing	Pastoralism promoted
1763 to 1857 (Colonial period)	The state took over and enclosed the CPRs and forests	Restrictions to pastoralism
Post 1857 (British period)	Large-scale diversion of CPRs to agriculture in the Kachchh region	Restrictions to pastoralism
1870-1920	Grazing and animal produce taxes were imposed. Sheep, goat and camels were categorized as useless. Grazing without a license was declared a crime. Animal registration and branding were made mandatory.	Restrictions to pastoralism
Since India's independence in 1947		
1947	Partition of India and Pakistan into two separate nations. The formation of political borders restricted/ ended the cross-country migration for grazing across borders.	Restriction/ end of long-route migration
1947-56 (Saurashtra State)	Land to the tiller and *Gauchar* to *Maldhari* (pasturelands/ rangelands/ grasslands to the pastoralists) were declared. Resettling *Maldharis* was one of the priorities of the first Five Year Plan (1951-56). It was mandatory to maintain gauchar records for village Panchayats (40 acres/100 animals ratio). All taxes on livestock were abolished.	Shift from nomadic pastoralism to semi-nomadic pastoralism
1947-55	*Banni* designated as a revenue wasteland. It was managed as grassland to meet the fodder demand of the livestock.	Ownership rested with Revenue department.
May 1955	*Banni* grassland was declared a Protected or Reserve Forest. Transfer of land from revenue department to forest department was not completed till recently. Thereafter, no new human settlement took place.	Change in ownership from Revenue to Forest department. Restrictions to Community Grazing Rights and pastoralism as per Forest Act.
1960 onwards	Gauchar standards were no longer practiced after formation of Gujarat State.	Degradation, Overgrazing
1960's	Plantation of *P. juliflora* in 315 km^2 by Gujarat State Forest Department to check salinity ingress and desertification. Cutting of *P. juliflora* was banned in 1980's and lifted in 2004. Ban was re-imposed in 2008. Gujarat State Forest Development Corporation (GSFDC) Limited regulates its cutting through contracting/licensing since 2009.	Degradation of *Banni.* Loss of native biodiversity Increase in soil salinity Increased migration Livelihood diversification
1960's	The construction of dams across rivers draining *Banni* area blocked water flow to the area and annual fertilization through riverine deposits of sediments. The washing out of salts was blocked by these dams. Salinity ingress by Arabian Sea persisted without check.	Increase in soil salinity
1966	Formation of *Banni* Development Agency (BDA). Responsibility of ensuring the fodder demand and construction of water bodies to address the drinking water requirement of livestock.	Community based collective/ organization of pastoralists
1970's onwards	Increase in *Banni* buffalo population over *Kankrej* cows due to mechanization in agriculture, reduction in demand of *Kankrej* bullocks and increased access to dairy cooperatives Pastoralists' primary occupation gradually shifted from breeding of *Kankrej* bullocks to rearing of *Banni* buffaloes for commercial milk production.	Shift in livestock composition Occupational shift Reduced migration
1980's	Introduction of dairy units/ Milk Collection Centers by the Gujarat Milk Cooperative Society. Shift from livestock breeding to production of milk.	Occupational shift Shift from nomadic pastoralism to semi-nomadic pastoralism and animal husbandry Reduced migration.

Period/year	Event	Key change/impact affecting pastoralism
2000's	Drinking water supply to selected villages from Narmada dam	Reduced dependence on natural/ traditional water harvesting structures *(Virdas)* for livestock during migration Reduced migration
2006	Gujarat government organizes Rann Utsav (tourism event at white desert) from November to March every year. Tourism got a boost in the region benefitting villages in Central *Banni.*	Livelihood diversification
2009	First bulk milk cooling center (BMC) at Bhirandiyara village by Mother Dairy in May 2009. Later several BMCs, dairies and Milk Collection Centers (MCCs) were established by Mother Dairy and Sarhad Dairy.	Occupational shift. Shift from pastoralism to semi-pastoralism and animal husbandry.
2010	*Banni* buffalo was recognized as a distinct breed by Indian Council of Agricultural Research's National Bureau of Animal Genetic Resources (NBAGR).	Promotion of animal husbandry/ dairy enterprise
2010 onwards	Pastoralists claim Community Rights over entire *Banni* Grassland under 'The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights Act) 2006'	Community based collective/ organization of pastoralists demanding community participation Demand for community rights
2021	National Green Tribunal of India ruled that the pastoralists will continue to hold the right to conserve the community forests in the area under Forest Rights Act (FRA), 2006. It also instructed the removal of encroachments by certain pastoralists for agriculture purposes within *Banni.* Joint committee of the forest and revenue department identified encroachments on 8,760 hectares whereas *Banni Pashu Ucchherak Maldhari Sanghatan* has claimed encroachments on 18,000 hectares of grassland. Encroachment on 8760 ha was gradually removed by the joint operation of the forest and revenue department.	Pastoralists' rights were recognized and upheld Ban on private encroachments.
2023	Pastoralism/ animal husbandry remains the primary livelihood option for the majority of the pastoralists. Pastoralists have also diversified their livelihood by integrating charcoal production, handicrafts, services and tourism/ trade as secondary enterprises/extra income generating activities.	*Banni* buffalo remains a significant livestock species both in terms of population composition and income generation.
2023-2025	The Ministry of Fisheries, Animal Husbandry and Dairying, Government of India has established a dedicated Pastoral Cell in 2023. For the first time in Indian history, 21st Livestock Census (conducted from October 2024 to February 2025) will include details of pastoral communities and their livestock for developing specific policies and targeted interventions.	Authentic and disaggregated data on extensive livestock and pastoral production systems in India including *Banni* grasslands.

Source: Synthesized based on review of following literature: Bharara, 1993; Saxena, 1993; Sharma *et al.,* 2003; Shah *et al.,* 2010; The Biocultural Community Protocol of *Maldharis* of *Banni,* 2010; Vijay Kumar *et al.,* 2011; Bharwada and Mahajan, 2012; Manjunatha *et al.,* 2019a; Manjunatha *et al.,* 2019b; Manjunatha *et al.,* 2021; Safriel and Vijay Kumar, 2021; Manjunatha *et al.,* 2022; Thorat and Rai, 2023; Banni, 2024; NBAGR, 2024; RAMBLE, 2024; Bhatti, 2024.

and ethnographic studies (Ibrahim, 2009; Kothari, 2013). *Banni* was proclaimed as a *Rakhal* (reserve grassland) by the Maharao of Kachchh during princely rule (late 19th Century to 1947), wherein only cattle were permitted to graze and small ruminants were prohibited. Permanent settlements by the *Maldharis* were also prohibited. Before the independence of India, pastoralists migrated across the borders to graze their livestock in *Banni* after paying *Panchari,* a grazing tax. The partition of Pakistan and India restricted the migration between the two regions (Bharwada and Mahajan, 2012).

Banni, once productive grassland, started deteriorating after the independence of India. The state of Gujarat permitted grazing in *Banni* for all livestock with taxes, which was abolished in the 1960's. These grazing restrictions were followed till 1957. Later, livestock from neighboring regions gained free access to the grasslands and continuous grazing during 3-4 months of monsoon (Bharara, 1993; Ferroukhi, *pers. Commun.*; GUIDE, 1998). After the independence of India, *Banni* was designated as a wasteland by the revenue department of Gujarat state. It was declared a "Protected Forest" in May 1955 under the Indian Forest Act 1927. Therefore, *Maldharis* do not have land ownership rights in *Banni.*

***Pastoralism at present*:** About 101235 livestock heads were estimated in *Banni* grasslands during 2021-22 (Table 2). Buffalo, cattle, sheep and goats constituted 77, 13, 5 and 5% of the livestock population, respectively. Pastoralism is the livelihood for 93% of households (73% as primary and 20% as secondary occupation) who are dependent on grasslands for grazing their livestock, mainly buffaloes, followed by cows, sheep and goats. Even those households whose primary/ secondary occupation is not pastoralism (charcoal production, services, trade, etc.) were basically pastoralists one/two generations ago. They have moved out of pastoralism in the context of the shrinking carrying capacity of the *Banni* grasslands. For all practical purposes, all households in *Banni* grasslands are dependent on grasslands directly and indirectly. Further, pastoralism contributed significantly (82%) to the *Banni* region's economy (Manjunatha *et al.,* 2019b; Manjunatha *et al.,* 2022). Khojasteh *et al.* (2022) reported that pastoralist dependence on rangelands, pastoralist income and the number of pastoralists in a specific area are directly associated with the economy and income of pastoralist households and affect the sustainability of rangeland. Islam *et al.* (2021) reported that the production of homestead tree resources was not a principal livelihood source in many households. Yet, the income earned is an indispensable source of self-respect, pride, and self-determination.

Recognizing community rights of Maldharis: The contemporary priorities of the pastoralists in *Banni* grasslands were recorded (Table 3). Pastoralists expressed their participation in all stages of decision-making by the government with respect to the management of *Banni* as their top priority. This priority was implicit and fundamental to the livelihoods of pastoralists. *Maldharis* have been claiming Community Forest Rights (CFRs) over *Banni* Grassland for the last two decades. Such provision is legally recognized and upheld under 'The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006'. The State Government appointed an Advisory Committee to resolve the CFR issue over *Banni* and it submitted the report in November 2016. The committee advised the government to approve titles to 47 committees and to carry out a revenue convergence process in *Banni*. The approval of the CFR title at the Divisional Level Committee (DLC) is still awaited. However, Gramsabhas of 47 villages have decided to form their own Community Forest Management Committees (CFMC) under FRA 2006 to initiate management and governance of their resources. This means self-declaration that this area is under the control of Gramsabha and Gramsabha therefore applying its' FRA rights. Few CFMCs have prepared their detailed CFR management plan, got approval from Gramsabha and now they are working on further management and conservation of their CFRs.

Table 2. Livestock population in *Banni* grasslands (2021-22)

Livestock species	2012	2022	CAGR (2012-2022)
Buffalo	48982	78371	6
Cattle	10681	12817	2
Sheep	4746	5221	1
Goat	4022	4826	1
Total	**68431**	**101235**	

Note: CAGR = Compound Annual Growth Rate (% p.a.)

The identity of the *Banni's* residents as pastoralists, first and foremost, is considered crucial behind the demand of pastoralists for granting community forest rights over *Banni* (Thorat and Rai, 2023).

Degradation of Banni: The recurrent droughts, invasion of *P. juliflora* and in-migration of livestock from neighboring regions in Gujarat and Rajasthan are all contributing to overgrazing and degradation of *Banni* grasslands. In a normal rainfall year, green grass grazing continues until January/ February and dry grass lasts till June/July. During drought years, the cost of livestock rearing increased because of a general reduction in milk production and the purchase of fodder resources. In the present context, the pastoralists in *Banni* purchase fodder and concentrate feed (grasses, crop residues, jowar stover, wheat straw, cotton seed cake, etc.) from the market for their livestock, especially for milching buffaloes and cows to supplement with natural grazing. Therefore, enhancing/ sustaining the production potential of the grasslands remains the core concern of the pastoralists.

Table 3. Contemporary priorities of the pastoralists in *Banni* grasslands concerning their livelihood (n = 280)

S. No.	*Priority*	*Mean score*	*Rank*
1	Consultation and participation of pastoralists in government decision-making process (Granting of community rights over *Banni* grasslands)	91.38	I
2	Enhancing the carrying capacity of *Banni* grasslands (management of *P. juliflora,* restricted/ rotational grazing, etc.)	87.65	II
3	Management of droughts (addressing fodder and water scarcity, migration, etc.)	80.63	III
4	Establishment of dairy cooperatives/ milk collection centers in interior *Banni*	65.26	IV
5	Policy interventions in favor of developing an organized dairy industry/ value chain	63.75	V

Management of Prosopis juliflora: The expansion of *P. juliflora* from 315 km^2 in the 1960s to 1500 km^2 in the 2010s resulted in a severe decline of grazing areas and loss of native biodiversity (SAC, 2002; RAMBLE, 2024). A decline in the grass and sedge species richness following *P. juliflora*'s invasion was found and in a survey conducted in 2012, twelve out of 41 grassland species documented at the same site 30 years before (1982) were missing (Pandya and Sidha, 1982; Singh and Kumar, 1998). Further, the productivity of grassland reduced from 4.65 ton/ha in 1961 to 0.48 in 2004 (Trivedi, 1965; GUIDE, 1998; GUIDE, 2004). Breakdown of traditional management systems and invasion of unpalatable species like *Lantana, Eupatorium, Parthenium, P. juliflora* and others have degraded the grazing lands, severely affecting grassland productivity. The carrying capacity is currently <1 ACU/ha in semi-arid areas and 0.2-0.5 ACU/ha in arid areas (Roy and Singh, 2013).

Prosopis juliflora is cut/ uprooted and used for the production of biochar/charcoal/briquettes as a source of income by pastoralists. Its use as a source of monetary benefit through the carbon credit program may be explored. Chand *et al.* (2023) reported that an additional benefit of $12.24 per ha was attained with pasture land development in the form of carbon credit in the Tonk district of Rajasthan, India.

Access to milk collection centers: Improved road connectivity, especially with metalled roads (central *Banni:* connecting Bhuj city to White Rann), has led to the establishment of dairy/milk collection centers (MCCs). Pastoralists in these villages fetched remunerative milk prices based on fat content in milk. However, remote villages in *Banni* (east and west *Banni*) not yet connected by good roads lacked MCCs, forcing them to sell milk at prices upto half of what their counterparts got in villages with MCCs. Therefore, improving road connectivity and establishing MCCs in interior villages will strengthen livelihoods and enhance the incomes of pastoralists. Maiti *et al.* (2024) reported that the adaptive capacity of *Changpa* pastoral nomads to cope with climate change was highly influenced by an assured market for their products.

Delineating the boundaries of *Banni* and removal of fencing/ encroachments by some locals around their houses/ farms are some of the policy interventions sought by the pastoralists. Severe degradation of *Banni* grasslands is the major issue affecting the livelihood of pastoralists. Therefore, a scientific approach involving several strategies such as demarcation and protection of the grasslands, management of *P. juliflora*, reseeding with improved varieties of native grass species, soil and water conservation measures along with following traditional practices of restricted and rotational grazing is essential for the revival of the grasslands. Kumawat *et al.* (2022) reported that interspaces of the shrubs may be utilized with reseeding of perennial grasses in the medium and deep soils for improving the fodder production from silvipasture systems and rangeland in low rainfall regions. Chandra *et al.* (2022) reported that modern technologies, such as drones fitted with seed-sowing devices, could be used for the successful sowing of grass seeds with very good germination. Further, the involvement of local pastoral communities by the government in the conservation and management of *Banni* would be a win-win strategy.

Conclusion

Pastoralism in *Banni* grasslands has evolved and been shaped by various natural, anthropogenic and policy changes after India's independence in 1947. The negative impact of these changes was manifested in terms of restrictions on community rights and pastoralism, invasion of non-native species, loss of biodiversity, overgrazing, increase in soil salinity and overall degradation of the grasslands, leading to reduced carrying capacity of pastures, thereby increasing the cost of rearing livestock. The positive impact was manifested in terms of better infrastructure (roads, markets and institutions), increased access to dairy cooperatives, government support during droughts and a reduction in migration. Policy intervention for granting community rights over *Banni* remains the topmost priority for the pastoralist community. Enhancing the carrying capacity of *Banni* and management of recurring droughts necessitates scientific interventions. However, community engagement and participation remain central to addressing all challenges affecting *Banni* grasslands.

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References

Banni. 2024. Biodiversity. http://banni.in/biodiversity/grasslands/. (accessed on Jan. 9, 2024).

Belgacem, A. Q., M. Alharbi, A. Alhajoj, F. Alruwaili and J. Njeru. 2023. Effects of community camel and sheep grazing on vegetation cover in Al-Mayla rangeland in northern Saudi Arabia. *Range Management and Agroforestry* 44: 226-232.

Bharara, L. P. 1993. Socio-economic aspects of *Banni* pastoralists and factors effecting changes in their perceptions toward the future. In: R.P. Cincotta and G. Pangare (eds). *Pastoralism and Pastoral Migration in*

Gujarat. Institute of Rural Management, Anand.

Bharwada, C and V. Mahajan. 2012. Let it be *Banni:* Understanding and sustaining pastoral livelihoods of *Banni.* Centre for Economic and Social Studies (CESS) Monograph. RULNR Monograph-13. Hyderabad.

Bhatti, R. 2024. Pastoral census as the first step towards scientific/ concrete planning. In: Proc. *Workshop on Rangeland Management for Sustainable Rural Development* (Jul. 29-31, 2024), Srinagar. pp. 21-23.

Chandra, A., N. Biradar, V. Kumar, A. M. Shivkumar, R. V. Kumar, R. Gopinath, V. Yajna, C. Lakshmi Devi, G. S. Ramyashreedevi and S. K. Mahanta. 2022. Possibilities and challenges of drone usage for grassland development. *Range Management and Agroforestry* 43: 185-191.

Chand, K., R. V. Kumar, S. S. Meena, N. Biradar, B. B. Choudhary, A. Ghosh, D. R. Palsaniya, S. K. Mahanta, R. P. Nagar, H. S. Meena and P. Kishore. 2023. Financial and environmental impact analysis of developing common pasturelands. *Range Management and Agroforestry* 44: 183-191.

Dabadghao, P. M and K. A. Shankarnarayanan. 1973. *Grass Cover of India.* Indian Council of Agricultural Research, New Delhi.

Dayal, D., M. Shamsudheen and K. Arvind. 2015. *Banni* grasslands of Kachchh, Gujarat: Problems, present status and prospects. In: P. K. Ghosh, S. K. Mahanta, J. B. Singh and P. S. Pathak (eds.). *Grassland: A Global Resource Perspective*. Range Management Society of India, Jhansi. pp. 1-473.

Directorate of Animal Husbandry. 2016. Livestock data pertaining to 48 villages in *Banni* grasslands collected by researchers from Animal Husbandry Office, Bhuj (Agriculture, Farmers Welfare and Cooperation Department, Government of Gujarat).

Geevan, C. P., A. M. Dixit and C. S. Silori. 2003. Ecological-economic analysis of grassland systems: resource dynamics and management challenges- Kachchh district (Gujarat). EERC Working Paper Series: CPR-5, Gujarat Institute of Desert Ecology, Bhuj. pp. 1-145.

GUIDE. 1998. Status of *Banni* Grassland and exigency of restoration efforts, Gujarat. Gujarat Institute of Desert Ecology, Bhuj. pp. 1-66.

GUIDE. 2004. Grassland action plan for Kachchh. Final Report Submitted to Gujarat Forest Department, Gandhinagar. Gujarat Institute of Desert Ecology, Bhuj. pp. 1-346.

GUIDE. 2011. An Integrated Grassland Development in *Banni,* Kachchh district, Gujarat State. Progress Report for the period between April 2010 and March 2011. Submitted by Gujarat Institute of Desert Ecology, Bhuj. pp. 1-14.

Ibrahim, F. 2009. Settlers, saints, and sovereigns: an ethnography of state formation in western India. Routledge.

Islam, M. A., A. A. Wani, G. M. Bhat, A. A. Gatoo, S. Murtaza, K. Anjum and U. Atta. 2021. Homestead tree resource production for rural livelihood security in Kashmir Himalaya. *Range Management and Agroforestry* 42: 334-340.

Joshi, P. N., V. Kumar, M. Koladiya, Y. S. Patel and T. Karthik. 2009. Local perceptions of grassland change and priorities for conservation of natural resources of *Banni*, Gujarat, India. *Frontiers of Biology in China* 4: 549.

Khojasteh, F., M. A. Z. Chahouki, H. Arzani and A. A. Barati. 2022. Prioritization of factors affecting rangeland sustainability in Iran. *Range Management and Agroforestry* 43: 154-160.

Kothari, R. 2013. Memories and movements: Borders and communities in *Banni,* Kutch, Gujarat. Orient Blackswan, New Delhi.

Kumawat, R. N., A. K. Misra, M. Louhaichi and K. Venkatesan. 2022. Vegetation dynamics under different management interventions in arid rangelands of Rajasthan. *Range Management and Agroforestry* 43: 11-18.

Mahajan, V and C. Bharwada. 2011. Pastoral Livelihoods of *Banni:* Case of Bullock Trade. In: Proc. *Symposium on Banni Grassland* (Mar. 4-5, 2011), Bhuj.

Maiti, S., S. Garai, B. Mukesh and K. S. Kadian. 2024. Vulnerability to climate change among the Changpa pastoral nomads of Leh-Ladakh. *Range Management and Agroforestry* 45: 184-187.

Manjunatha, B. L., M. Shamsudheen, M. Sureshkumar and P. Tewari. 2021. Ecological, economic and socio-cultural sustainability of different livelihood options and enterprises practised by pastoralists in *Banni* grasslands of Gujarat. *Indian Journal of Animal Sciences* 91: 305-312.

Manjunatha, B. L., M. Shamsudheen, M. Sureshkumar, P. Tewari and O. P. Yadav. 2019b. Occupational structure and determinants of household income of pastoralists in *Banni* grasslands of Gujarat. *Indian Journal of Animal Sciences* 89: 453-458.

Manjunatha, B. L., M. Sureshkumar, P. Tewari, D. Dayal and O. P. Yadav. 2019a. Livestock population dynamics in *Banni* grasslands of Gujarat. *Indian Journal of Animal Sciences* 89: 319-323.

Manjunatha, B. L., A. Naorem, D. Hajong and P. Tewari. 2022. Dynamics of household and regional economy in *Banni* grasslands, India: a cross-sectional study. *Sustainability* 14: 11236.

NBAGR. 2024. *Banni* Buffalo Accession Number: INDIA_BUFFALO_0400_BANNI_01011. Registered breeds of buffalo. National Bureau of Animal Genetic Resources. http://www.nbagr.res.in/regbuf.html. (accessed on Jan. 08, 2024).

Pandya, S. M and V. K. Sidha. 1982. Ecological studies of arid regions of Kutch (Gujarat State). Final Progress Report, Department of Biosciences, Saurashtra University, Rajkot.

RAMBLE. 2024. About BANNI. Website of Research and Monitoring in the *Banni* Landscape (RAMBLE). http://www.bannigrassland.org (accessed on Jan. 10, 2024).

Roy, A. K and J. P. Singh. 2013. Grasslands in India: Problems and perspectives for sustaining livestock and rural livelihoods. *Tropical Grasslands– Forrajes Tropicales* 1: 240-243.

SAC. 2002. *Prosopis juliflora* mapping in Saurashtra and Kachchh, Gujarat using remotely sensed data and GIS technique. Space Application Centre, ISRO, Ahmedabad. pp. 1-30.

Safriel, U. N and V. Vijay Kumar. 2021. Land degradation and restoration driven by invasive alien- *Prosopis Juliflora* and the *Banni* grassland socio-ecosystem (Gujarat, India). *Global Journal of Science Frontier Research: H Environment and Earth Science* 21: 7-38.

Sahjeevan. 2024. Center for pastoralism.http://sahjeevan.org/pages/center_for_pastoralism.html (accessed on Jan. 10, 2024).

Saxena, S. K. 1993. Present status of *Banni* grassland. In: R. P. Cincotta and G. Pangare (eds) *Pastoralism and Pastoral Migration in Gujarat*. Institute of Rural Management, Anand.

Shah, J. P., A. M. Patel and P. N. Joshi. 2010. Participatory natural resource mapping: A case study of Bhitara panchayat in *Banni* grassland, Kachchh (Gujarat). *Asian Journal of Environmental Sciences* 5: 192-198.

Sharma, V. P., Ilse Köhler-Rollefson and J. Morton. 2003. *Pastoralism in India: A Scoping Study.* Centre for Management in Agriculture, Indian Institute of Management (IIM), Ahmedabad (India) and the League for Pastoral Peoples, Ober-Ramstadt. pp. 1-63.

Singh, Y. D and V. Vijay Kumar. 1998. Status of *Banni* grassland and exigency of restoration efforts. Study Report, Gujarat Institute of Desert Ecology, Bhuj. pp. 1-66.

The Biocultural Community Protocol of *Maldharis* of *Banni*. 2010. *Banni* Pashu Uchherak *Maldhari* Sangathan, Bhuj. pp. 1-38.

Thorat, O and N. D. Rai. 2023. Commoning under the new rangeland development paradigm: Pastoralisation of the *Banni* grasslands of India. *Political Geography* 105: 102924.

Trivedi, R. K. 1965. Census of India (1961). Volume V, Part-VI –No 3 and 4. Village Survey Monographs. 3. Bhirandiyara, Kutch. Nayan Printing Press, Ahmedabad. pp. 1-113,

Vijay Kumar, V., A. K. M. Roy and R. Patel. 2015. Ecology and management of *'Banni'* grasslands of Kachchh, Gujarat. In: G. S. Rawat and B. S. Adhikari (eds). *Ecology and Management of Grassland Habitats in India*. ENVIS Bulletin: Wildlife & Protected Areas, Wildlife Institute of India, Dehradun 17: 240.

Vijay Kumar, V., N. Gajera and P. Patel. 2011. Grasslands of Kachchh, In: K. Kathju, V. Vijay Kumar, G. A. Thivakaran, P. Patel and V. Devi (eds). *State of Environment in Kachchh.* Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar and Gujarat Institute of Desert Ecology (GUIDE), Bhuj. pp. 113-132.