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ORIGINAL ARTICLE

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Assessing Community Participation and Ecosystem Services from Common Property Resources of Hot Arid Ecosystem of Western Rajasthan

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ABSTRACT

Common property resources (CPRs) are vital natural assets, particularly for tribal and rural poor with limited landholdings, who depend heavily on CPRs for livelihood, fuel-wood and fodder needs. Most common CPRs in rural areas include common grazing lands, community forests, wastelands, and common water bodies. The CPRs in arid ecosystems provide not only fruits, vegetables, herbs, fibre, and even water for drinking and irrigation; but also income and employment opportunities. Considering their importance, these resources are jointly utilised and accessed by the community. The present study was undertaken in the Bikaner and Jaisalmer districts of western Rajasthan, India to assess the status of the CPRs, evaluate their impact on livelihoods and also to measure the extent of community participation in the management of these critical resources. A stratified random sampling was employed and data were collected from 720 households via personal interviews using standardized schedules to quantify ecosystem services from water harvesting structures and pasture lands. Results revealed majority of farmers (45.6%) possessing low socio-economic status but maintaining favourable attitude (42.6%) towards CPRs. Overall extent of people's participation in CPR management was measured at 60.3%, with the highest engagement occurring during the development stage. Key ecosystem services included provision of water for domestic and livestock, fuel-wood, food materials and building materials, and increased cropping intensity. The study concludes that while CPRs are essential for subsistence, they are threatened by encroachment and invasive species. Establishing CPR management bodies and leveraging traditional "*Oran*" systems are essential to ensure sustainable regeneration and long-term livelihood security.

1 | INTRODUCTION

Common Property Resources (CPRs) are an integral part of the natural resource base in rural areas and include common pastures/grazing land, water bodies, community forests, government wastelands, watershed drainages etc., which are commonly accessed and managed by the village community for distribution of benefits to villagers, under locally evolved norms and regulations. These are particularly useful for the tribal and rural poor with limited own land resources, who get access to fuel wood, fodder, building materials, fruits and vegetables, medicinal plants, water for drinking and irrigation from these resources.

These resources also play a vital role in providing income and employment to rural people. Garnett et al. (2018) estimates that indigenous people and local communities, oversee 37% of the world's remaining intact natural areas and nearly 25% (38 million km^2) of its land, while in India, common property resources (CPRs) covered nearly one-quarter of total geographical area (Chopra and Gulati, 2001).

In the arid Rajasthan, experiencing extremes of temperatures (+50°C to -6°C), with high coefficient of variability of annual rainfall (40-70%), high wind velocities, and a 50-60% drought probability (Gaur et al. 2020), the CPRs are a lifeline for livestock based community in western Rajasthan. *Orans* and *gauchars* are some of the most important community resources in arid regions, supporting both the livelihoods of pastoralists and also helping maintain the ecological balance of the desert ecosystem (Chaudhry *et al*., 2011; Singh and Singh, 2024). Here *orans* refer to sacred groved, normally linked to local deities. These serve as community forests and/or pastures. Similarly, *gauchers* refer to community pastures in village for livestock grazing. DTE (2012) reported that *orans* and *gauchars* were the most important CPRs in western Rajasthan, being traditionally set aside to support livestock rearing, with *orans* alone contributing to 8-9% of arid Rajasthan. Particularly in western Rajasthan, these CPRs cover 34.75% of the geographical area, and contribute significantly to the livestock-based economy, meeting about 66% of fodder demand for livestock (Misra and Kumawat, 2020). Several researchers have analysed the economic benefits from CPRs

in India. NSSO (1999) estimated average value of annual collections per household as ₹ 693; while Jodha (1986) illustrated that the rural poor derive between ₹ 445 and ₹ 830 annually from CPRs. CPRs in the hill region are main sources of high inputs of green manure required to sustain upland agricultural production and of grazing and collected animal fodder to sustain the livestock which play a major role in the agricultural economy (Arnold and Stewarts, 1991).

The Ecosystem Approach acknowledges the interdependencies that exist between ecosystems and humans, with which we coexist and have coevolved. Common Property Resources have been described as the 'village ecosystem centres' in dry lands by Gaur *et al*. (2020). A thorough analysis by Sandhu et al. (2023) revealed 34 ecosystem services produced by intact common property resources in India, valued at $90.5 billion annually ($2108 per hectare). Despite their significance, the area as well as quality of the CPRs is decreasing over time. Mertia and Santra (2012) estimated a decline in grazing lands from 50% (1950s) to 34.75% (2011-12). The degradation of these resources has a direct negative impact on the livelihoods of the poor and has become a matter of serious concern in many parts of the country, including Rajasthan. The decline has been caused primarily by increasing biotic pressure, commercialization of the rural economy, encroachment, and the breakdown of traditional rules and regulations governing their use and management. At the same time their degradation also poses serious environmental problems to the society and country at large in the long run. Preserving these resources, therefore, paves the way for long lasting local solutions to livelihood issues. Equity and management aspects of utilization of CPRs have considerable social relevance in the changing paradigm of people's participation in the management of common property resources. While the problem of equity is common to all common property resources, this is pronounced in case of water bodies, pasture lands and forest, especially in resource poor regions like the western Rajasthan.

In this context, the present study was undertaken in the hot arid ecosystem of western Rajasthan, specifically the Bikaner and Jaisalmer districts, to assess the present status of different CPRs existing in different villages and to measure the extent of people's participation in planning, development and maintenance of these resources. Furthermore, the study aims to assess the various benefits derived from CPRs supporting rural livelihoods and the constraints in its development and management. Based on findings, the study aims to recommend suitable strategies for their sustainable management, to support policymakers and implementing agencies in developing and implementing sustainable management plans.

2 | MATERIALS AND METHODS

2.1 | Study Area Description

The study was conducted in the hot arid ecosystem of western Rajasthan covering Bikaner and Jaisalmer districts.

HIGHLIGHTS

- 720 households surveyed across Bikaner and Jaisalmer districts of arid Rajasthan (2019–2023) to assess CPR status, benefits, and community participation.
- 42.6% of farmers held a favourable attitude toward CPRs despite low socio-economic status (45.6%).
- CPRs boosted ecosystem services including provisioning and service functions such as well recharge, increased cropping intensity, employment for local households, food, fodder and firewood supply and water for livestock and people.
- Encroachment and invasive species threaten CPRs, calling for dedicated management and revival of traditional "Oran" systems.

These districts are characterized by arid climatic conditions, low and erratic rainfall, high temperature extremes, sparse vegetation, and heavy dependence on livestock and common property resources for sustaining rural livelihoods. The study was implemented over a period of four years from 2019 to 2023. The study focused on selected CPRs commonly found in these regions, and playing a significant role in the livelihoods of the rural households, namely: (i) water harvesting structures (such as village pond, tank, check dam, community diggi), and (ii) pasture lands.

2.2 | Sampling Design and Data Collection

In Bikaner district, all the eight tehsils, namely Bikaner, Lunkaransar, Sridungargarh, Nokha, Kolayat, Pugal, Khajuwala, and Chhatargarh were included in the study; while in Jaisalmer district, all the four tehsils, namely Jaisalmer, Pokhran, Bhaniyana and Fatehgarh were selected. From each tehsil, three different types of villages - irrigated, partially irrigated and unirrigated (*Barani*) - having greater extent of selected CPRs were purposively chosen. From each selected village, 20 beneficiaries comprising 10 males and 10 females were selected on the basis of proportionate stratified random sampling technique. Thus, 60 beneficiaries were selected from each tehsil. Thus, the sample size consisted of 480 beneficiaries from Bikaner district, and 240 beneficiaries from Jaisalmer district, making an overall sample size of 720 beneficiaries for the study.

Standardized data collection schedules were developed for the study and testing of schedules was done to ensure clarity, relevance and reliability. Primary data on the socio-economic status of farmers, present status of the selected CPRs, extent of people's participation in planning, development and maintenance of CPRs, attitude of stakeholders towards CPRs, various management mechanisms, the types and extent of benefits derived from the CPRs, constraints in development and management of CPRs etc. were collected through personal interview from the selected respondents. Information was also collected on ecosystem services derived from the CPRs, including water availability, cropping intensity, and provision of fuel-wood, fodder and food materials.

In addition, the measurement of density of trees, bushes, and grasses in pasture land CPRs was measured using standard quadrat methods. Quadrat sizes of 10 m × 10 m for trees, 5 m × 5 m for bushes, and 1 m × 1 m for grasses and forbs were laid in selected pasture lands of the study villages. Data on species composition, density, and biomass production were recorded to assess the availability of palatable and non-palatable vegetation in pasture CPRs.

2.3 | Data Analysis

The collected data were compiled, tabulated, and analyzed using appropriate statistical techniques. Descriptive statistics were used to assess socio-economic status, attitude of farmers, extent of people's participation, and ecosystem services derived from CPRs. Socio-economic status of farmers was analyzed based on the scale developed, considering factors such as income, type of house, material possession, animal power, implement or equipments available, irrigation facilities, etc. For analysis of socio-economic status of the surveyed farmers, respondents were classified into three categories based on their composite socio-economic status score obtained from the questionnaire, with the help of following criteria:

Range of score	Category
a) < Minimum score + CI	Low
b) > Minimum score + CI to < Maximum score - CI	Moderate
c) > Maximum score - CI	High

where, CI = Class Interval

Class Interval (CI) was computed with the help of following formula:

$$CI = \frac{Maximum\ Score - Minimum\ Score}{Number\ of\ classes}$$

The attitude of farmers towards Common Property Resources was assessed using a composite attitude scale comprising statements related to three dimensions: planning, development, and maintenance of CPRs. A scale to measure attitude towards CPRs was developed with the help of available literature, discussion with extension scientists, and analysed by correlational method as suggested by Murphy and Likert (1937). The developed attitude scale contained twenty statements (thirteen positive and seven negative), covering all aspects including their views on CPRs, contributions in kind or financial or labour, and the perceived roles of local communities and government in CPR management as has been described in detail by Bagdi *et al*., (2021). Each statement is scored using a Likert-type scale. Attitude Index (AI) was developed to measure the extent of attitude of people based on scores obtained, and classified into less favourable, favourable, and more favourable.

The extent of people's participation in CPR management was quantified using a People's Participation Index (PPI), covering participation in planning, development, and maintenance stages, using the following equation:

$$PPI = \frac{\text{Average participation score obtained by respondents}}{\text{Maximum possible score}} x\ 100$$

Ecosystem services derived from the pond and pasture land CPRs were measured through the structured questionnaire. The ecosystem services were categorized into four major groups as per the Millenium Ecosystem Assessment framework into: (i) provisioning services (additional area irrigated, pond silt obtained, water availability for livestock and domestic use, fuelwood, grazing resources, fencing materials, and food products), (ii) regulating services (improvement in water availability), (iii) supporting services (increased cropping intensity and enhanced agricultural productivity) and (iv) cultural (not measured, however, the spiritual value of some *orans* due to linkage with local deities were noted). Socio-economic benefits, represented by employment generated through CPR development and management activities, were also assessed as an important outcome of CPR interventions. The responses obtained were compiled and analyzed to evaluate the ecosystem services derived from the selected CPRs.

3 | RESULTS AND DISCUSSION

3.1 | Socio-Economic Status of Farmers

The socio-economic status of farmers in the selected villages is represented in Table 1. The data reveal that majority of farmers (55.4%) in Bikaner district had low socio-economic status, followed by those with moderate (34.3%) and only 10% farmers were in the high socio-economic status. Whereas in Jaisalmer district, maximum number of farmers (42.5%) had moderate socio-economic status, followed by low (35.8%) and only 21.6% farmers had high level of socio-economic status in the selected villages. The pooled data from both districts revealed that maximum numbers of farmers (45.6%) had low socio-economic status, followed by moderate level (38.4%) and only 15.9% farmers had high level of socio-economic status in selected villages of Bikaner and Jaisalmer districts of western Rajasthan. This data reveals the economic vulnerability of rural households in the selected villages and reinforces earlier studies (Jodha 1986; NSSO 1999) indicating that common property resources serve as an important livelihood support system for rural households, particularly for landless-poor and marginal farmers in dry regions.

TABLE 1 Socio-economic status of farmers in Bikaner and Jaisalmer districts of western Rajasthan.

Levels of Socio-economic status of farmers	Farmers selected from different districts		Pool
	Bikaner (N=480) (%)	Jaisalmer (N=240) (%)	N=720 (%)
Low	55.4	35.8	45.6
Moderate	34.3	42.5	38.4
High	10.2	21.6	15.9

*where N is the sample size

3.2 | Attitude of Farmers towards Common Property Resources

The attitude of farmers towards CPRs is presented in Table 2, which reveals that maximum (46.6%) numbers of farmers were having favourable attitude towards CPRs, 34.3% having more favourable and only 18.9% less favourable attitude towards CPRs in selected villages of Bikaner district. Similarly, in Jaisalmer district, maximum numbers of farmers (38.5%) were having favourable, 36.6% more favourable and only 24.7% farmers having less favourable attitude towards CPRs. The pooled data from both the districts revealed that 42.6% of farmers had a favourable attitude towards CPRs, followed by more favourable (35.5%), while 21.8% expressed less favourable attitude towards CPRs in the selected villages. Despite low to moderate socio-economic conditions, the generally positive attitude towards CPRs indicates strong community recognition of their importance in meeting daily livelihood needs and supporting agricultural and livestock-based systems in arid environments, in terms of the direct and tangible benefits derived in terms of fuelwood, fodder, and food. Similar observations have been reported in earlier studies, which noted that rural communities maintain favourable perceptions towards CPRs due to their direct contribution to subsistence and livelihood security (Pretty 2003, Ostrom 1990).

TABLE 2 Attitude of farmers towards CPRs in Bikaner and Jaisalmer districts of western Rajasthan.

Levels of attitude of farmers towards CPR	Attitude among farmers selected from different districts (%)		Pooled data
	Bikaner (N=480)	Jaisalmer (N=240)	N=720 (%)
Less favourable	18.9	24.7	21.8
Favourable	46.7	38.6	42.7
More favourable	34.4	36.7	35.5

3.3 | People's Participation in Management of CPRs

The extent of people's participation in different stages of CPR management is presented in Table 3. The major activities in planning stage, activities include participation in meetings conducted by gram sabha, suggestions of CPR areas needing intervention, etc.; developmental stage includes contribution of labour or tools or money for plantation activities, irrigation and protection to ensure maximum survival of trees/ shrubs/grasses, while in maintenance stage, activities include contribution of labour or tools or money for periodic cleaning or minor repair of community ponds or maintenance of pastures, watering of trees, enforcing community rules for sustainable use of resources, reporting major damages to panchayat, etc. Data reveal that, in Bikaner district, the highest level of participation (56.4%) was exhibited by farmers during the development stage of CPRs, followed by 52.5% participation in maintenance stage and 50.4% participation in planning stage of CPRs. The overall People's Participation Index (PPI) exhibited by local people in management of CPRs in Bikaner district was 53%, indicating a moderate level of participation. In Jaisalmer district, maximum 73.7% participation was exhibited in development stage, followed by 68.5% in planning stage and 62.4% participation exhibited by local people in maintenance stage of CPRs in selected villages. The overall PPI for Jaisalmer district was 67.7%, which was higher than that for Bikaner district, which might be because of the greater dependence on CPRs due to more extensive rangelands and higher reliance on pastoralism combined with lower agricultural production in Jaisalmer, compared to the more stable agricultural production system in Bikaner owing to the higher coverage of irrigation assured facilities due to the Indira Gandhi canal thus reducing dependence on CPRs.

The pooled data from both the districts showed that highest participation (65.1%) was exhibited by respondents in development stage of CPRs, followed by 59.4% during planning stage and 57.5% during maintenance stage. According to PPI value, it was revealed that the pooled overall extent of people's participation in sustainable management of CPRs was measured 60.3% in the selected villages of Bikaner and Jaisalmer districts of western Rajasthan. Community participation is widely recognized as a key determinant of successful common property resource management, and higher levels of participation generally lead to improved sustainability and equitable resource use (Fidler *et al*., 2022; Jodha and Bhatia, 1998). In addition, positive attitude is associated with perceived benefits from the CPRs and its sustainable management such as better fodder and water availability for longer duration, improved livelihoods, and long-term community welfare, which encourages greater participation in different stages. Similar findings have been reported by Pretty (2003), who observed that rural communities maintain positive attitudes towards shared natural resources when they contribute directly to household subsistence and income security. The relatively higher participation during the development stage in both the districts compared to planning and maintenance stages suggests that community involvement is often more activity-driven, while long-term planning and upkeep receive comparatively less attention. This pattern highlights the need for strengthening institutional mechanisms, such as the constitution of CPR management boards, to ensure sustained community engagement across all stages of CPR management.

TABLE 3 People's Participation in management of CPRs in Bikaner and Jaisalmer districts of Western Rajasthan.

Different stages of CPR management	People's participation (%)		Pooled data (N=720) (%)
	Bikaner (N=480)	Jaisalmer (N=240)	
Planning stage	50.4	68.5	59.4
Development stage	56.4	73.7	65.1
Maintenance stage	52.5	62.4	57.5
Overall PPI	53.0	67.7	60.3

* where N is the sample size

3.4 | Ecosystem Services from Water Pond and Pasture Land CPRs

The ecosystem services derived from village water pond CPRs are presented in Table 4. The availability of water for drinking and for livestock is a critical factor for sustenance of livelihoods in the interior and rural areas of western Rajasthan, where the supply of water through pipelines is uncertain, making them more dependent on village ponds or other small water bodies. The results from study indicated that pond water availability in the selected villages of Bikaner and Jaisalmer districts extended for an average of 9.3 months (from July to March) during the years 2019–2023. Due to water availability in village ponds, approximately 28.7% more water recharge was observed in nearby wells, which contributed to an average 26% increase in cropping intensity in adjacent agricultural fields, cultivating mainly pearl millet (bajra) and cluster bean (guar).

TABLE 4 Benefits derived by local people from village water pond CPRs in western Rajasthan.

Type of benefits	Quantity/Value
Area irrigated	28.7% more water recharged in nearby wells
Cropping intensity increase	26% in nearby farms
Employment generated	1 person per family employed for 100 days in a year as labour under MGNREGA
Quality of pond silt obtained and used	2.9 trolley of silt used per family per year
Water availability for livestock	8 animals per family used 87.1 liters of water per day for 9.3 months in a year
Water availability for domestic use	31.5 liters water used by each family day for 9.3 months in a year or approximately 8,800 litres of additional water annually per family

On average, 8 animals per family consumed about 87.1 litres of water per day from village ponds for duration of 9.3 months in a year. Additionally, each household, having an average of 5-6 members per household, used approximately 31.5 litres of water per day for domestic purposes during the same period. Government programmes have played an important role in generating employment and strengthening the management of common property resources in rural areas, with initiatives such as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) supporting the creation and maintenance of community assets through activities like water conservation, desiltation of village ponds, and afforestation, thereby providing wage employment to rural households (Hughes *et al.*, 2024). Our study also supports this statement, recording employment generation among the villagers, with one person per family being employed for about 100 days annually as labour in pond-related activities. Furthermore, an average of 2.9 trolleys of pond silt per family per year was utilized for agricultural purposes.

Traditional water harvesting systems have long been recognized as vital for enhancing water security and agricultural productivity in arid and semi-arid regions (Dupdal *et al*., 2024). These findings also demonstrate the multifunctional role of water pond CPRs in enhancing water security, supporting livestock, improving agricultural productivity, and generating employment in arid regions. Village local people should be motivated for participation in desiltation and strengthening of earthen embankments of village ponds for harvesting more water.

The data as shown in Table 5 highlights the provisioning ecosystem services provided by the pasture land CPRs. The fuel wood needs of the landless and marginal households were met mainly from the common grazing lands, and survey revealed that on average, 9.69 quintals of fuel wood were collected by each family during the year from pasture CPRs in the villages of Bikaner and Jaisalmer tehsils of hot arid region of Rajasthan.This may be assumed to save ₹ 6000 to ₹ 10,800 per household (in terms of money saved from purchase of LPG cylinders saved, assuming 12 cylinders are used per year at rates ranging from ₹ 500-900 per cylinder).

Most of the households in these rural areas are having livestock based economy. The pasture land CPRs provide fodder in terms of palatable grasses, fodder from trees like *khejri*, *ber*, *jal*, *babool,* etc. Each family grazed on average 8 animals in pasture CPRs every day, highlighting their importance for sustaining livestock-based livelihoods especially during the arid and drought prone conditions.

Additionally, an average of 9 quintals fencing materials such as branches of *Prosopis juliflora* (bavli), *Acacia nilotica* (babool), *Ziziphus nummularia* (bordi) etc. was collected per family from pasture CPRs per year; and the pasture also serves as a source of nutrient-rich alternate food sources. Food materials collected from pasture CPRs included Ker (*Capparis decidua* berries), Sangri (*Prosopis cineraria* pods), Ber (*Ziziphus nummularia* fruits), Pilu fruit (*Salvadora persica*), Khumbhi (Desert mushroom), Khimpoli (*Leptadenia pyrotechnica* buds), Phogla (*Calligonum polygonoides* buds/flowers) and gum (edible gum from *Acacia nilotica*). Though typically collected for domestic consumption, the fruits of ker, sangari as well as the desert mushrooms are sold in nearby markets, fetching a good price. The total quantity of food materials collected averaged 29 kg per family per year in both districts. These results emphasize the role of pasture CPRs in providing diverse provisioning ecosystem services that contribute to food and nutritional security of rural households and their role in the economy of the area. The local people can be encouraged to raise grasses in pasture lands for grazing of animals on sustainable basis.

Pretty (2003) quotes that common resources, in India,

help the rural poor earn almost US$5 billion annually; highlighting the importance of CPR ecosystem services. Other studies also highlight the potential of the CPRs to be developed as biodiversity sites, silvo-pastures and for ecosystem services. However, the study also revealed several challenges affecting the sustainability of CPRs. It was observed that land of pasture CPRs in several villages have been encroached upon by local people. Communities sometimes lack the understanding necessary to recognise the potential harm of their actions, where interventions by the higher bodies may be necessary. An interesting fact observed in *Jangloo* village, Nokha tehsil in Bikaner, was the association of the pasture and pond CPRs with their local god, ensuring that there was no encroachment and unsustainable harvesting of trees or shrubs by the local people. Appropriate steps by the local bodies to ensure the protection of CPRs is necessary, so that the common land is available for animal grazing and for better utilization of CPRs.

TABLE 5 Benefits derived by local people from pasture land CPRs in western Rajasthan.

Benefits derived by local people	Average quality collected		Average of both districts
	Bikaner district	Jaisalmer district	
Fuel wood	7.9 qtls $Fly^{-1}yr^{-1}$	11.47 qtls $Fly^{-1}yr^{-1}$	9.69 qtls $Fly^{-1}yr^{-1}$
Grazing of livestock	7.10 animals $Fly^{-1}yr^{-1}$	9.47 animals $Fly^{-1}yr^{-1}$	8.29 animals $Fly^{-1}yr^{-1}$
Fencing materials	11.78 $qtl^{-1}Fly^{-1}yr^{-1}$	6.4 $qtl^{-1}Fly^{-1}yr^{-1}$	9.09 $qtl^{-1}Fly^{-1}yr^{-1}$
Food materials			
I) Ker	4.23	5.05	4.64
ii) Sangari	5.42	5.45	5.44
iii) Ber	5.87	3.86	4.87
iv) Pilu fruits	2.18	2.0	2.09
v) Khumbhi	6.42	7.73	7.08
vi) Khimpoli	3.28	5.10	4.19
vii) Phogla	1.34	3.81	2.58
viii) Gum	1.38	1.48	1.43
Sub-Total	30.12 Kg $Fly^{-1}yr^{-1}$	34.48 Kg $Fly^{-1}yr^{-1}$	32.32 Kg $Fly^{-1}yr^{-1}$

*where qtls=quintals, Fly=Family, yr=year

3.5 | Major Vegetation in pasture CPRs

The vegetation has also undergone changes in the pasture CPRs over the years. The density of trees, bushes, and grasses in pasture land CPRs is presented in Table 6 . Among palatable tree species, *Acacia tortilis* (156.7 plants ha^{-1}) and *Prosopis cineraria* (39.5 plants ha^{-1}) were predominant, while non-palatable *Prosopis juliflora* recorded a density of 53.9 plants ha^{-1}. The major palatable shrubs found were *Calligonum polygonoides* (740.3 plants ha^{-1}), followed by *Acacia jacquemontii* (341.6 plants ha^{-1}) and *Ziziphus nummularia* (253.3 plants ha^{-1}); and non-palatable shrubs were *Aerva javanica* (1033 plants ha^{-1}), followed by *Leptadenia pyrotechnica*, *Cassia angustifolia* and *Calotropis gigantea*. Predominantly, palatable grasses found were *Ochthochloa compressa*, *Cenchrus biflorus*, *Lasiurus scindicus*, *Cenchrus ciliaris*, and palatable forbs found were *Bekar*, *Kanti*, *Lapdi*, *Silavari*, *Magari*, and *Kakaroti* and non-palatable forb found was *Dhamasa*. The average productivity of grasses was found 6.06 quintals dry biomass per ha in pasture CPRs in the Bikaner and Jaisalmer districts of western Rajasthan. In general, the CPRs are home to a variety of perennial grass species, some of which have very high forage value, along with a few prickly trees, bushes, and shrubs, thus supporting higher biodiversity (Misra and Kumawat, 2020). However, the presence of invasive and non-palatable species, particularly *Prosopis juliflora*, indicates suppression of useful biodiversity and reduced availability of quality fodder resources. This finding supports the need for targeted pasture management interventions to enhance palatable species composition and improve biomass productivity. The spread of *Prosopis juliflora* has been widely reported as a major ecological concern in arid and semi-arid regions due to its suppressive effects on native biodiversity and pasture productivity, leading to widespread global discussions on its management aspects (Josephat *et al*., 2025; Singh *et al.,* 2024; Gaur *et al*., 2020).

4 | CONCLUSIONS

The study clearly highlights the critical role played by Common Property Resources in sustaining rural livelihoods in the hot arid ecosystem of western Rajasthan by providing water, fodder, fuel wood, food materials, and employment opportunities. However, moderate levels of people's participation and the presence of invasive species and encroachment pose serious challenges to sustainable CPR management. The favourable attitude of farmers in the present study indicates the potential for strengthening community-based management approaches for CPR conservation and sustainable utilization. Strengthening community participation across all management stages through local institutions and promoting inclusive decision-making and adopting appropriate regeneration and protec-

tion measures are essential for ensuring long-term sustainability and equitable utilization of CPRs. In addition, creating awareness about the provisioning services provided by the CPRs should be emphasized and locals should be encouraged to maintain and improve the biodiversity in these areas to ensure sustained livelihood and nutritional security. As seen in some villages, the pasture CPRs may be taken up for few years by the forest department, for restoration and regeneration of native biodiversity in the area, so that it may benefit the local rural population in the long run. In fragile ecosystems like the arid western Rajasthan, the CPRs also act as a buffer against climatic and economic uncertainties, by providing some form of economic and nutritional security for the local population, in the form of fruits and forest produce from the native vegetation. Overall, the findings of the present study underscore the need for integrated and participatory management strategies to ensure sustainable utilization and regeneration of CPRs in the hot arid regions of western Rajasthan.

TABLE 6 Average density of trees, bushes and grasses in pasture land CPRs in western Rajasthan.

Palatable		Non-Palatable	
Common Name (Scientific name)	Density/ (nos. per ha)	Common Name (Scientific name)	Density/ (nos. per ha)
Trees			
• Israeli babool (*Acacia tortilis)*	156.73	• Mesquite (*Prosopis juliflora*)	53.9
• Khejri (*Prosopis cineraria)*	39.55		
• Babul (*Acacia nilotica*)	15.00		
• Jaal (*Salvadora persica*)	4.67		
• Neem (*Azadirachta indica*)	9		
• Shisham (*Dalbergia sissoo*)	2		
• Kumat (*Acacia Senegal*)	3		
Shrubs			
• Jharberi (*Ziziphus nummularia)*	253.33	• Sonamukhi (*Cassia angustifolia*)	250
• Ker (*Capparis decidua*)	54.78	• Khimp (*Leptadenia pyrotechnica*)	400
• Lana (*Haloxylon salicornicum*)	53.67	• Bui (*Aerva javanica*)	1033
• Phog (*Calligonumpolygonoides*)	740.33	• Aak (*Calotropis gigantea*)	59.33
• Bavali (*Acacia jacquemontii*)	341.67		
Grasses and Forbs			
• Ganthia (*Ochthochloacompressa*)	Avg. 6.06 qtls dry biomass ha^{-1}	• Dhamasa (*Fagonia arabica)*	
• Bhurat (*Cenchrus biflorus*)			
• Sewan (*Lasiurus scindicus*)			
• Dhaman (*Cenchrus ciliaris*)			
• Local grasses like Bekar, Kanti (*Tribulus rajasthanensis*), Lapdi, Silavari, Magari, Kakaroti, *Mollugocerviana*			

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CONFLICT OF INTEREST

The authors declare that they have no known conflict of interest.

DATA AVAILABILITY STATEMENT

All data supporting thr findings of the study are available from the first author upon reasonable request.

AUTHOR'S CONTRIBUTION

GLB: Project execution, questionnaire preparation, survey, data analysis and manuscript preparation; SKR: survey, data analysis, vegetation analysis, manuscript preparation; DK: Project execution, survey, vegetation analysis; SV: vegetation analysis and data interpretation.

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