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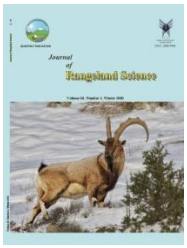

Research and Full Length Article:

Common Property Resources as Village Ecosystem Service Centre in Drylands of Rajasthan, India

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Abstract. There is an enormous stress on livelihood analysis of rural communities and their economies. Village Common Property Resources (CPRs) have played a substantial economic role for the sustenance in rural areas of the drylands. The CPRs of drylands of western Rajasthan, India show a varied range of habitats due to strong functional disparities in topographic, geomorphological, climatic, edaphic and physiographic characteristics. The situation is aggravated due to severe biotic pressure on local ecosystem due to overgrazing and anthropogenic activities. There is an interplay between rural communities and their dependency for livelihood on the CPRs. It is a well-known fact that CPRs more or less act as a village ecosystem service provider in the life and economy of the rural communities of the drylands of India. The main objective of the present study was to make an evaluation of the role of CPRs as a village ecosystem, emphasizing its functioning as a service provider and the socio-economic repercussions of its degradation or loss. It has been revealed that CPRs have played a very important part in the economy of the surveyed villages and the reliance of landless, marginal and small households has remained much higher and critical for their subsistence. There is an urgent need for the sustainable management of CPRs by the village bodies with the active participation of communities.

Key words: Common property resources, Village ecosystems, Service centers, Community, Drylands

Introduction

About 61% of the total area of Indian arid zone is concentrated in 12 western districts of Rajasthan with a total geographical area of 208,751 km^2 with 7 agro-ecological sub-regions and 21 agro-ecological zones (Faroda *et al.*, 1999) where people belonging to different cultural, caste, ethnic and occupational groups inhabit in 17,475 small to medium villages (Gaur *et al.*, 2018). The villages of dryland Rajasthan are not isolated entities but are well connected with several outside units like family, castes, division of labour, exogamy, migration, economic ties, and the market. So, these villages are quite different from villages of the rest of the country (Chouhan, 1967; Sachidananda, l988). According to Dubey (1996), the village has a distinct identity, fixed limits (revenue and forest), village commons, and shared resources like wells tanks and grazing lands. Communities followed caste-based pre-defined traditional occupation and interactions between several castes were maintained by age-old *jajmani* or *yajman* systems (Chakravarti, 1975; Dubey, 1996).

The desert of India exhibits a wide variety of habitats and high biodiversity (Blanford, 1901; Pocock, 1939, 1941; Prakash, 1963) in the various agro-climatic zones. The majority of the area consists of a dry undulating mass of loose sand, thereby, leading to the shifting of sand dunes. The sandy plain is full of sand dunes with several low interdunal depressions where salts are deposited after drying. Trees are rather a few and far (Bhandari, 1990). The drylands of western Rajasthan show a varied range of habitats due to strong disparities in topographic, geomorphological, climatic, edaphic and physiographic characteristics (Sharma and Mehra, 2009). Consequently, several environmental problems like low and high erratic rainfall, high evaporation loss and extremes of diurnal and seasonal temperatures are often encountered (Gaur, 2004; Gupta and Bakshi, 2008; Gaur *et al.*, 2014). The average annual rainfall varies from 456 mm in northeast to less than 100 mm in the westernmost part of Jaisalmer district (Ram, 2013, Gaur, 2013). The coefficient of variability of annual rainfall varies from 40 to 70 percent (Gaur, 2013). The temperature during long hot summer days goes as high as 50°C while in cold winter, it falls below – 6°C. The mean aridity index is 78% and the probability of occurrence of drought varies around 50-60%. The mean moisture index varies from -59.5 in Sikar to -88.9 in Jaisalmer (Krishnan, 1977). The mean maximum expected wind velocity is about 30-40 km h^{-1} but can reach as high as 100 km h^{-1} during severe dust storms. The mean relative humidity during July and August ranges between 75-80%, but during winter, it varies from 46-56% (Gaur and Sharma, 2013, Gaur, 2013). About 45% area has saline to very saline water and 40% moderately brackish groundwater (CGWB, 2013). The vegetation of this region is quite sparse with a limited number of xerophytic plants and thorny bushes (Gupta and Saxena, 1972; Dabadghao and Shankarnarayanan, 1973; Sharma and Mehra, 2009).

Despite these limitations, the Thar desert is the most densely populated desert of the world in terms of human and livestock population (Gaur *et al.*, 2018). It harbors a total domestic livestock population of nearly 30.18 million heads about 52.3% of the State's livestock (Gaur *et al.*, 2018). As per 2011 census, the region had 27.12 million human population. The density of human population varies from 17 in Jaisalmer to 361 in Jhunjhunun district and that of livestock from 83 in Jaisalmer to 274 Sikar (Gaur *et al.*, 2014; Gaur *et al.*, 2018). As a result, severe biotic pressure on its ecosystem and natural resources exists in the form of overgrazing and land degradation. A high livestock population and repeated droughts are the major causes of inducing deterioration in ecosystem

production and regeneration system (Gaur, 2015; Gaur *et al.*, 2016).

Common Property Resources of Drylands

Areas of land or water are used and managed collectively by a community or a group of communities for their livelihood termed as common property resources (Gaur *et al.*, 2018). A very large part of the country's natural resources has remained freely accessible to the rural communities during the pre-British period in India (Muhnot Nainsi, 1968). The "tragedy of the commons" (Hardin, 1968) is a problem that occurs when individuals over-exploit shared or common property resources to such an extent that demands engulf supply and the resource ultimately becomes unavailable or it would be no longer enough to support the demand. In this context, "shared" means that an individual does not have a claim on any part of the resource but rather to the use of the portion of it for his/ her own benefit (Ponse, 2009). The *commons* in the drylands of western Rajasthan include village pastures, community forests, wasteland, common threshing grounds, waste dumps, watershed drainage, village waterbodies (like *baoris, talabs, nadis* and ponds, and tanks, rivers, rivulets, wetlands, riverbeds), community conserved and protected areas, *Dhaam* or *Dhooni*, culturable wastelands, barren & un-culturable land, etc. The area under commons often ranged from 9 to 28% of the total village area (Jodha, 1994; Gaur *et al.*, 2014). Also, a few villages are dedicated to the cause of CPRs and have been functioning as village ecosystem service centers during distress as well as normal periods. Therefore, these village-based CPRs have always remained a strong support-base as well as an important source of livelihood for the sustainability of rural communities (Gaur *et al.*, 2018).

In the drylands, CPRs have played a significant role in the maintenance of ecosystems through their contributions to social equity. Jodha (1985a and 1985b) has conducted pioneering studies on CPRs at the village level in the dry regions of India. It has worked as baseline data for designing strategies for the sustained development of the rural poor (Gaur and Squires *et al.*, 2018). The present paper results from the socio-ecological studies of four villages of three agro-climatic zones of drylands of western Rajasthan. The main objective is to make an evaluation of the role of CPRs in the village ecosystem, focussing on its functioning as a service provider and the socio-economic implications.

Study Area

The four selected villages represents three different diverse agro-climatic zones – hyper-arid, arid and semi-arid. Odhania village is situated in Jaisalmer district, Doli and Melwa villages in Barmer and Jodhpur districts, and Dhurasani in Pali district representing hyper-arid, arid, semi-arid and dry sub-humid zones, respectively (Fig. 1). The selected villages represent unique characteristics like low and high erratic rainfall, extremes of diurnal and seasonal temperatures, low relative humidity and high evaporation loss. The coefficient of variability of annual rainfall varies from 40% to 70%. Mean relative humidity during July and August ranges between 75% and 80% and during winter from 46% to 56% (Narain *et al.*, 2006). Vegetation is sparse and limited in number. Mostly xerophytic plants and thorny bushes dominate.

Selected villages are predominantly agriculture and livestock based. Agriculture is rain-fed and livestock rearing includes both stall feeding, semi-migration and nomadic pastoralists. Village grazing land-pasturelands are the main sources of grazing for cattle, mainly sheep and goats. The community grazing lands are important coping with mechanisms developed by the people of this desert region and preserved through centuries in the interest of desert ecology dealing with the constant threat of drought and famines.

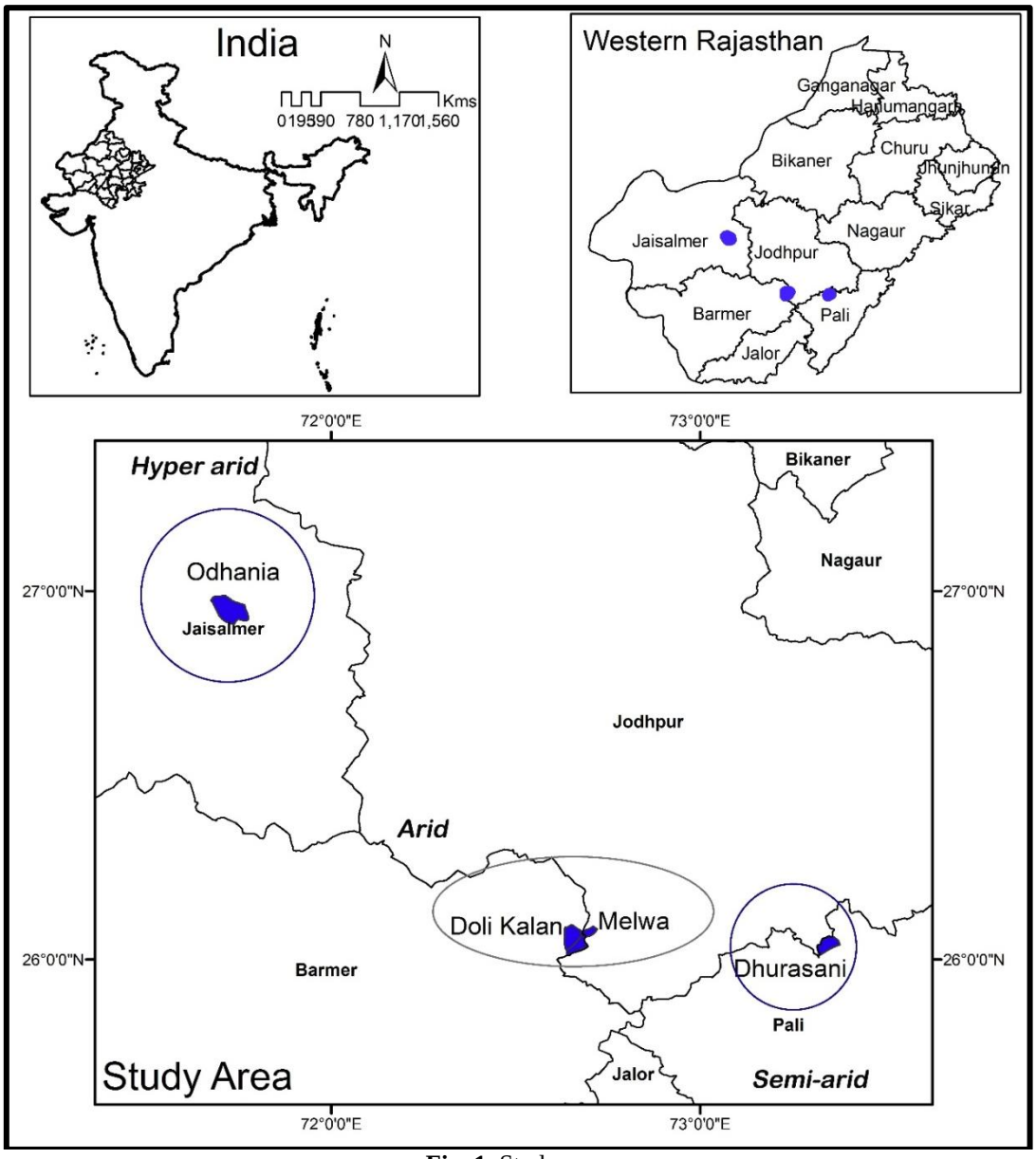

Fig. 1. Study area

The selected villages more or less experience water scarcity and have drought every third year and famine once in five years. The underground water resources are deep and brackish to saline. The monsoon season usually onsets after 15th July and recedes by the last week of September. Winter rain may be experienced. Soils are sandy to sandy loam with coarse to a fine texture. The characteristics of selected villages are presented in Table 1.

Table 1. Characteristics of selected villages for study

Characteristics	Odhania	Doli Kalan	Melwa	Dhurasani
Block and District	Sankra, Jaisalmer	Balotra, Barmer	Luni, Jodhpur	Sojat, Pali
Area	5357.2 ha	3549.9 ha	2195.0 ha	2263.5 ha
Agro-climatic zones	Arid	Arid	Arid	Semi-Arid
Average Rainfall (mm)	209.5	295.7	310	470
Average Annual Temperature (°C)	26.5°	27.1°	27.0°	26.6°
No. of households	334	345	225	273
Human Population (2011)	2132	2056	1350	1466
Human Population (2015-16)	2385	2661	1422	1826
Density (persons km^{-2})	45	75	65	97
Growth of Population (2011-15)	11.87 %	29.43 %	5.33 %	25.56 %
BPL[1] Card-holder Families*	89	104	33	87
Area under CPRs (ha.)	1966.20	236.68	144.00	751.0
(% CPR of total area)	(36.7)	(10.0)	(6.6)	(33.2)
Persons per ha. of CPR area	1	19	9	35
Work Profile				
• Main Workers	43.0%	61.85 %	37.76%	85.87%
• Cultivators**	3.56%	21.45%	15.63%	18.08%
• Agricultural labour	0.09%	0.78%	0.00%	0.07%
• Marginal workers	57.0%	38.15%	62.24%	14.13%
Number of Operational Land Holdings (%)				
• Landless families	3.9	4.3	4.0	2.2
• Marginal (< 1 ha)	3.0	3.8	9.3	28.9
• Small (1 to 2.0 ha)	4.2	5.5	12.9	23.4
• Semi-medium (2.0 to 4.0 ha)	10.1	13.6	22.2	22.0
• Medium (4.0 to 10.0 ha)	46.9	34.2	29.8	15.4
• Large (10.0 ha & above)	31.9	38.6	21.8	8.1
Livestock Population	22.2	19.8	12.9	26.2
Cattle	0.1	10.3	5.2	17.3
(2012) (%)	38.1	23.2	21.7	26.3
Buffalo	39.1	45.6	59.7	28.1
Sheep	0.5	1.1	0.5	2.2
Goat				
Camel				
Livestock density (heads km^{-2})	102	169	209	66

*Source: http://food.raj.nic.in/DistrictWiseCategoryDetails.aspx

** Percentage derived from total population of the village.

[1]Below Poverty Line

Materials and Methods

The present study is primarily experimental in nature. Basically, the data were collected from primary as well as secondary sources. The data collection was made with the Focus Group Discussions (FGDs) in Odhania (Jaisalmer district), Doli-Melwa (Barmer-Jodhpur district) and Dhurasani (Pali district) villages to find out the trend of resources utilization from the Community Grazing Lands (CGLs). These FGDs included members from different classes, castes, gender, age group, etc. of these selected villages (Table 2). A special focus was laid upon pastorals as they solely depend for their livelihood on the CGLs of the respective village and a semi-structured random survey method was applied. The data obtained during the course have been represented while discussion with one group included 'village leaders' who shared their views on behalf of the larger community and another with 'pastoral community members'. The involvement of elderly among discussions was significant to gain the perspective in the history of dependence, resources generated from CGLs, flora, and fauna, herd size, seasonal variations, etc. were all considered for data collection. Most

respondents belonged to the ages of 18 to 60.

A semi-structured household interview schedule was applied to collect information regarding demography as well as socio-economic characteristics of households, occupational pattern and sources of livelihood, landholdings, tenure, and production, collection, use and dependency on community lands, etc. The area and extent of the CGLs existing at present were determined by Resourcesat-2 LISS-III satellite data and ground truthing. On the basis of their land holdings, the households were classified into different income groups (Table 2).

Table 2. Composition of Focused Group Discussion (in %age)

Characteristics		Dhurasani (Pali district)	Doli Kalan (Barmer district)	Melwa (Jodhpur district)	Odhania (Jaisalmer district)
Discussion Groups (gender-wise)					
	Male	57.14	60.00	56.25	70.00
	Female	42.86	40.00	43.75	30.00
Caste:	General	50.00	36.00	31.25	36.67
	OBC	14.29	24.00	50.00	26.67
	SC/ST	14.29	32.00	18.75	23.33
	Minorities	21.43	8.00	NA	13.33
Profession-wise					
	Agriculture	21.43	44.00	31.25	40.00
	Pastoral	7.14	4.00	12.50	16.67
	Housewives	28.57	24.00	18.75	16.67
	Trading	14.29	8.00	18.75	6.67
	Transportation	7.14	16.00	6.25	13.33
	Government Job	21.43	4.00	12.50	6.67

OBC: Other Backward Castes; SC: Scheduled Caste; ST: Scheduled Tribe Caste

The open-ended questionnaire based interviews with the villagers indicate that approximately 20 to 40% of commons (as compared to 1960s) have been encroached by the neighboring fields farmers for the purposes of extending their farm areas and housing purpose. However, there have been no *pucca* (solid and permanent made of stones, brick, cement, concrete, etc.) houses built on the encroached land. Such a portion of the land is used for individual cultivations. Such most frequent incidences relate to the encroachment of CGLs, especially lands by the means of cultivating or covering with crops or trees.

Result

As per the Census 2011, the selected villages had a collective population of 7004 persons. The majority of the population in Doli Kalan and Dhurasani village is dominated by main workers. Whereas in Melwa and Odhania villages, marginal workers are dominant. As per the definition adopted during Census 2011 operations, those workers who had worked for the major part of the reference period (i.e. 6 months or more) were termed as *Main Workers* whereas workers who had not worked for the major part of the reference period (i.e. less than 6 months) were termed as *Marginal Workers* (*censusindia.gov.in/Tables_Published/A-Series/A-Series_links/t_00_009.aspx*). On the basis of the industrial category of workers, the *Main Workers* were further classified into four categories like (i) Cultivators, (ii) Agricultural Laborers, (iii) Household Industry Workers, and (iv) Other Workers (*http://www.arthapedia.in/index.php?title=Worker_(Census_Definition)).*

Based on the Census 2011 and field survey data, it is calculated that the population of the Odhania village is growing at a rate of 11.87%, Doli Kalan at

29.43%, Melwa at 5.33% and Dhurasani at 25.56%. The average density of Odhania village is 45 person km^{-2}, Doli Kalan is 75, Melwa is 65 and that of Dhurasani is 97 person km^{-2}. As we move away from the hyper-arid area (Odhania) to dry sub-humid area (Dhurasani), the density of population is increasing. The increase in density shows more dependency on the community grazing lands for domestic fuel, fodder, fiber, herbs and even for drinking water (for fulfilling requirements of livestock) (Table 3). In comparison to the other dry zones of the world, the population density in this dry zone is extremely high. The study also reveals that the available CPRs (people per hectare) are in the range of 6.56 to 35.65. Also, there are numerous environmental constraints associated with dry zones like the relief, the poor quality of soil, and frequent failure of rainfall, extremes of temperature, high wind speed, and the large areas under culturable wastelands, the *per capita* land holding size is reasonable here, 5 ha in Kalyanpur block of Barmer district, 15.0 in Sankra block of Jaisalmer, 6.8 ha in Luni block of the Jodhpur district and 3.6 ha in Sojat block of the Pali district. The average size of the operational land holding is 3.96 ha in the State.

According to the revenue record, the village CPR lands fall into seven groups: village pastures and groves, scrublands, sand dunes, wastelands, waterbodies (village ponds for drinking purpose), fallow lands (seasonal), and roads. Among other lands which are a part of CPRs, there are cremation grounds and land earmarked for use as public toilets.

Changing contours of CPRs in the Thar Desert

Investigations into the village level records and personal interview (through the application of open-end questionnaire) with elderly persons of these villages revealed that both the area and the productivity of the CPRs in terms and quality and quantity of products have severely declined. People say that the contribution of the CPRs towards the village economy was quite better in the 1940s and 1960s than now. The physical loss of the CPR lands started only after 1980s when land prices soared to new heights and the government, through local *gram panchayats* (*Gram panchayats* (village councils) are the grassroots-level elected bodies for formalizing local self-governance system in India at the village level, and has a *Sarpanch* (Head) as its elected head), took possessions for housing settlement for Below Poverty Line (BPL) families, widening of village roads, construction of new school buildings, primary health centers, *Panchayat Bhavans* (official buildings for elected local bodies), *Anganwadi Kendras* (pregnant mother and child health care centers), *Seva Kendras* (community service centers), forest plantation, etc. (Table 3).

Table 3. Benefits derived from village CPRs

S. No.	CPRs	Benefits
1	Village grazing lands (*Gauchar*)	Grazing of animals, fodder, fuel, and collection of some medicinal property parts of the plants (grass, shrub, trees, etc.). Some of the grasses are consumed by human beings.
2	Sacred groves (*Orans*)	Fodder, fuel collection of some medicinal property parts of the plants (grass, shrub, trees, etc.) and also grazing on fallen plant material
3	Village pond *(talabs* and *nadis)*	Village waterbodies/ reservoirs, providing drinking water for human and livestock; silt of the pond is sold due to its high fertility content
4	Fallow lands (seasonal)	Grazing of local livestock
5	The catchment area of watershed or waterbodies (*Agor* and *pachor*)	Clean water for year-round drinking purposes and recharge of groundwater in downstream
6	Stepwells (*Baoris)*	Used to provide water for year-round drinking purposes.
7	Culturable wastelands	Grazing of animals, fodder, fuel and livestock drinking, and provided shelter to the wildlife.
8	Scrublands	Grazing purpose, fodder, fuel and also a collection of some medicinal property parts of the plants (grass, shrub, tress, etc.), provided shelter to the wildlife.

Fuelwood Need: The fuelwood need of the village, especially landless, marginal and small households is largely met from the grazing land, fallow lands and scrubland (It is an area of land which is uncultivated and covered with sparsely distributed natural trees and bushes) of the village. These lands are under the direct control of the elected body of the village. Villagers have been freely allowed to collect litter from the trees like *Azadirachta indica, Prosopis cineraria, Prosopis juliflora, Tecomella undulata, Salvadora oleoides, Balanites aegyptica, Capparis decidua, Calotropis procera, Ziziphus nummularia,* etc. Table 4 reveals the dependence of landless, marginal, small and semi-medium households of each village on CPRs for fuelwood. People also use *Crotolaria burhia, Dactyloctenium sindicum, Eleusine flagellifera, Leptodenia pyrotechnica, Euphorbia caducifolia,* etc. for fuel. Even though many affluent households have got Liquefied Petroleum Gas (LPG) connections and are refilling gas cylinders from gas agencies located in the nearby town but still, households belonging to landless, marginal, small and semi-medium landholders cannot afford it. These minor forest products are collected during dry seasons (particularly during the post-monsoon period) by these families and they draw such support directly from the CPRs whereas the fuelwood collection is done during pre-monsoon (dry) period and again during the post-Spring season when litterfall from the trees is at a maximum. The average annual income of the landless, marginal, small and semi-medium households ranges from Indian Rupees 2000 to 7000 (USD 33 to 117) (One USD equals to INR 60).

Table 4. Fuelwood consumption (kg/day)

Village	**Dependent households on CPR land for fuelwood (%)**	**Average fuelwood[a] consumption (kg day^{-1} household^{-1})**
Odhania	21.3	10.3
Doli Kalan	27.3	9.8
Melwa	44.0	10.1
Dhurasani	76.6	9.9

[a]Data collected from landless, marginal, small and semi-medium households and fuelwood includes fallen as well as chopped shoots of the trees; tree litter; dung of the cow and buffalos, etc.

Animal husbandry system: It is not well developed in the selected villages due to insufficiency of quality community grazing lands. Since aridity is a constant feature in

this area, the composition of vegetation mainly consists of woody plants (trees and shrubs) during most of the year and grasses grows when there is sufficient rain at regular intervals. So, the leaves of thorny woody trees like *Prosopis cineraria* (locally known as *khejari*), *Ziziphus nummularia* (known as *Pala*), *Calligonum polygonoides* (phog), *Salvadora oleoides* (jal), *Tecomella undulate* (rohida), *Grewia tenax* (kankeda), *Balanites aegyptica* (hingota), *Acacia Senegal* (kumat), *Calotropis procera* (dhatura), *Z. mauritiana* (jhar ber), *Acacia nilotica* (babool), etc. are collected as fodder and given to the livestock. Sheep and goat together constitute 73.79% livestock population (Fig. 2). It shows that the people are highly dependent upon the sheep and goats due to their easy availability, economic importance and swift adaptability to the climatic variations. Secondly, stall-fed animals are not much preferred due to the unpredictability of the weather and limited availability of grazing lands in the area. The bovine animals are mostly stall-fed in the lean season in these villages.

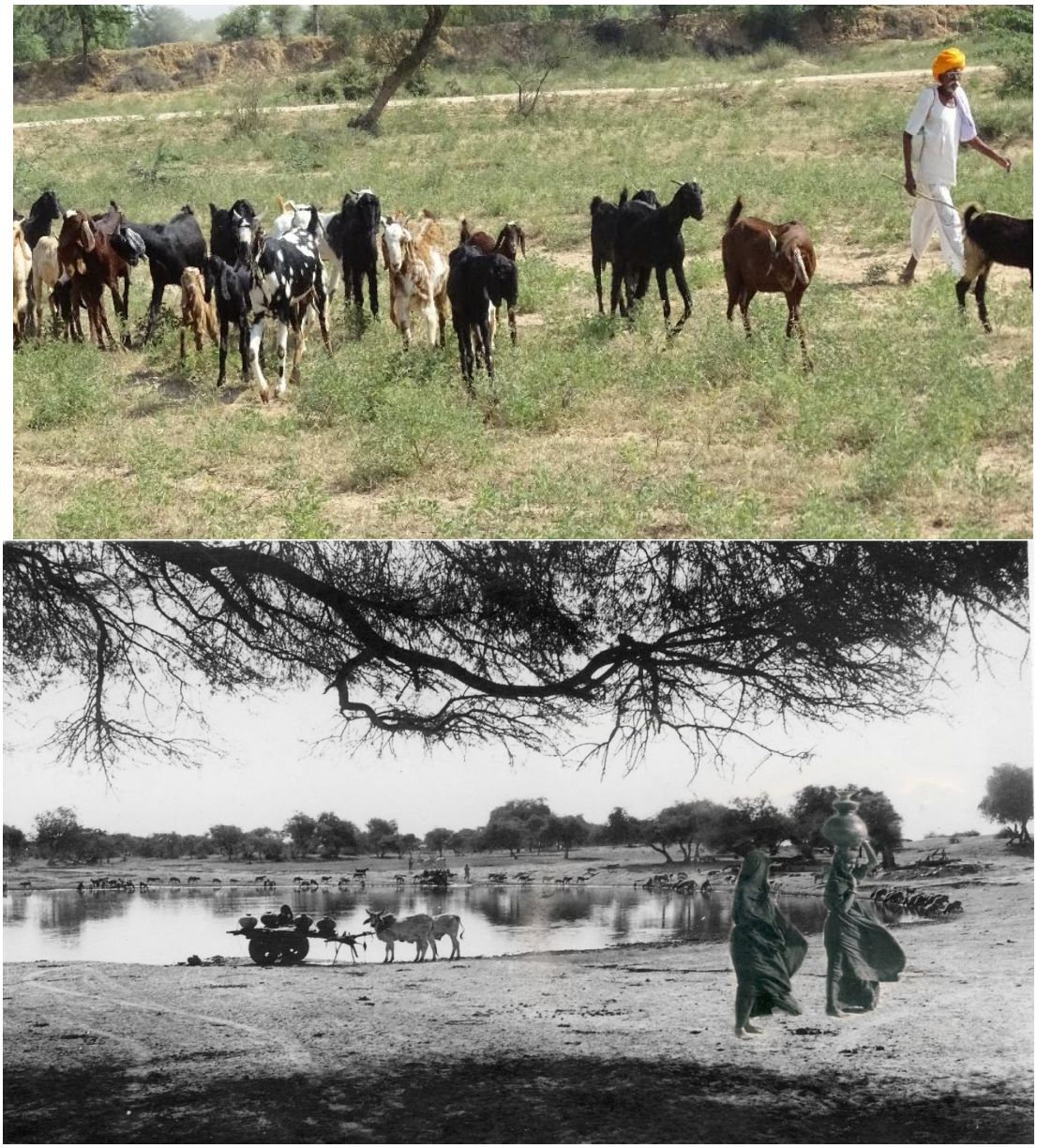

Fig. 2. Benefits of CPRs: (a) Livestock grazing in community grazing land; (b) Community pond: Source of drinking for human beings and the livestock

The majority of the fodder for these stall-fed animals comes from their farm fields in Dhurasani village whereas in Doli Kalan, Melwa and Odhania villages, it is either purchased from private sellers or the government fodder camps. Due to heavy grazing pressure, the grazing lands have become more or less unproductive as sheep and goats can graze upon the last blade of grass. These villages have a large number of households in the landless, marginal and small landholder categories, i.e. they have less land left for grazing purpose. So, the larger portion of the animals belonging to these households also depends on the village CPRs. The animals are graze freely and degrade the village CPR further. Moreover, unproductive animals are deserted by the owners and depend upon the CPRs for survival. However, the grazing is sometimes supplemented by fodder such as chopped stalks of pearl millet, cluster bean, moong bean, sesame mixed with leaves of *P. cineraria* and *Z. nummularia.* It was revealed during Focus Group Discussions (FGDs) with the community members that pastoral households used all the resources more than non-pastoral household. The collection of top leaves by pastoral households are nearly four times as compared to the non-pastoral household. The resources like fuelwood, thatching top leaves and fodder from CPR are collected and used for consumption by both pastoral and non-pastoral households.

Apart from the animals, the dried ripened yellow fruits or pods of *Prosopis cineraria*, locally called *Kho-Kha*, are eaten by human beings too. The fruits of *Capparis decidua (*kair) and *Prosopis cineraria* (unripened green pods are locally known as *sangari*) have gained a popularity as a portion of exotic food, fetching the locals a good price. Usually, green unripe pods are also used as an animal feed, which is prepared by drying the young boiled pods. The dried green pods are consumed as a dried vegetable by human beings. Local inhabitants consume the green and unripe pods (*sangri*) for *curries* and pickles.

Collection of foodstuffs: Dryland of western Rajasthan is rich in the wild xerophytic plants. They are assumed significant as alternative food sources in this zone, particularly during periods of scarcity like drought and famines. There are several fruits bearing nutrient-rich plant species like *Ziziphus nummularia, P. cineraria, Calligonum polygonoides, Ziziphus mauritiana, Capparis decidua* (*kair*), etc. that provide means of survival as well as a food supplement for poor and landless households. Typically, these are collected for domestic consumption and rarely sold in the market. Except for pods of *Capparis decidua, P. cineraria* and *Acacia Senegal*, people have not thought about making it as an enterprise or source of income. Pods of *Capparis decidua, P. cineraria,* and *Acacia Senegal* are sold at a very high price in the market, e.g., berries of *Capparis decidua* ranges from Rs. 500 kg^{-1} to 1500 kg^{-1} (USD 8 to 25). Smaller the size, higher is the market price. The plucking of berries is a time-consuming process and usually, it is done by kids and women.

Balanites aegyptiaca (locally known as *Hingota* or *Hingona*) is found on open sandy plains of Pali and Jodhpur districts. Fruits, young shoots and leaves are very often used by the locals for various purposes. Every mature tree yields 100 to 150 fruits. *Calligonum polygonoides* (locally known as *phog*) is a shrub which grows on the sand dune. It is found in the entire arid zone and flowers are consumed as a salad with curd or fried. *Salvadora oleoides* (known as *jhal*) is extensively found in sand dune areas of Barmer, Bikaner, Churu, Jaisalmer, Jalore, Jodhpur and Nagaur districts. The yield of fruits (known as *piloo*) is 10-15 kg per mature tree. Fresh fruits of *piloo* are sold at the rate of Rs. 50-75 kg^{-1} (¢ 0.83 to $1.25) in the market. Berries of *Z. mauritiana* (known as *jhar ber*) is extensively found in any type of topography in the arid zone.

Depending upon the cultivar, its yield ranges between 45-85 kg fruit tree^{-1} under rainfed conditions of the dry area. It is sold at the rate of Rs. 25-50 kg^{-1} (¢ 0.42 – 0.83).

There are enough opportunities provided by the CPRs towards employment and income generation of the rural communities provided these items are collected at the appropriate time of their life cycle.

Change in vegetation varieties in the common property lands from the 1980s to present

Table 5 reveals the changes in vegetation composition in the community grazing lands. It has been revealed during FGDs with community members that grasses have decreased as the natural regeneration process is very slow due to intense biotic pressure, overgrazing, extraction of fodder and fuelwood, deterioration in soil quality and land degradation. Respondents from these villages participated in this exercise to find out decline/ change in high nutritive value grass species, herbs/ shrubs, and trees in common land.

Table 5. Vegetation changes in the selected common grazing lands from the 1980s onwards

a.	**Dhurasani**
	• In forbs and shrub, the highest population decrease was observed *Cyperus rotundus* (15-20%) whereas the highest population increase was observed in *Tribulus terrestris* (10-15%). • The highest population increase under grasses was observed in *Cenchrus biflorus* (10-15%). • In tree species, the highest population increase was observed in *Prosopis juliflora* (40-50%) whereas the highest decrease in population was observed in *Salvadora oleoides* (10-12%)
b.	**Doli Kalan**
	• In forbs and shrub, the highest population decrease was observed *Cymbopogon jwarancusa* (5-10%) whereas the highest population increase was observed in *Corchorus tridens* (10-15%). • The highest population increase in case of grasses was observed in *Ochthochloa compressa* (30-35%) whereas the highest decrease in population was observed in *Dichanthium annulatum* (30-35%). • In the tree, the highest population increase was observed in *Prosopis juliflora* (25-30%) whereas the highest decrease in population was observed in *Tecomella undulata* (>40%).
c.	**Melwa**
	• The highest population increase in grasses was observed in *Ochthochloa compressa* (30-35%) whereas the highest decrease was observed in *Dichanthium annulatum* (25-23%). • In tree species, the highest population increase was observed in *Prosopis juliflora* (25- 30%) whereas the highest decrease in population was observed in *Tecomella undulata* (60%). • In the case of shrubs and forbs, the highest population decrease was observed *Leptadenia pyrotechnica* (10-20%) whereas the highest population increase was observed in *Cyperus rotundus* (15-20%).
d.	**Odhania**
	• The highest population decrease under grasses was observed in *Cenchrus setigerus* (70-80%), *Euphorbia hirta* (90-100%) and *Lasirus sindicus* (90-100%). • In the case of forbs and shrub, the highest population decrease was observed *Calligonum polygonoides* (40-50%) whereas the highest population increase was observed in *Indigofera cordifolia* (25-30%) and *Calotropis procera* (30-35%). • In tree species, the highest population increase was observed in *Prosopis juliflora* (>30%) whereas the highest decrease in population was observed in *Prosopis cineraria* (>5 -15%).

It is clear from the above Table 5 that the share of highly nutrition valued grasses like *Cenchrus setigerus* (*Dhaman)* and *Lasirus sindicus* (*Sewan*) has drastically decreased (and ultimately through lost habitat) because of high grazing pressure, decrease in productivity of pastures and improper maintenance. Community members have revealed during the course of FGDs that majority of tree species are present but densities have reduced appreciably. As per the respondents, the population of *Prosopis cineraria* (*khejri*) and *Capparis decidua* (*kair*) is also dwindling and the tree density is not what used to be four decades ago. Similarly,

densities of *Ziziphus nummularia* (*jhar beri*) shrubs are negligible according to the community members.

Discussion

Challenges to CPRs to Function as Village Ecosystem Service Centres

Historically, human beings have been instrumental in modifying natural ecosystems for their own benefits (e.g. agricultural commodities) but overlooked the invisible vital ecosystem services (DEWHA, 2009). From the 1940s to 1970s, this process of change had been taken at a very slow pace due to a mix of ethical, moral and religious issues. Furthermore, people used to use these CPRs but this use was extremely restricted to personal use and the more materialistic approach as well as grabbing of resources mentality had not taken roots by this time. During the mid-1970s, the green revolution had taken place in the country. Although the sandy soils of western Rajasthan are poor in fertility and nutrients, not very productive but the land grabbing mentality saw large tracts of CPR land taken up. The situation was compounded due to the sudden boom in the land prices in the region during the 1990s. It further caused damage to the CPRs. Even though, Government of India attempted to strengthen Village *Panchayats* (local bodies at village level) through 73rd and 74th Amendments to the Constitution but it could not improve the status of CPRs for reasons that are beyond the scope of this study. After the 1990s, projects like Watershed Development Programs, Education for All, Health for All, Prime Minister's Rural Road Program, etc. were initiated and the land was acquired to develop infrastructure and CPRs became easy prey for all. In particular context of CPRs, the following pertinent challenges are described as below:

1. Lack of awareness and coordination among stakeholders: Apart from village *panchayats*, rural communities of the particular village(s) are natural stakeholders for maintenance, protection, and conservation of the CPRs. But strong commitment and an understanding of the significant value of natural resources for village communities are required for conserving the ecosystem. Take-over of the CPRs by the state for building essential infrastructure such as schools, clinics, veterinary hospitals, housing for government functionaries, Special Economic Zones (SEZ) and industrial corridors, etc. is a cause of serious threat to their existence. Infrastructure projects and investments are either oriented to short-term development goals and even when they consider CPR ecosystem and biodiversity conservation, they are poorly implemented. That is why ecosystem services in CPRs always remain neglected in mainstream models of development.

2. Conflicting ownership issues: There has always been an ownership related conflict between various agencies of the government. Forest Department, Wildlife Department, Watershed Department, Panchayat Raj bodies, etc. all claim ownership over the CPRs. As a result, no single agency is keen to develop, protect and conserve CPR biodiversity. Even they are afraid to create any infrastructure there, leading to its progressive deterioration and encroachment. The Indian Forest Act (1878) was implemented during the British period (Peabody, 2001) and the Forest Conservation Act by the Government of India in 1980. Since then, several amendments have also been incorporated at the Central and State levels to ensure proper management and utilization of forests. Presently, 'the Cattle Trespassers Act' of 1871 is the Act applicable to regulate grazing in public and forest lands. Further, different jurisdictions of government agencies and the categories of land use largely determine which CPRs are *de facto* or *de jure*. The laws provide provisions for custodianship of these lands. Presently, there is no clarity about the ownership rights over CPRs and there are many owners like revenue, forest and local

bodies (Panchayats). The 12th plan of the Planning Commission of India also recognized the importance of the commons and a need for favorable land tenure arrangements, institutional design, and program architecture was highlighted for effective governance and management of the commons. There is a need to further strengthen existing Acts to deal with the present situation of CPRs. National Grazing Policy is also required to ensure sustainable use of pastureland/ grasslands. Presently, there is no clarity about the ownership or use rights over pastureland.

3. Exponential population growth: India has seen uncontrolled population growth after the independence which has brought unnecessary pressure on the natural resources and CPRs were also not spared. For example, the population of Doli Kalan village in 1971 was 843 people, which has increased to 2661 in 2015-16. Similarly, the population of Dhurasani village was just 627 in 1971 but grew to 1826 in 2015-16. Growth in the population at such a pace has caused expansion and intensification of land use, over-utilization of biological resources, loss of habitat and ultimately over-exploitation of CPRs for food, feed, and fodder, environmental and social services.

4. Poverty: In India, nearly 40% rural people who are largely dependent on CPRs suffer from poverty. Nearly 30% of the total land, 40% of the total forest and bulk of the water resources and fisheries are CPRs and traditionally have been used by the rural poor (Singh *et al.*, 1996) and it continues to be one of the major challenges of our time. Poverty has been a curse on the natural resources because poor people directly depend heavily on the natural resources for survival as well as consumption of CPRs ecosystem services. Poor farmers and pastoralists draw from CPRs to support their livelihoods, poverty, food insecurity and insufficiency contribute much to habitat loss and land fragmentation as a result of the loss of community areas and pressure due to cultivation (Gaur and Squires *et al.*, 2018). One of the major causes of the rural poverty in India is the unequal access and control of the poor on CPRs (Jodha, 1986; Singh *et al.*, 1996). Therefore, efficient use of CPRs at grass-root level play an important role in generating and sustaining the source of livelihood for the rural poor.

Conclusion

The study reveals that the quality and quantity of village CPRs has declined the case of Odhania village that is typical. These CPRs have also become unproductive due to severe grazing pressure and improper maintenance due to lack of interest. The pastoral community's traditional livelihood is based on grazing of animal on the pastoral area of the village (common property) and old fallow in cultivated area. So, the dependency of the pastoral households on CPRs was quite a lot higher in the past and pastoral people relied upon the resources to a greater extent than the non-pastoral households. There is a need for undertaking concerted efforts to rejuvenate the productivity of these CPRs. Rural communities should also protect CPRs from encroachments from anyone because the survival of village livestock is entirely dependent upon the existence of productive CPRs (Gaur and Squires *et al.*, 2018). Even, landless, marginal and small households also depend upon the CPRs for fuel, fodder, water, and foodstuffs. It is a mainstay of their livelihood. Conservation of the CPRs and proper recycling involve human labor as an important energy input (Maikhuri and Ramakrishnan, 1990; Nishanka and Mishra, 1990) which is the actual function of ecosystem services. The villages CPRs help for the sustainable development, maintenance and regulation of the village ecosystem properly. It will help in meeting daily fodder and fuelwood requirements of the landless and smaller households. The contribution of CPRs continues to be more in the context of a survival strategy for the rural population.

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Glossary of local terms:

Jajmani systems or yajman system: It was a typical caste-based economic-cum-social system in India. Lower castes used to perform various activities for upper castes for receiving food grains and other edible items in return.

Dhaam: It is a holy place where saints stay until attaining salvation/ divinity.

Dhooni or dhuni: It is a holy place where another saint has lived and attained divinity or salvation by practicing penance and austerity.

Baori: These are step-wells, usually used for fetching water for drinking and domestic purposes. These are quite deep.

Talab: These are village ponds/ tanks and their source of water is monsoon rains only. Water stored in these is used by human as well as livestock for drinking purposes.

Nadi: These are another kind of rainwater harvesting ponds in a rural area. Size varies. The water of these is used by human as well as livestock for drinking purposes. These are traditional water source systems.

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چکیده. تاکید بسیاری بر روی تجزیه و تحلیل معیشت جوامع روستایی و اقتصاد آنها وجود دارد. منابع طبیعی مشترک روستایی (CPRs) نقش حیاتی را در اقتصاد روستاهای مناطق خشک بازی می‌کنند. این مناطق در ایالیت راجستان هند، طیف متنوعی از زیستگاه‌ها را به دلیل اختلافات خیلی زیاد توپوگرافی، جغرافیایی، اقلیمی، عوامل خاک و فیزیوگرافی در خود دارند. این زیستگاه‌ها به دلیل فشار شدید زیست محیطی بر اکوسیستم محلی، چرای بیش از حد و فعالیت‌های زیاد انسانی در معرض خطر می‌باشند. باید بیان نمود که میان جوامع روستایی و وابستگی آنها به معیشت در مناطق مشاع تعاملی وجود دارد. این واقعیتی است که منابع مشاع چرای دام بعنوان یک منبع اصلی خدمات اکوسیستم در مناطق روستایی در زندگی و اقتصاد این جوامع در ایالیت‌های خشک هندوستان می‌باشند. هدف اصلی این تحقیق بررسی نقش CPR ها به عنوان اکوسیستمی از روستا، تأکید بر عملکرد آن‌ها به عنوان ارائه دهنده خدمات و پیامدهای اجتماعی و اقتصادی تخریب یا از دست دادن آنها می‌باشد. نتایج نشان داد که CPR ها نقش مهمی در اقتصاد روستاهای مورد بررسی بازی کرده‌اند و وابستگی خانوارهای بدون زمین، حاشیه‌ای و کوچک، بسیار بیشتر و حیاتی برای امرار معاش به آنها بوده است. بنابراین باید توجه داشت که نیاز مبرمی به مدیریت پایدار CPR ها توسط افراد روستایی با مشارکت فعال این جوامع وجود دارد.

واژگان کلیدی: منابع طبیعی عمومی، اکوسیستم‌های روستایی، مراکز خدماتی، جوامع، سرزمین‌های خشک