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Characterizing Vegetation of Playa Lake Surfaces as Potential Grazing Resources for Arid Livestock in Western Rajasthan

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Abstract: Playa lakes or Ranns characterized by ephemeral waterbody are the common hydrological features in most arid lands. These water bodies hold rainwater for a few months which gets dried up with time and letting adapted vegetation (grasses/herbs/shrubs) to germinate and grow. Local pastoralists depend heavily on these lands to graze their livestock, thus these vegetation resources come under high grazing pressure, creating a case of land degradation. In the present article vegetation resources of two playa lakes called Meetha (non-brackish) and Khara (brackish) Ranns from Jaisalmer district have been reported. The results are based on field surveys, measurements and information gathered on ethnic importance of vegetation. The study found occurrences of two true halophyte species within the Rann surface *viz. Aeluropus lagopoides* locally known as 'Bukan' and *Cressa cretica* called as 'Oaen'. In the surrounding catchment area, *Ochthochloa compressa* (Gathia), *Panicum turgidum* (Murath) and *Crotalaria burhia* (Sinia) were dominant.

Key words: Playa lakes, Ranns, vegetation, halophytes, grazing resources, arid environments.

Playa lakes are one of the important physiographic units of hot arid desert ecosystem. In hot arid western part of Rajasthan, playas occur in 565 km^2 area out of which about 66% area lies within arid district of Jaisalmer, Barmer, Bikaner, Jodhpur and Churu. Playas occur in different morpho-edaphic situations such as in sandy or even in rocky terrains (Moharana *et al*., 2013; Moharana, 2017). Playas of Sambhar (Jaipur district), Didwana (Nagaur district), Tal Chhapar, (Churu district), Pachpadra (Barmer district), Thob & Bap (Jodhpur district) and Lunkaransar (Bikaner district) are largely located in sandy terrain while those of Jaisalmer district like Lawan, Pokaran, Dediya, Meetha Rann, Kanodwala Rann and Khardariwala Rann are located in extensively rocky terrain. Salts and evaporites brought by run-off from surrounding catchments during rains accumulate in these sites. The surface of playa remains dry for large part of the year. The sediment profiles generally indicate alternate layers of silt, clay and sand, as well as gypsum at some places (Anonymous, 1992; Deotare *et al*., 2004). Different postulations have been proposed on the basis of geomorphic studies to explain the origin of different playas lake formations *viz*. riverine connection of the Pachpadra and Didwana lakes (Aggarwal, 1957), evidences of salt deposition at the confluence of streams, especially at Pachpadra (Ghose, 1964). The process of deflation in the wake of high hills, dune formation along the hill margins and trapping of ephemeral channels in the deflation hollows led to the formation of many playas in eastern Thob (Kar, 1990; 1993). According to Kar (2011) a long-continued process of sand blasting on softer limestone beds formed the playa basins in Jaisalmer-Mohangarh area, while process of neo-tectonism might have played a major role in the formation of Sambhar lake and some small playas in the Luni basin. Studies also indicated that playas near Dediya, Lawan and Pokaran, were formerly connected through a stream. Soils and groundwater are saline in this area. The pH of soil is 7.6 at surface to 7.4 at 40-60 cm depth while EC is 22.9-14.5 dS m^{-1}. Since, these lands tend to accumulate water and sediments; such surfaces sustain vegetation for most part of the year except during rainy season and are regularly utilized as grazing lands. However, with time, many useful species of plants have become extinct. Therefore, it was necessary to survey these lands for an inventory of available plant species and assessing their status. The authors have reported and discussed the results of such assessments in this article on two playas located in Jaisalmer district.

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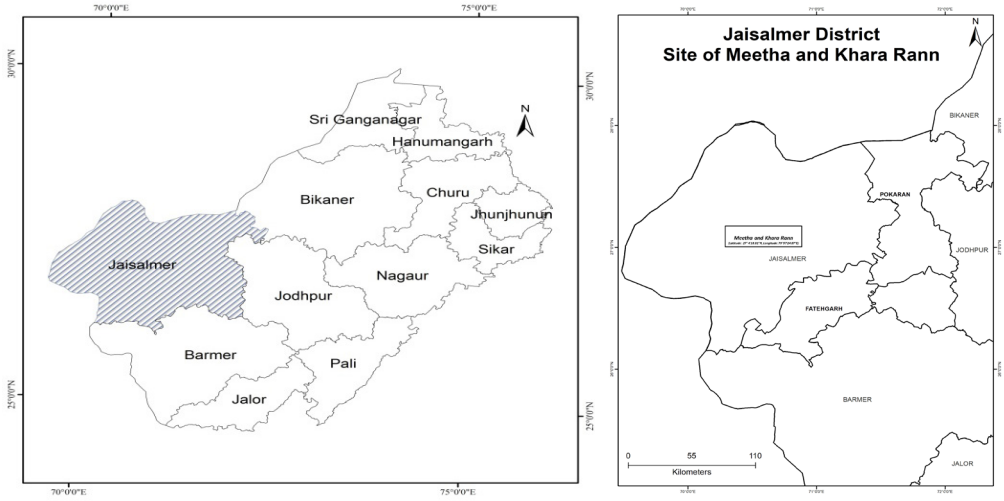

(a). Jaisalmer district in western Rajasthan *(b). Study area, Meetha and Khara Rann in Jaisalmer District*

Fig. 1. Location of Jaisalmer in Rajasthan (a) and of Meetha and Khara Rann (b)

Location and Environment

The Meetha and Khara Ranns occur in Jaisalmer district, the western extreme of India. The district has two forms of desertic conditions; sandy and rocky. These playas occur within the part of rocky desert. Lodurva, Pohar and Lanela are important nearby villages. Mean total annual rainfall ranges between 200 to 250 mm occurring in about 12 rainy days (https://mausam.imd.gov.in/jaipur/district_extreme.php). The Survey of India toposheets (No.40 I/16 and 40 M/4), published during 1959 also mentioned these Ranns or playas as Meetha and Khara Rann, indicating normal and brackish nature of sediment respectively.

Methodology

The methodology involved field survey of Meetha and Khara Rann, personal interviews with the local grazers, use of satellite images for interpreting the bio-physical features like present landform, land use/land cover and vegetation resources. Field survey of these two playa lakes (Ranns) were conducted during the first week of March, 2022. The Rann area and its surrounding catchments were traversed and observations on type of landforms, vegetation, soil and water quality were recorded randomly within and outside the Rann area. Satellite images of high resolution (IRS-LISS IV) were used for mapping the physical features like landforms, land cover etc. Besides, information about the use of these Ranns for grazing was collected through interaction with local inhabitants and the grazers. For vegetation appraisal, standard quadrats of 1 m x 1m size were placed on the surface to identify, assess, characterize and quantify the vegetation.

Results

***Physiography and Landforms of Studied area*:** The landforms of both sites are presented in Fig. 2. Topographically these surface features are local depressions or flat plains (155 m msl with 0 to 1° slope) being surrounded by a higher relief due to rocky undulations and low sand dunes with contour value of 160 m. The landform map (Fig. 2) prepared using interpretations from satellite images and in GIS showed distribution of low sand dunes (at elevation 170-180 m), low residual rocky uplands and stony/gravelly plains (170-200 m) in the surrounding catchments. Area of Meetha Rann is 2788 ha and of Khara Rann is 1370 ha. Runoffs are generated from the rocky uplands during rains flows to these depressions through natural slope and remain stagnated there for 3-4 months depending upon the rainfall. The stagnated water dries up later but subsurface retains some moisture and adapted vegetation thrives on them which are helpful for grazing of livestock of surrounding villages.

***Vegetation types in the Rann site*:** Vegetation types identified in the Meetha and Khara Rann sites and their surrounding are given in Table 1, Fig. 3 (a-h) & Fig. 4 (a-d). Vegetation inside both Ranns was dominated by two true

Table 1. Plant species in outside and inside of Rann area

Site/landform types	Plant species	Description
Outside the Rann/Khadin bund area	*Ochthochloa compressa* (Gathia), *Crotalaria burhia* (Sinia), *Panicum turgidum* (Murath), *Salvadora oleoides* (Meethajal), *Leptadenia pyrotechnica* (Kheep), *Aerva javanica* (Bui) and *Tamarix* spp. (Farash)	*O. compressa* and *P. turgidum* are important grass species; *C. burhia* and *L. pyrotechnica* are shrub species while *Salvadora oleoides* is an important tree species occurring in desert region of Rajasthan. Whereas, *Tamarix* spp. is a halophytic shrub occurring only in saline area of Thar desert.
Within the Rann area	Dominance of two true halophyte species viz. *Aeluropus lagopoides* locally known as 'Bukan' and *Cressa cretica* called as " Oaen"	*A. lagopoides*is a short height perennial grass and *C. cretica* is a small forb of family Convolvulaceae. *C. cretica* is considered as one of the important medicinal plant in Ayurvedic system and called '*Rudanti*' in Hindi.

halophytic species i.e. *Aeluropus lagopoides* (L.) Trin. ex Thw. and *Cressa cretica* L., with sporadic distribution of *Portulaca* spp. in West and patches of *Zygophyllum simplex* in North side in Khara Rann. Presently, livestock of nearby villages graze on these two halophytes. In the North side of Meetha Rann, there is a small patch dominated by *Cyperus* spp., a member of family Cyperaceae. One interesting thing in both Ranns is the sporadic occurrence of *Prosopis juliflora* (Swartz.) DC. (Fig. 4h). However, in north side of both Ranns, and in east side of Khara Rann the population of *P. juliflora* is more at outside the Rann area. Since this is a wild and invasive species, there is urgent need to root out these plants to check the menace of this species. Vegetation on surrounding catchments side was dominated by *Ochthochloa compressa* (Forsk.) Hilu (Gathia), *Panicum turgidum* Forsk. (Murath) and *Crotalaria burhia* Buch.-Ham. ex Benth. (Sinia), whereas, sporadic occurrence of *Salvadora oleoides* Decne. (Meethajal), *Leptadenia pyrotechnica* (Forsk.) Decne. (Kheep) and *Aerva javanica* (Burm. f.) Juss. ex Schult. (Bui) in both Ranns. One halophytic shrub/tree *Tamarix* spp. (Farash) was reported only on surrounding side of Khara Rann.

Field measurements and ethnic importance of vegetation in the Rann area: Plant population and growth of two key dominant species i.e. *A. lagopoides* and *C. cretica* within

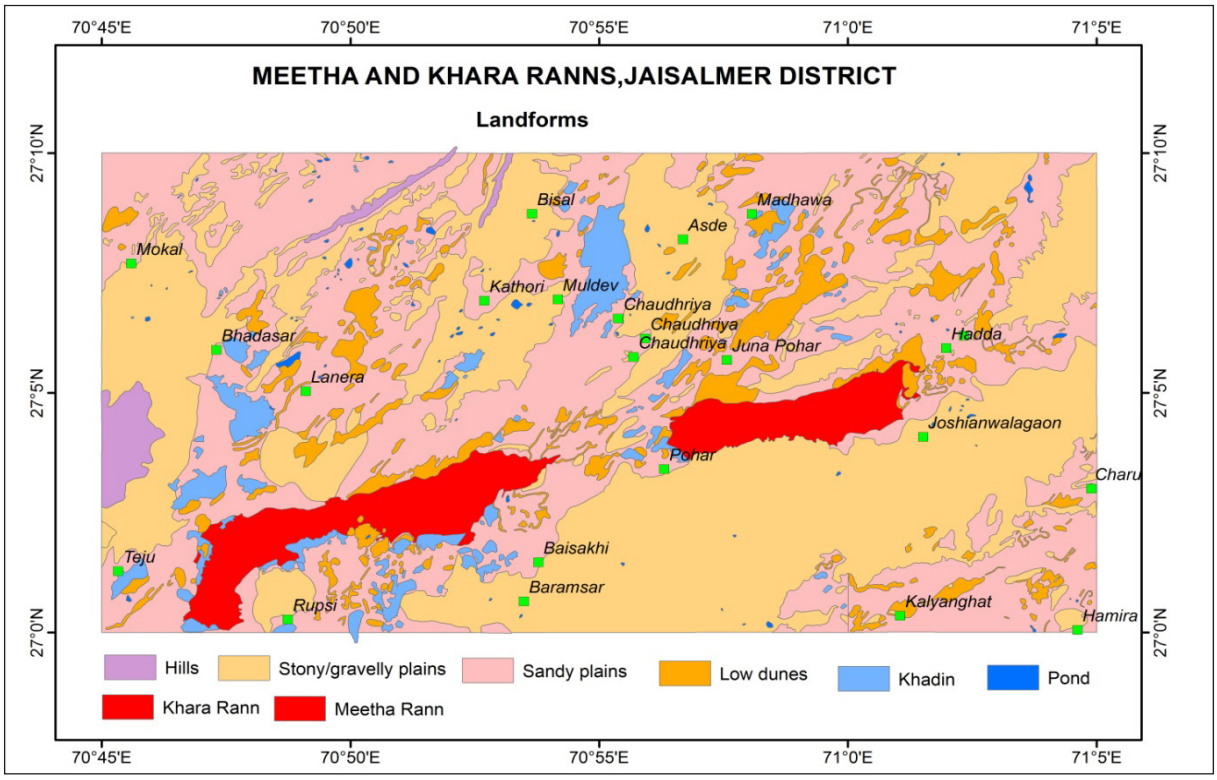

Fig. 2. Distribution of landforms and water bodies in the study area.

Table 2. Plant population of Aeluropus lagopoides and Cressa cretica in the Meetha rann and Khara rann

Plant Species	Number of plants (m^{-2}) in different sides of the Rann (Average)											
	North		South		Central		East		West		Average	
	MR*	KR**	MR	KR	MR	KR	MR	KR	MR	KR	MR	KR
A. lagopoides	74.0	45.1	36.0	37.5	42.5	-	65	33.0	16.5	53.5	48.3	42.3
C. cretica	34.5	3.5	41.0	10.0	17.5	-	-	32.5	107.5	5.5	50.1	12.8
Total number of plants	108.5	48.6	77.0	47.5	60.0	-	65	65.5	124.0	59.0	98.4	55.1

*Meetha Rann ** Khara Rann

the Meetha and Khara Rann area was measured by laying down $1m^2$ random quadrate in all the directions i.e. extreme south, north, east, and west and at the centre of the Rann site (Fig. 4c). The plant population of *A. lagopoides* was 48.3 plants m^{-2} and *C. cretica* was 50.1 plants m^{-2} in Meetha Rann, whereas, in Khara Rann the plant population of *A. lagopoides* and *C. cretica* was 42.3 and 12.8 plants m^{-2} respectively. However, the population of these two dominant species was not evenly distributed (Table 2). The presence/dominance of these species was very much influenced by the soil salinity factor and also the grazing pressure by the animals.

In Meetha Rann, *A. lagopoides* was observed in all the sides, but it dominated in northern and eastern side followed by central, southern and western side. *C. cretica* was very much dominant in western and southern side followed by north and central part. Interestingly, *C. cretica* was totally absent in the eastern part where flow of water is received from the *Khadin* areas. As far as plant growth is concerned, better plant growth and greenness was observed in central, western and northern side, than in extreme southern portion. Overgrazing by livestock could be a reason for it as main Jaisalmer-Ramgarh road passes through this side which provide more opportunity to livestock by grazer. Whereas, in Khara Rann, *A. lagopoides* and *C. cretica* were observed in all the sides except in central part because of stagnant highly saline water. *A. lagopoides* was dominated in western and northern side followed by south and eastern side. *C. cretica* dominated in eastern side followed by southern, western northern side. Plant growth and greenness were better in western side of the Rann. The overall greenness was low in Khara Rann as compared to Meetha Rann. Overall, plant population of the *C. cretica* was more compared to *A. lagopoides* in Meetha Rann whereas, in Khara Rann plant population of *A. lagopoides* was more. These differences could be due to preferential grazing by different animals in the herds of livestock.

A. lagopoides locally called as *Bukan* is one of the preferred grasses by goats but *C. cretica* locally known as *Oaen* is preferred by sheep. Buffaloes, camel and cattle graze both species. One of the grazers informed that sheep drink more water after grazing *C. cretica*. Eating of *C. cretica* is believed to increase blood, milk and wool and production in sheep. Also the problem of cough (khansi) in sheep is believed to drastically reduced if they graze *C. cretica* in the Rann. However, some grazers believed that over grazing/eating of *C. cretica* may create health problem in sheep, locally known as 'Phrakia'.

Grazing pressure in Ranns: The Meetha and Khara Ranns are the known grazing sites for the livestock of the surrounding villages nemely Baramsar, Lanela, Rupsi Pohra, Hadda and Choudhariya villages of Jaisalmer district. Other than this cluster of villages, as per local pastoralists, livestock from other far off villages like Kheenvsar also come to these sites regularly for grazing. During normal rains, the water collected within the Meetha rann remains stagnant for about three months which is reduced to 7 to 8 days in case of sporadic rains. Normally sheep herds graze on Rann for 2 to 3 hours in a day. During the annual camel festival which is held in the month of February, this Rann area is also used for horse racing and other cultural activities which erodes the available vegetation. During the field survey, we also noticed grazing by a number of herds of livestock on this land. As per the respondents, more than 23,000 livestock including cattle, sheep, goat and camel graze in the Meetha Rann area which is roughly equivalent to ~~say~~ 8500 adult cattle unit (ACU) grazing pressure over this Rann site (Table 3). In Khara Rann, rain water remains

Fig.3 (a) Meetha Rann: Grazing of livestock inside Meetha Rann; (b) Interaction with the grazer and collection of information about livestock visiting; (c) Recording of vegetation data and collection of soil samples; (d) Close up view of Aeluropus lagopoides; (e) Close up view of Cressa cretica; (f) Reporting of small patch of Cyperus spp. in north side of Meetha Rann; (g) Showing root tubers in Cyperus sp. and (h) Sporadic occurrence of Prosopis juliflora.

Table 3. Estimate of animal grazing pressure in Rann area

Livestock	Approximate Number	Total ACU*
Cattle	5000	5000
Sheep	15000	2500
Goat	3000	500
Camel	500	500
Total		8500

*ACU: Adult cattle unit.

stagnant throughout the year in central part and gradually dries up on periphery of rann. As per the respondents, mostly cattle and camel visits for grazing and drinking of water. Goat, sheep and other livestock visited occasionally. Farmers allowed livestock for drinking of Khara rann water up to March month only and not allowed in summer because salinity increases gradually when water is evaporated. More than 3500 livestock including cattle, camel, goat and sheep graze in Khara rann.

Discussion

The major halophyte species reported at Meetha and Khara Rann of Jaisalmer were *A. lagopoides*, and *C. cretica*. Mangalassery *et al.*, (2015) have also reported the dominance of these species at different sites of salt Rann of Kachchh, Gujarat, India. Reported density of *A. lagopoides* was 1.7 m^{-2} to 33.8 m^{-2} and of *C. cretica* 0.33 m^{-2} to 120.9 m^{-2}. Along with this, one *Cyperus* spp. was also identified in salt Rann of Kachchh. Joshi *et al.*, (2018) and Singh *et al.*, (2019) have described valuable information regarding different halophytes of Thar Desert which are potential source of nutrition for livestock in saline area. Animal husbandry is major source of livelihood for the local inhabitants. The hot arid region has reached about 29.25 million total livestock population in the year 2001 from 10.34 million in the year 1951 (Tewari and Arya, 2005). This is very high ACU grazing pressure in Ranns

Fig. 4. (a) Khara Rann; (b) Water stagnant in central part; (c) Grazing of cattle in periphery of Khara Rann, and (d) Vegetation of surrounding catchment area -close up view of Tamarix spp.

of Jaisalmer which has been aggravated land degradation and remove more palatable plant species like 'Rata khad' as one of respondents told us during survey and interaction. Further, removal of invasive plant species like *P. juliflora* and control grazing in this Rann is going to increase overall productivity and conserve the existing plant diversity.

Conclusion

The survey and interaction with the grazers brought out some interesting facts on a very useful plant species locally called as 'Rata khad'. Once, this species was one of the important fodder species in the Rann area but gradually disappeared due to high grazing pressure. This species, however, could not be traced even in nearby areas. To minimize occurrence of such extinction controlled grazing with shifting of livestock of different villages should be adopted. Introduction of other fodder halophytes (*Haloxylon* spp., *Suaeda* spp. and *Sporobolus* spp.) should also be attempted to reduce the competition and increase feed resources for livestock. Additionally, anthropogenic activities should be reduced and rehabilitation work in the form of development of silvi-pastoral system should be followed for overall improvement and productivity of these Ranns. However, further research is also needed for nutritive and anti-nutritive factors present in these halophytes for its wider use and safe consumption.

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