Grasslands of Arid Kachchh, India: Present Status and Management Strategies for Higher Productivity

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Introduction

The hot arid region covers an area of 31.70 million hectares in India, covering seven states that include Rajasthan, Gujarat, Punjab, Haryana, Andhra Pradesh, Karnataka and Maharashtra. The arid region in Gujarat is distributed in eight districts namely, Kachchh (100% of the district area), Jamnagar (80%), Surenderanagar (29%), Junagadh (20%), Banaskantha (18%), Mehsana (7%), Ahmadabad (6%) and Rajkot (6%). Gujarat accounts for 19.6% of the total arid zone in the country of which Kachchh district alone accounts for more than 70% arid area of the state (Shamsudheen *et al.*, 2009). Under the conditions of low and erratic precipitation, high evapotranspiration and poor soil physical and fertility conditions, grasses and trees form the major vegetation that make natural rangelands and hence grasslands form one of the major ecosystem types in Kachchh. There are two major unique grassland ecosystems in Kachchh, namely Banni and Naliya. Banni, once referred as Asia`s finest grasslands cover an area of 2,617.72 km^2 constituting 51.56% grassland area in Kachchh whereas Naliya grassland is covered in 654 km^2 (12.89%) (GEER GUIDE, 2011). Banni alone constitute 45% of the permanent pasture and 10% of the grazing land available in Gujarat state (Patel, 2013). However these grasslands are under degraded condition due to biotic and abiotic factors including climatic factors, overgrazing, invasion of *Prosopis juliflora*, construction of dams and salinity ingress (Dayal *et al.*, 2009b). To revive the grasslands introduction of native and potential alternate grasses are needed along with scientific management practices (Dayal *et al.*, 2009a). The objective of this paper is to highlight the current status of research findings on measures to improve grassland productivity of rangelands in Kachahh region.

Materials and Methods

A series of research experiments were carried out to explore elite germplasm of native grasses in Kachchh at Central Arid Zone Research Institute, Regional Research Station, Kukma-Bhuj, Gujarat, India from 2004 to 2008. Experiments were conducted from 2008 to 2012 to identify legume forages that have potential to grow faster and supply protein to animals when introduced into rangelands. Research studies on combining grasses and legumes in silvipastoral combination with trees were also conducted. Research on halophyte plants as potential fodder resource is being carried out since 2013.

Results and Discussion

Out of 24 germplasm lines of birdwood grass (*Cenchrus setegirus*) evaluated for two seasons during 2004 and 2005 indicated that germplasm significantly differed for all the traits. The germplasm lines CAZRI-BH-CS-15 and CAZRI-BH-CS-3 recorded increased dry and green fodder yield. Based on the increased genotypic coefficient of variation with respect to number of leaves, green and dry fodder yields accessions numbers CAZRI-BH-CS-3, 4, 7, 13, 19 and 24 found promising which could provide material for further improvement (Ram *et al.*, 2011). Germplasm evaluation studies of marvel grass (*Dichanthium annulatum*) during *Kharif* seasons of 2006 to 2008 indicated a significant and linear genotype x environment interaction and the genotype CAZRI-BH-DA-2, 3 and 4 found to exhibit consistently stable high performance (Ram *et al.*, 2013b). The stability analysis indicated that selection based on plant height and tillers per plant will be useful for further improvement in dry fodder yield and seed yield per plant (Ram *et al.*, 2013a).

Three perennial forage legumes namely, wild groundnut, stylo and clitotia were evaluated for their establishment, growth and fodder yield. Four species of wild groundnut, namely *Arachis glabrata, A, rigonii, A. prostrata* and *A. pusilla* were evaluated and *A. prostrata* and *A. glabrata* performed well as their survival was recorded more than 80% over three years. Twenty accessions of *Clitoria ternatia* evaluated for 4 years at Bhuj and two years (2008 and 2009) at Jodhpur. The highest yielder (more than 3.5 t/ha) among clitoria accessions were IGFRI 73-1, JHC 94 CAZRI 752, and CAZRI 1440.

Protein content in clitoria accessions ranged from 15 to 19.8%. Accessions CAZRI 1433, 1440, IGFRI 73 and 94-1 had protein content more than 18% whereas CAZRI 1428 had the lowest protein content of 15%. The protein content and protein yield could also be improved by applying 30 kg N and 60 kg phosphorus per ha. Intercropping of perennial forage

legumes namely clitoria and stylo with grasses enhanced protein yield of fodder. Sole grass yielded 382 kg protein whereas intercropping with clitoria and stylo produced protein yield of 680 and 810 kg/ha, respectively.

The optimum dose for N and P_2O_5 found to be 30-60 kg/ha. This dose of fertilizer not only improved fodder yield but protein as well. Integrated nutrient management including fertilizer and biofertilizer were standardized and 50% RDF+PSB+PGPR gave the best results. The soil of the region is deficient in micronutrients namely, Zn, Mn and Boron. Application of Zn 3kg, Mn 4.50 kg and B 0.6 kg gave better yield and found optimum.

Optimum spacing for Clitoria and stylo were identified as 60 cm producing 2.7 to 3.4 t dry fodder/ha. Adopting seed rate of 15 kg/ha for clitoria and 6 kg/ha for stylo gave the maximum dry fodder yield of 3.35 and 2.71 t/ha, respectively.

Productivity of range land can be increased by intercropping perennial forage legumes with grasses. Experiments conducted for two years revealed that intercropping of clitoria/ stylo with grass (*D. annulatum*) gave total dry fodder yield of 4816-5467 kg/ha.The system was biologically efficient as it gave LER of 1.14-1.38 indicating advantage of 14 to 38% as compared to sole grass. The intercropping not only improved the total fodder production but also improved fodder quality as total protein yield was increased under intercropping system compared to sole grass treatment.

Both clitoria and stylo were demonstrated at the research farm and on the farmer's field as a sole crop and with as an intercrop orchard. At research farm , clitoria (CAZRI 752) adopting INM, micronutrient and optimum spacing with recommended seed rate produced dry fodder yield ranging from 3.17 to 3.2 t/ha, whereas stylo gave production of 2.95 to 3.05 dry fodder. Intercropping of stylo and clitoria with mango orchard was demonstrated on the farmer's field for two years. The result indicated that stylo produced additional dry fodder yield of 2.8 to 3.2 t/ha, whereas clitoria yielded dry fodder yield of 2.5 t/ha with mango orchard.

The studies on halophyte grasses and non-grasses revealed some potential palatable halophytes that could be used for highly saline patches.

Conclusion

The grasslands of Kachchh are in a state of degradation owing to overgrazing, salinity and invasion of Prosopis. Different germplasm of grasses such as C. cliaris, C. setegerus and D. annulatum was identified which could be utilized for revival of these degrading rangelands. The studies on leguminous forage legumes such as wild groundnut and clitoria indicated that these can be successfully integrated to rangelands and can supplement protein to the livestock.

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