



Potential of range grasses for sustainable agriculture and environmental conservation in the arid ecosystem

Reena Rani^{1*}, Archana Sanyal^{2†} and Sunayana³

^{1,2}Scientist, ICAR- Central Arid Zone Research Institute, Jodhpur- 342003 (Rajasthan), India

³Plant Breeder, Dr JC Bakhshi Regional Research Station, Punjab Agricultural University, Abohar – 152116 (Punjab), India

*Corresponding author - reena.rani@icar.org.in

Abstract

Range grasses are increasingly recognized for their significance in sustainable agriculture and environmental conservation. These grasses contribute substantially to soil health, carbon sequestration, and climate change mitigation, while also playing an important role in suppressing invasive plant species. Their extensive and deep-rooted systems improve soil structure, minimize erosion, and enhance water infiltration capacity. In addition, being perennial in nature, range grasses provide greater resilience under changing climatic conditions and represent a sustainable resource for renewable energy production.

Introduction:

A considerable proportion of arid lands across the world is currently undergoing different levels of degradation accompanied by severe vegetation loss. Rangeland ecosystems are deteriorating due to both natural and anthropogenic factors. Among these, continuous overgrazing has emerged as a major cause of accelerated soil erosion and depletion of vegetation cover, ultimately intensifying

desertification processes. Extreme temperatures and prolonged dry spells further expose the soil surface, making it highly susceptible to erosion by wind and water, thereby aggravating land degradation.

The harsh environmental conditions prevailing in arid ecosystems have exerted strong selection pressures over time, allowing only a limited number of plant species to survive and reproduce successfully. Such species possess specialized adaptive mechanisms that enable them to withstand extreme climatic conditions. Important range grasses such as *Lasiurus indicus*, *Cenchrus ciliaris* and *Cenchrus setigerus* are well adapted to desert environments and have considerable potential for fodder production as well as rangeland rehabilitation. Their ability to tolerate prolonged drought and harsh arid conditions makes them highly valuable for restoring degraded desert ecosystems.

Major benefits of range grasses:

1. Soil health and ecosystem services-

- a) *Improvement in soil structure:* The extensive root systems of range grasses

enhance soil aeration, reduce compaction, and improve water infiltration, thereby contributing to better soil physical properties.

- b) *Reduction in wind and water erosion:* The deep roots of range grasses bind soil particles effectively, reducing soil loss caused by wind and water erosion.
- c) *Nutrient recycling:* Range grasses can absorb nutrients from deeper soil layers through their extensive roots, thereby promoting nutrient recycling and improving soil fertility.
- d) *Carbon sequestration:* The ability of perennial grasses to store carbon in below-ground biomass and soil organic matter makes them important contributors to climate change mitigation.
- e) *Ecosystem Restoration:* These grasses are widely utilized in ecological restoration programs for reclaiming degraded lands and enhancing ecosystem stability and resilience.

2. Climate change mitigation and adaptation-

- a) *Climate resilience:* The drought-tolerant and water-efficient nature of range grasses enables them to survive under changing climatic conditions and support resilient ecosystems.
- b) *Reduction in greenhouse gas emissions:* Cultivation of range grasses generally requires fewer tillage operations and lower fertilizer inputs, which helps reduce greenhouse gas emissions associated with agricultural practices.

3. Sustainable agriculture and bio energy-

- a) *Lower input requirement:* Compared with conventional crops, range grasses require minimal fertilizer and pesticide inputs, making them suitable for sustainable agricultural systems.
- b) *Utilization of marginal lands:* These grasses can be cultivated successfully on marginal and degraded lands, thereby reducing pressure on fertile agricultural areas.
- c) *Biodiversity conservation:* Properly managed perennial grasslands provide habitat and shelter for numerous wildlife species, including birds and beneficial insects, thereby supporting biodiversity conservation.
- d) *Biogas production:* Range grasses are being explored as promising feedstocks for biogas production, offering a sustainable and renewable source of energy.

4. Management of invasive plant species -

Due to their competitive growth habit and extensive root systems, range grasses can effectively suppress invasive plant species and help maintain ecological balance in rangeland ecosystems.

Conclusion:

Continuous overgrazing of fragile desert rangelands has accelerated soil erosion, vegetation depletion, and desertification. In this context, range grasses such as *Lasiurus indicus*, *Cenchrus ciliaris* and *Cenchrus setigerus* play a crucial role in the improvement and restoration of rangelands and have already been successfully utilized in reseeding programs. These grasses

possess remarkable tolerance to prolonged drought and harsh desert conditions prevalent in regions of northern India and Pakistan. In addition to their high nutritive value as livestock fodder, they require comparatively low management inputs. Ongoing research continues to highlight their multiple benefits in improving soil health, mitigating climate change, supporting sustainable agriculture, and conserving biodiversity. Their potential for restoring degraded ecosystems and contributing to renewable energy production makes them an essential component of sustainable land management strategies for the future.

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