ICAR – Central Coastal Agricultural Research Institute, Goa

PROJECT INFORMATION

Natural grassland ecosystem monitoring system for peninsular and Trans Himalayan India to sustain pastoral communities

PROJECT OVERVIEW

Funding Agency	National Agricultural Science Fund (NASF)
Total Outlay	289.424 lakh
Duration	3 Years (2024-2027)
Single / Multi-Institutional	Multi-Institutional
Cooperating Centre(s)	ICAR-IGFRI, Jhansi, GBPNIHE, Ladakh Regional Centre, ICAR-IASRI, New Delhi, ICAR-CCARI, Goa
Principal Investigator	Dr. Avijit Ghosh
Co-Investigators	1. Co-PIs of the lead centre: Dr Amit Kumar Singh, Dr J P Singh, Dr A K Shukla, Dr Nagaratna B Biradar (ICAR-IGFRI, Jhansi) 2. PI of Cooperating Centre 1(GBPNIHE, Ladakh Regional centre): Dr Ajay Kumar Gupta, Co-PIs of centre 1: Dr Sandipan Mukherjee 3. PI of Cooperating Centre 2 (ICAR-IASRI, new Delhi): Dr Md Ashraful Haque, Co-PIs of centre 2: Dr. Sapna Nigam 4. PIs of centre 3 (ICAR-CCARI, Goa): Dr Uthappa A R

RATIONALE

Natural grasslands of Amrit Mahal, Banni and Changthang Valley are ecologically important landscapes that support pastoral livelihoods, livestock production, biodiversity and multiple ecosystem services. However, these grasslands are exposed to grazing pressure, degradation, climate variability and changing management practices, while their condition and carrying capacity vary considerably across landscapes. Conventional field-based monitoring is often spatially limited and unable to provide timely information over large and remote areas. Integrating remote sensing, GIS, GPS-based ground observations and ecosystem-service indicators can provide a spatially explicit and repeatable framework for monitoring grassland condition. The proposed study will therefore develop a Grassland Ecosystem Monitoring Index and real-time decision-support system to assess degradation, grazing intensity, carrying capacity and climate-change impacts, thereby supporting evidence-based grassland management and sustainable pastoral livelihoods.

RESEARCH GAPS

- Research Gaps Despite the ecological and livelihood importance of these grasslands, several knowledge and technology gaps remain:
  - Limited spatially explicit monitoring: Lack of an integrated RS–GIS framework for regularly assessing grassland condition, degradation and grazing intensity across Amrit Mahal, Banni and Changthang landscapes.
  - Fragmented biophysical information: Existing information on vegetation productivity, species composition, biomass, soil condition, moisture and management practices is often fragmented and lacks standardized spatial integration.
  - Absence of a composite monitoring index: There is no widely applicable Grassland Ecosystem Monitoring Index that integrates biophysical condition with key ecosystem services to provide a standardized assessment of grassland health.
  - Uncertainty in carrying capacity: Limited spatial and temporal information is available for estimating potential and effective livestock carrying capacity, particularly under changing vegetation productivity and grazing regimes.
  - Climate-change impacts: Insufficient understanding of how temperature, precipitation and other climatic variables influence grass productivity, degradation and the spatial distribution of grassland resources across contrasting agro-ecological regions.
  - Limited real-time decision support: Existing grassland monitoring approaches have limited capacity to provide near-real-time, spatially explicit information to pastoralists, managers and policymakers for timely management decisions.
  - Weak integration of field and geospatial observations: There is a need to systematically integrate GPS-linked ground truthing, conventional ecological observations, satellite-derived indicators and climate data to improve the reliability of grassland assessments.

OBJECTIVES

To retrieve different biophysical parameters and management characteristics such as degradation and grazing intensity using RS-GIS and conventional approach (GPS linked ground truthing) in grasslands of Amrit Mahal, Banni, Changthang Valley b. To develop a composite Grassland Ecosystem Monitoring Index using biophysical parameters and ecosystem services c. To assess the potential and effective carrying capacity of grasslands and the impact of climate change on spatial distribution of grasses d. To develop a decision support system for real time monitoring of grasslands of Amrit Mahal, Banni, Changthang Valley.

ACTIVITIES

Objective 1:

Satellite data acquisition and processing, GPS-based ground surveys, soil and vegetation sampling, laboratory analysis, measurement of soil CO_2 flux, and estimation and validation of grassland biophysical and management parameters using RS-GIS and field observations across two seasons.

Objective 2:
Collection and integration of meteorological data, development of soil and grass spectral libraries using a portable spectroradiometer, assessment of grassland ecosystem services, and development and validation of a composite Grassland Ecosystem Monitoring Index.

Objective 3:
RS-GIS-based mapping and temporal assessment of grasslands, estimation of potential and effective carrying capacity based on biomass production and livestock consumption, and assessment of climate-change impacts on grassland productivity and spatial distribution.

Objective 4:
Development and integration of a Natural Grassland Ecosystem Monitoring System, including spatial databases, monitoring indicators and a web-based decision-support application for near-real-time assessment and management of grassland resources. Data integration, statistical analysis, model validation, documentation, report preparation and dissemination of the Grassland Ecosystem Monitoring System and management recommendations.

EXPERIMENTAL DETAILS

Treatment:	T1 Casuarina (Seedling) T2 Casuarina Clone CH-5 T3 Casuarina Clone OV-15 T4 Casuarina Clone ITC-1761 T5 Eucalyptus Clone ITC-1803 T6 Subabul (Leucaena leucocephala) T7 Melia dubia (K-10) T8 Corymbia Hybrid
Fertilizer Doses	Recommended dosage of fertilizers
Variety	Casuarina (Seedling), Casuarina Clone CH-5, Casuarina Clone OV-15, Casuarina Clone ITC-1761, Eucalyptus Clone ITC-1803, Subabul (Leucaena leucocephala), Melia dubia (K-10), Corymbia Hybrid
Replications:	4.0
Observations:	A. Growth and Productivity Assessment Tree Parameters • Tree height • Collar diameter • Diameter at breast height (DBH)

- Survival percentage Productivity Assessment
- Biomass production
- Wood yield
- Economic returns

B. Wood Property Analysis The harvested wood samples will be evaluated for:
   - Basic wood density
   - Fibre characteristics
   - Pulping suitability
   - Industrial wood quality parameters

C. Soil Property Assessment Changes in soil quality will be assessed through analysis of:
   - Soil physical properties
   - Soil chemical properties
   - Soil biological properties

D. Biomass and Carbon Assessment
   - Above-ground biomass estimation using non-destructive methods.
   - Validation through destructive sampling.
   - Biomass carbon estimation.
   - Soil carbon stock estimation.

Bamboo observations in

1. Survival (%)
2. Number of culms per clump
3. Number of new culms per year
4. Culm height (m)
5. Culm diameter (cm)
6. Internodal length (cm)
7. Clump diameter (m)
8. Culm weight (kg)
9. Pest and disease incidence
10. Overall growth performance

GPS Coordinates: 15.486560, 73.919803

EXPECTED OUTPUT

- Identification of suitable fast-growing tree species and clones for the lateritic soils of the West Coast region.

- Generation of scientific data on wood properties, biomass productivity, and carbon sequestration potential of commercially important tree species.
- Identification and characterization of promising bamboo germplasm for growth, productivity, and adaptability to the lateritic soils and agroecological conditions of the West Coast region.

EXPECTED OUTCOME

- Improved farmer income and livelihood diversification through adoption of high-performing tree species and bamboo germplasm for wood, biomass and value-added industries.
- Enhanced climate resilience and carbon sequestration through increased biomass production, soil carbon storage and wider adoption of suitable tree and bamboo-based land-use systems.

FIELD INFORMATION

When the field was developed:	July 2024
What are crops being cultivated season-wise:	No season wise crops. Only fast growing tree species/clones are grown
Soil type:	Lateritic and gravelly clay loam
Soil pH, EC, OC:	pH 5.5, EC: 0.10–0.14 dS m^{-1};Soil organic carbon (SOC): 0.79–1.10%.
Soil depth:	0-0.60m
Soil NPK and Micronutrient status:	Available N: 44–107 kg ha^{-1} (low); P: 10–13 kg ha^{-1} (low to medium); K: 128–226 kg ha^{-1} (medium)
Common pests and diseases:	No major pest and diseases reported yet