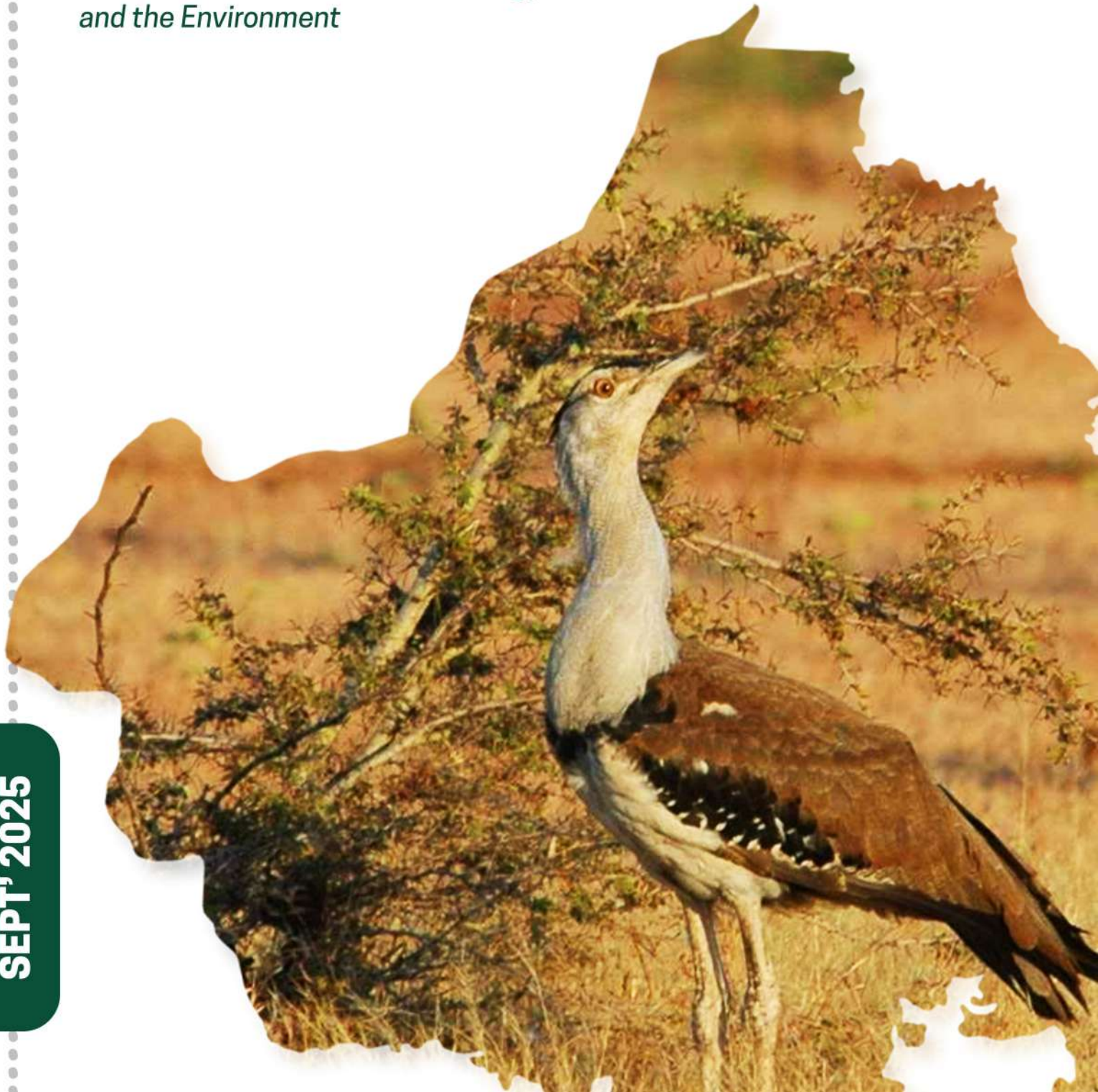
Policy Brief

SANDS AND GRASSES OF 'GOLD': VALUING RAJASTHAN'S OPEN NATURAL ECOSYSTEMS FOR PEOPLE, CLIMATE AND BIODIVERSITY

CENTRE FOR POLICY DESIGN
Ashoka Trust for Research in Ecology and the Environment



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ONE

OPEN NATURAL ECOSYSTEMS *of* INDIA

Open Natural Ecosystems refer to naturally open, non-forested landscapes that are sparsely vegetated and range from ecosystems such as semi-arid savannah grasslands, savannah woodlands, and some mesic savannahs, shrublands, deserts and rocky outcrops. These landscapes support unique biodiversity as well as the livelihoods of numerous agro-pastoralist and pastoralist communities. However, ONEs are increasingly under the threat of conversion and degradation. The map outlines the extent of ONEs in India.

N W E S

Always watchful, like a herder leads their herd, the omniscient Sun heads the vast stretches of open natural ecosystems

Changpa

The Changpa are a semi-nomadic pastoralist community that primarily live in the Changtang region of Ladakh, India. The Changpa raise yaks, sheep, goats and horses for their livelihood. They are known for their prized Changra goats, which produce the rare Pashmina (Cashmere) fibre.

Raika

The Raikas are pastoralists from northwestern India, particularly the arid and semi-arid parts of Rajasthan. Although they raise goats, cattle, and sheep, the most important animal for the Raikas is the camel.

Gaddi

The Gaddis are a pastoralist community living mainly in the states of Himachal Pradesh and Jammu and Kashmir.

Dokpas

The Dokpas are a pastoralist community that rear livestock in the Trans-Himalayan region of North Sikkim. Livestock reared by Dokpas include the Tibetan breed of yak and sheep.

Maldhari

Maldharis are a group of pastoralists spread across Gujarat, specifically the Kachchh and Saurashtra regions. They rear buffaloes, cattle, goats and camels.

Kuruba

Kurubas are from Karnataka, Tamil Nadu, Andhra Pradesh and Telangana. They traditionally raise mixed herds of sheep, goat and cattle.

Dhangar

The Dhangars belong to Maharashtra, Goa, Madhya Pradesh and northern Karnataka and migrate through ONEs and farmlands in these states.

ONEs
(GIS Map of ONEs may be referred for accurate location data)

Rocky outcrop

High Altitude Grasslands

Semi-arid Savanna

Thar Desert

OPEN NATURAL ECOSYSTEMS of INDIA

ONEs cover approximately 10% of India's geographical area. Less than 5% of these ONEs fall under India's protected area network. Additionally, a vast majority of these landscapes (approximately 70%) are classified as "wastelands", making them susceptible to land-use conversion. However, these landscapes host magnificent biodiversity. They are home to the Indian Grey Wolf, the Striped Hyena, the Indian Gazelle, as well as a range of birds such as the Great Indian Bustard, the Lesser Florican, the Rain Quail and the Indian Courser. They also support the livelihoods of numerous agro-pastoralist and pastoralist communities such as the Dhangar, Rabari and Raika across India for whom mobility is key in these landscapes. Pastoralism enables conservation of unique breeds of livestock.

Open Natural Ecosystems contribute to India's milk & meat production highlighting their value for food security & people's nutritional requirements. They also generate livelihood for millions of livestock keepers & herders who have engaged in extensive pastoralism in such ecosystems for thousands of years now.

LIST OF FLORA & FAUNA

1 Indian Grey Wolf	11 Short-Eared Owl	21 Kharai Camel
2 Blackbuck	12 Bengal Florican	22 Toda Buffalo
3 Striped Hyena	13 Red Avadavat	23 Yak (Dong)
4 Spiny-Tailed Lizard	14 Red-Headed Vulture	24 Acacia nilotica
5 Desert Fox	15 Chestnut-Bellied Sandgrouse	25 Indian jujube
6 Caracal	16 Montagu's Harrier	26 Persian mesquite (Khejri)
7 Chinkara	17 Indian Courser	27 Bermuda grass
8 Ibex	18 Peninsular Rock Agama	28 Indian Indigo
9 Jungle Cat	19 Gaddi Sheep	29 Marvel grass
10 Great Indian Bustard	20 Osmanabadi Goat	30 Prostrate sandmat

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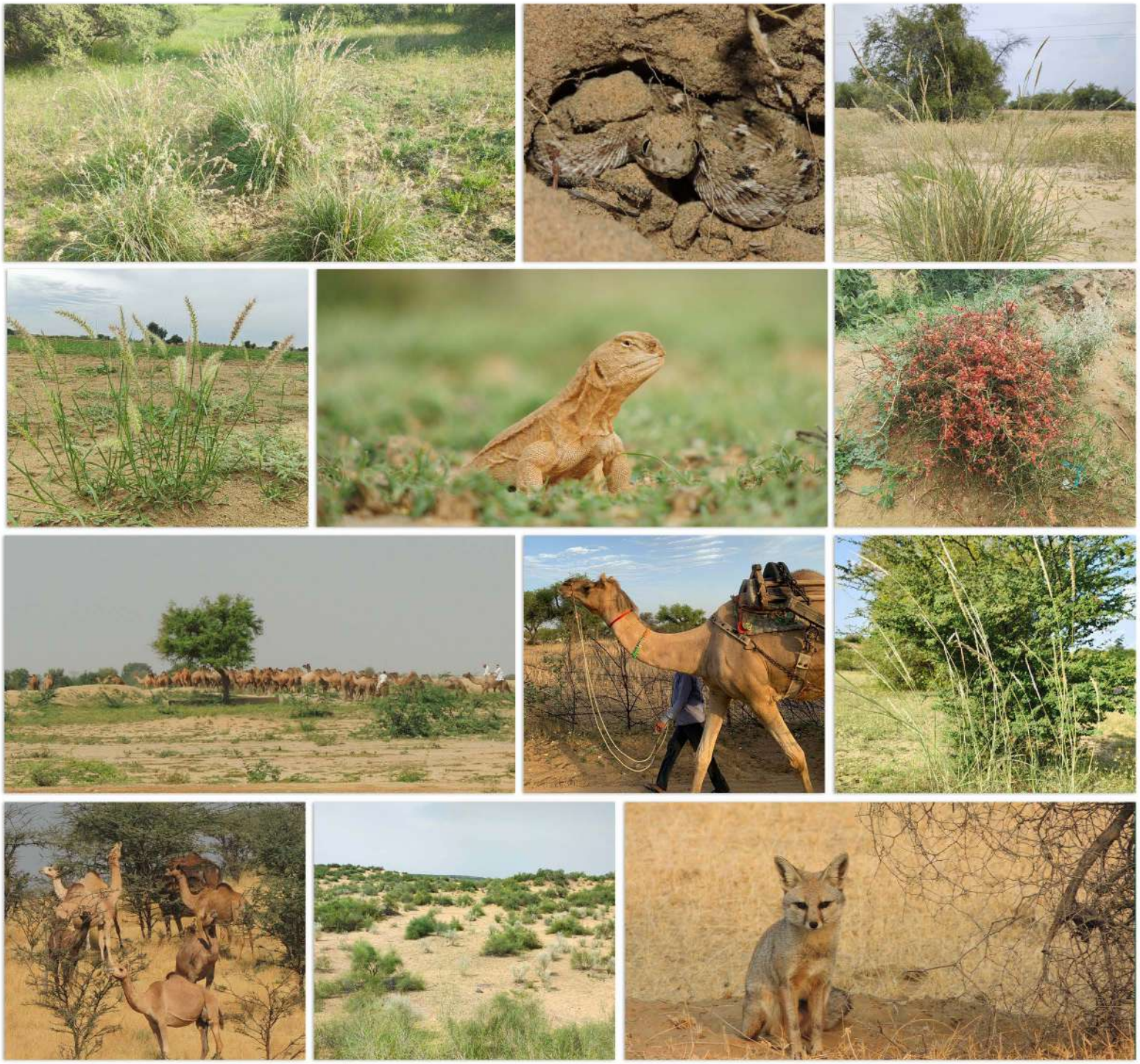

PHOTO CREDIT: KARANI SINGH BITHOO, SHUBHAM KALWANI, LAKSYA LAMBA

EXECUTIVE SUMMARY

Rajasthan has the largest area of Open Natural Ecosystems (1,16,172 sq. km) in India spanning approximately one third of its total area. These Open Natural Ecosystems (ONEs) include *Oran*, pasturelands, commons, the great Thar desert, grasslands, scrublands and open savannas.

ONEs **sustain the livelihoods of a majority of Rajasthan's rural population** of pastoralists and agro-pastoralists, and make Rajasthan the **second highest milk producer and the largest wool producer in India.**

ONEs (such as deserts) **are one of the main attractions** for tourism in the state.

ONEs are **essential habitats for unique biodiversity**, particularly the critically endangered Great Indian bustard, the Indian wolf, the Blackbuck antelope, the Indian gazelle (also known as Chinkara), and several migratory and resident birds.

ONEs embody cultural and religious significance in Rajasthan evidenced by the **presence of *oran* or sacred groves**

ONEs **sequester carbon below-ground**, and if managed appropriately, will help Rajasthan meet its climate action goals.

However, the value and unique ecological significance of ONEs in Rajasthan have not been adequately recognised, and should be harnessed through improved management actions and policy programmes. Historically, environmental and development policies have altered the landscape rather than establish actions more suited to the state's biophysical and geographical characteristics, and those of its natural resource-dependent communities. As outlined in the Rajasthan's State Action Plan for Climate Change, there is a need to move towards context-specific actions for different bioregions. By focussing on improved management and restoration of ONEs, Rajasthan can meet its fodder requirements and strengthen livelihoods, conserve biodiversity, and sequester below-ground carbon for climate action. This requires the following key actions:

Key Actions for Rajasthan's Open Natural Ecosystems (ONEs):

1. Recognising that ONEs provide multiple benefits to various stakeholders
2. *Re-classifying "wastelands" to grasslands, deserts and other ONEs*
3. *Emphasising land restoration programmes over afforestation*
4. *Ensuring sustainable use of groundwater in environmental and development interventions*
5. *Improving invasive species management to prevent loss of native biodiversity*
6. *Fostering frameworks that promote socio-ecological health of ONEs*
7. *Assigning a nodal agency to navigate cross-sectoral governance of ONEs*

EXECUTIVE SUMMARY

The management of ONEs requires collaboration and coordination of objectives and mandates across different stakeholders and government departments through cohesive actions. This policy brief outlines the significance of these ecosystems, along with a strategic department-wise roadmap for the state of Rajasthan, with the following recommendations for:

Rajasthan Forest Department

- Prioritising districts for grassland restoration through area-based mapping
- Moving from afforestation programmes to land restoration programmes that will benefit people and wildlife.
- Creating a network of grass nurseries, to restore community grazing zones in buffer of protected areas
- A state-level invasive species management plan
- Utilising and harnessing village-level bodies to manage, conserve and restore common lands (gauchar)
- Conserving oran with state support and community stewardship

Rajasthan Department of Animal Husbandry

- Prioritising areas with low grazing sustainability for grassland and fodder improvement with native species
- Fodder-based agroforestry and grassland restoration in common lands
- Grazing and pastoralist rights in coordination with the Departments of Tribal Affairs and Panchayati Raj

Rajasthan Watershed Development and Soil Conservation Department, Rural Development and Panchayati Raj Department, Department of Water Resources

- Using a Nature-based Solutions framework for developing watershed development works under PMKSY and MGNREGA for rainfed areas, and grassland and commons development

Rajasthan Board of Revenue

- Streamlining gauchar and other common lands restoration and protection initiatives
- Integrating climate-resilient land management and climate mitigation programmes
- Reclassifying "wastelands" to promote sustainable use of dryland ecosystems

District Level Environment Action Plans and Nodal Agency

- Developing a State-level Grassland and Rangeland Conservation Policy

KARANI SINGH BITHOO

1. BACKGROUND

Rajasthan, India's largest state, occupies an area of approximately 3,42,239 sq km, nearly 11 percent of India's total area. It is predominantly a semi-arid and arid region, which significantly influences the vegetation, biodiversity, local economy and rural livelihoods in the state. With more than 70 percent of its population residing in rural areas, there is a high dependence on nature-based livelihoods.[1] By 2030, 60% of India will still be predominantly rural,[2] deriving their primary source of income from land and livestock-based activities. However, rural landscapes face challenges such as land degradation and conversion. Rajasthan, with land as a vast resource, needs to conserve and restore natural ecosystems in the state, and prevent land degradation, and thereby contribute to India's Land Degradation Neutrality targets.[3]

Rajasthan has made significant efforts to enhance the resilience of its ecological, economic, and social systems. It has established a separate department for Environment and Climate Change, distinct from its State Forest Department, made tremendous strides in the renewable energy sector and climate mitigation, and, introduced several transformative measures in recent years to boost the state's economy, including its Tourism Policy 2020, Handicraft Policy 2022, and Investment Promotion Scheme 2022. Additionally, the Government has started a practice of thematic annual budgets to converge efforts and energy on the most pressing issues. government has started a practice of thematic annual budgets to converge efforts and energy on the most pressing issues.[4]

These steps highlight the state's efforts to foster resilience that must be accompanied by a distinct emphasis on the management of the state's Open Natural Ecosystems (ONEs), **that span a third of its area.**

ONEs such as grasslands, deserts, and shrublands hold the key for the state's **socio-economic growth, food security, climate mitigation and biodiversity conservation** and are integral to the state's culture, society, economy, and climate. However, these landscapes are facing the threat of degradation, conversion and neglect.

This policy brief proposes a strategic roadmap for the sustainable management of Rajasthan's Open Natural Ecosystems (ONEs), with actionable policy recommendations for state departments.

WHAT DO *ONEs* LOOK LIKE?

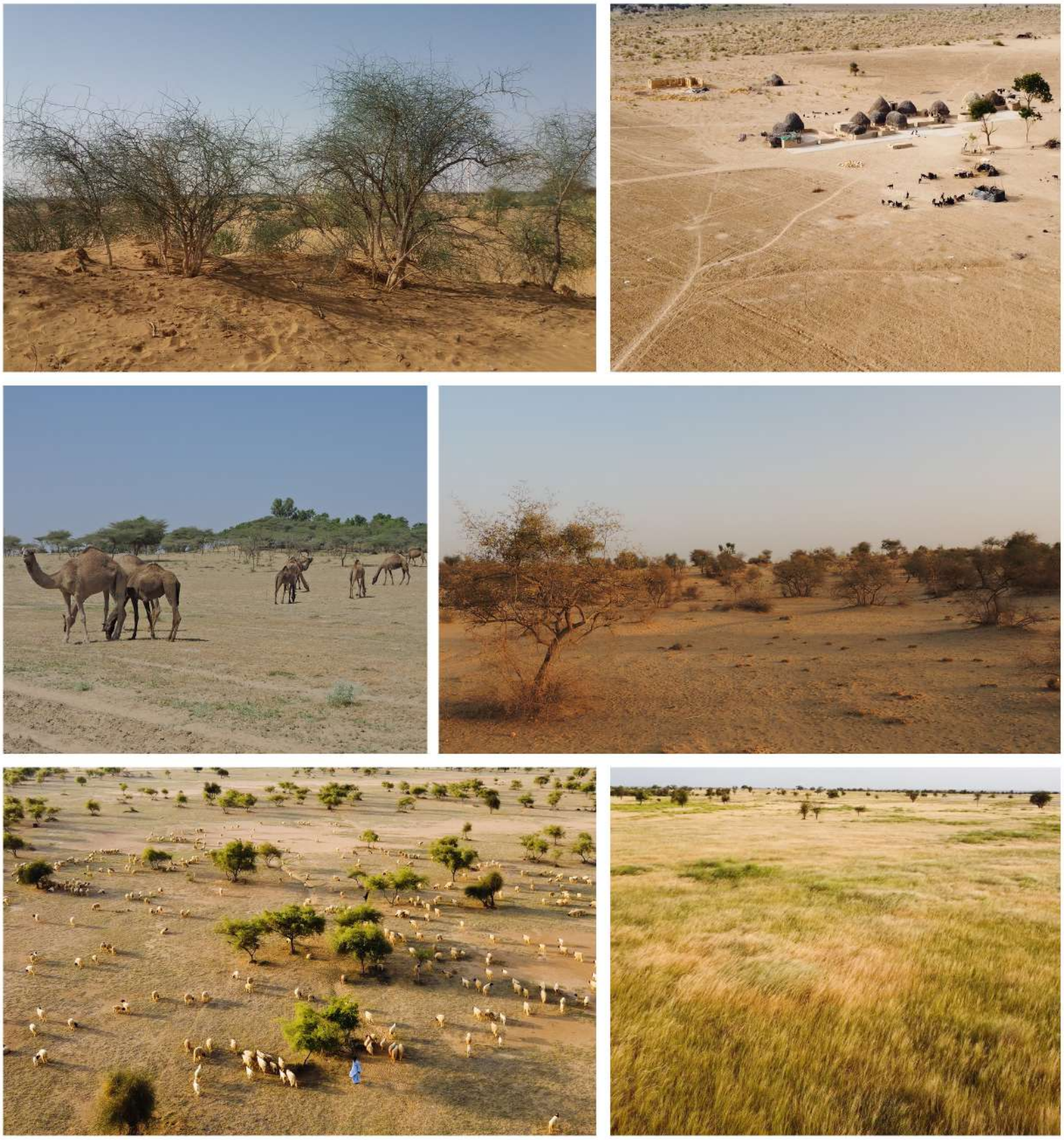

Figure 1: ONEs are significant for people, biodiveristy and climate.
Photo credit: KARANI SINGH BITHOO, THE GRASSLANDS TRUST

2. MAKING A CASE FOR RAJASTHAN'S OPEN NATURAL ECOSYSTEMS

Rajasthan has roughly four bioregions—the Western arid plains, the Eastern plains, the Aravalli belt, and the South-Eastern Hadoti region. Rajasthan also has the **largest area (1,16,172 sq. km, approximately 33.9% of the state) of Open Natural Ecosystems (ONEs)** in India which include grasslands, deserts, shrublands, and rocky outcrops characteristic of arid and semi-arid regions.[5]

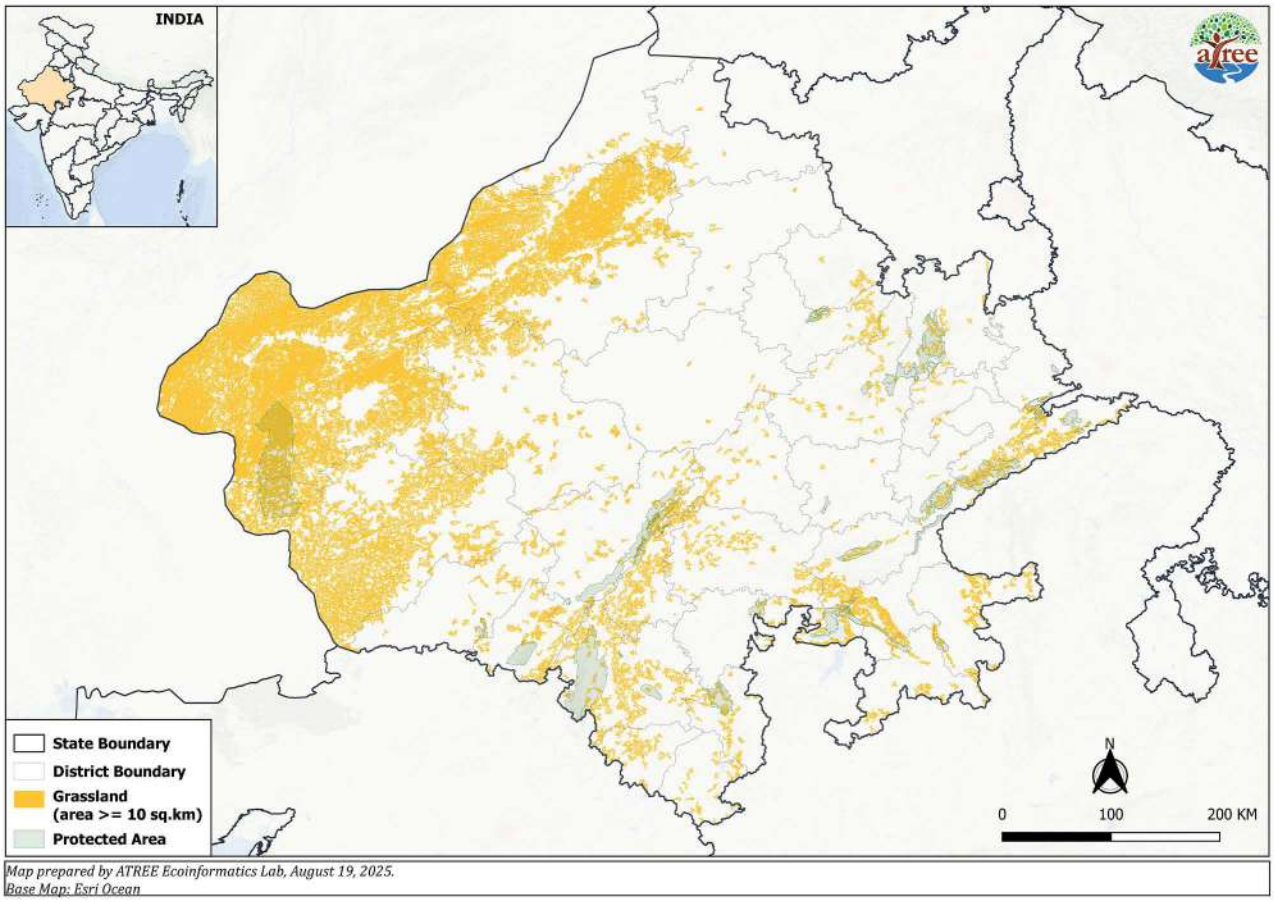

Figure 2: Map of Open Natural Ecosystems in Rajasthan. While 20% of ONE area comes under various forest circles of the state forest department, only 8% of these ONEs are protected under National Parks and Wildlife Sanctuaries. *Source: Madhusudan and Vanak, 2023.*

District	District area (sq.km)	ONE area (sq.km)	Proportion of ONEs
Jaisalmer	37161	31071	84%
Rajsamand	4486	3237	72%
Udaipur	9034	6195	69%
Salumbar	2671	1796	67%
Dungarpur	3791	2381	63%
Bhilwara	10203	5251	51%
Sirohi	5138	2590	50%
Beawar	4462	2199	49%
Barmer	18921	9067	48%
Neem-ka-thana	2856	1283	45%

Table 1: Top 10 districts with the highest area under ONEs

The districts of Western Rajasthan in particular have a significant area of ONEs (Figure 2), implying that governance and management in these districts, need to be tailored for the bioregion. The 16 districts of Western Rajasthan fall under the Thar Desert region, consisting of the largest landmass of the state, with variably low rainfall. The majority of the ONEs in this region fall outside the protected area (PA) network, except one PA–Desert National Park. ONEs generally fall under the common property resources—locally known as *Gauchar, Oran, Johd-Paytan,* and *Aagore*—reflecting long-standing socio-cultural institutions. These commons sustain distinctive regional biodiversity and the livelihoods of large pastoralist and semi-pastoralist, livestock-dependent communities.

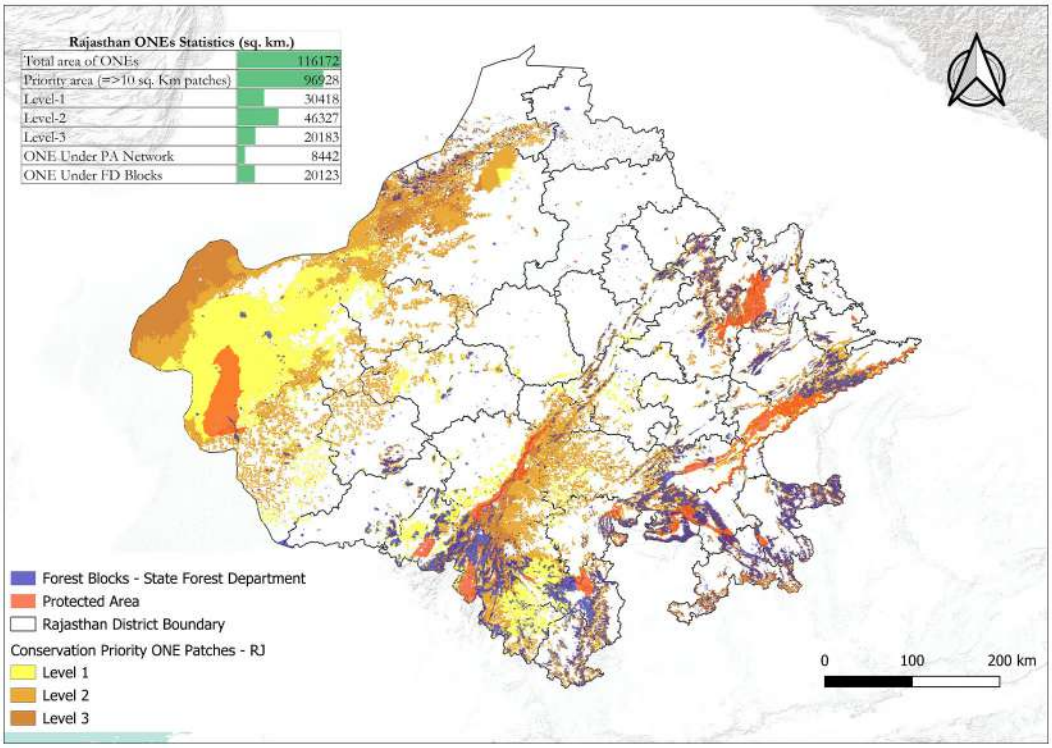

Figure 3: Map depicting the conservation priority patches of the ONEs in Rajasthan (only patches > 10 sq km included), categorised into three levels along with the protected area network and area under various forest blocks of the State Forest Department. The table on the top left depicts key statistics of ONE patches. *Source: ATREE*

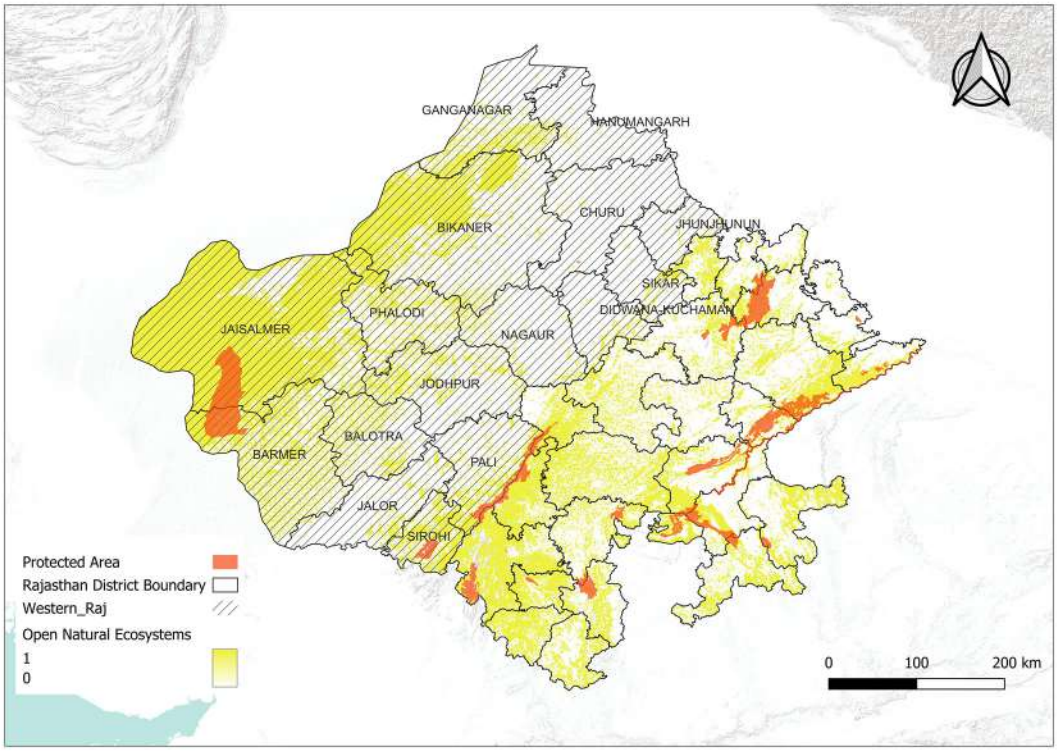

Figure 4: Map highlighting the Thar region of Western Rajasthan and its protected area network. *Source: ATREE*

2.1. *ONEs* SUSTAIN RURAL LIVELIHOODS AND STRENGTHEN RAJASTHAN'S ECONOMY

Rajasthan's ONEs produce almost half of India's wool and the second-highest amount of milk in the country. Restoring grasslands and supporting extensive pastoralism can improve incomes.

2.1.1. MORE THAN 4 LAKH FAMILIES IN RAJASTHAN ARE STEWARDS OF *ONEs*

Agriculture is a challenging occupation due to high aridity and water scarcity in the region, making **extensive pastoralism and livestock rearing the primary source of livelihood** for many rural communities. Numerous pastoralists and agro-pastoralists thus depend on ONEs for grazing their livestock. These communities include the Raika, Rabari, Gujjar (in central and eastern Rajasthan), Jat, Kaimkhani (in Jaisalmer), Rath (in Ganganagar and Hanumangarh), Gairi (in Udaipur), and Bharwad. In the Thar particularly, communities such as the Jaluka, Johya, Parihar, Baloch, Ludar, Uttera, Sameja, and Machi practice pastoralism.[6][7][8] The positive influence of grazing and herbivory on grassland health is well-established.[9]

Pastoralists also play a significant role in the **management of animal and plant genetic resources.** They are the creators and custodians of breeds such as Nari, Rathi, Tharparkar, Nagori, and Kankrej cattle; Boti, Jaiselmeri, Marwari, Nali, Magra, Chokala, and Bhagli sheep; Marwari and Sirohi goats; and Mewari, Marwari, Malvi, Bikaneri, and Jaisalmeri camels, that are particularly hardy and well-suited to harsh conditions.

Sr.	Land Use	Area in Rajasthan (sq. km)
1	Barren and Unculturable Land	23,670.99
2	Permanent pastures and other grazing lands	16,667.68
3	Culturable wasteland	37,272.89
4	Fallow lands other than the current fallows	20,932.15
Area under extensive or open grazing		**98,543.71 (28.8 % of total land area)**

Table 2: Rajasthan Land Use-Land Cover ('22- '23)[10]

SWETA DAGA, PARI WEBSITE

2.1.2. EXTENSIVE PASTORALISM IN *ONEs* PRODUCES MILK, MEAT, WOOL, AND DUNG, BENEFITING THE STATE'S ECONOMY

The pastoralist economy (from just sheep and goat) of Rajasthan is worth Rs. 10,271 crore annually, comprising 7 percent of India's total pastoralist economy.[11] Additionally, Rajasthan has consistently been the **highest wool producer** for the past 5 years, contributing **almost half of India's wool production**.[12]

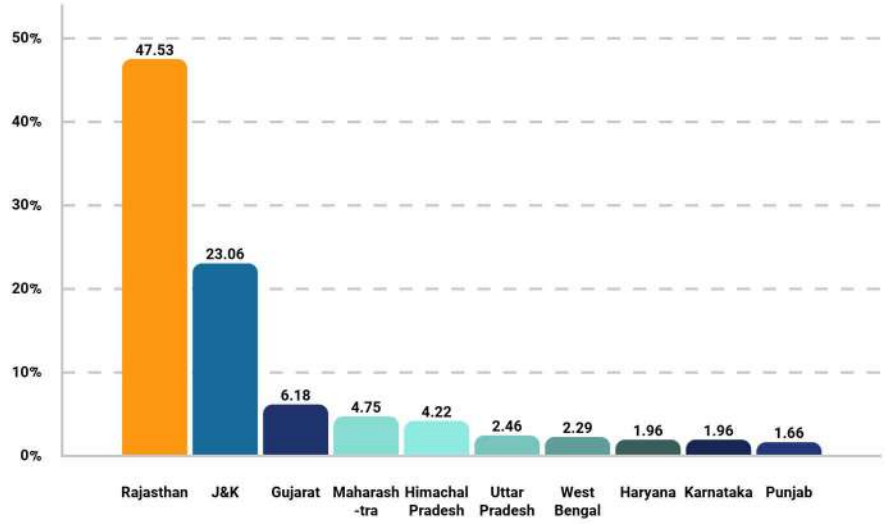

Figure 5: Statewise percentage share of wool production from 2023-24
Source: Basic Animal Husbandry Statistics, 2024

Rajasthan has the **second-highest milk production** in the country. However, the growth in milk production for the year 2023-24 was around 4%, with Rajasthan ranking 16th in this list. There is potential for improving milk production in the state by focussing not just on stall-feeding of livestock but prominently, extensive systems of livestock production, which can be a strength for the state.

It has been estimated that livestock kept under extensive systems and using some form of mobility contribute around 10 million tonnes of milk production per year (the value of which is more than Rs. 0.5 lakh crore per year).[13]

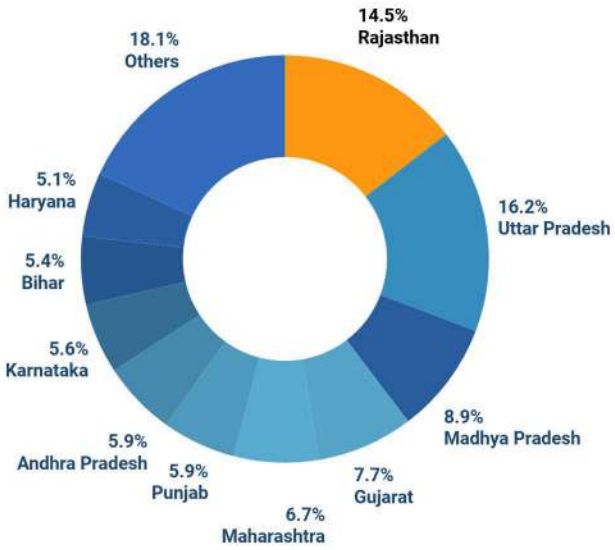

Figure 6: Percentage share of milk production of 10 major livestock-producing states for the year 2023-24
Source: Basic Animal Husbandry Statistics, 2024

The dung economy in India is worth Rs. 14.68 billion annually (from sheep alone).[13] **Livestock dung also produces vital nutrients**, such as nitrogen, phosphorus, and potassium, which are crucial for enriching soil health and contributing to food security and soil fertility in the state.[15]

2.1.3. RESTORED *ONEs* WILL HELP RAJASTHAN ADDRESS ITS FODDER DEFICIT

The availability of fodder poses a challenge for livestock keepers in Rajasthan, primarily because fodder crops compete with more lucrative commercial crops for agricultural land (ICAR-IGFRI, 2021). Additionally, water availability also influences the choice of crops on arable land. Reviving and restoring ONEs can help address the existing **fodder deficit** by boosting forage availability.[16]

Many suitable trees, grasses, and shrubs are native to grasslands and can be used as fodder, such as Khejri and Anjan, along with range grasses and legumes such as Sewan, Dhaman, Blue panic, etc.[17] There is a wide gap between demand and supply of native grass seed, which makes it difficult to revive degraded grazing lands, resulting in the majority of such lands being underutilized. Development of native grass nurseries could help address this issue.

Rejuvenation and establishment of improved grasslands with suitable native species and community-based management of pasturelands can improve the sustainability of livestock production.

Rajasthan's Fodder Development Plan highlights challenges such as a reduction in fodder resources from forest areas and 'wastelands'[18] due to decreasing rainfall, increasing pressure of stray animals, and lack of seeding of grass/legumes. The Plan also notes the availability of rainfed land with low chemical fertilizer input, which is **favourable for organic livestock production, whose demand is continuously rising**

Additionally, community pastures are an essential source of fodder that need to be developed through appropriate measures. Common Property Resources (CPRs) act as a village-level ecosystem service centre in the drylands of Rajasthan and are significant for pastoralist livelihoods and landless and smaller households. Their presence is part of a survival strategy for rural households in Rajasthan.[19] Declining availability of grazing land leads to increasing pressures on these CPRs and further degradation of ONEs and forage availability. Understanding pressures on grazing land in ONEs is key to managing and restoring ONEs to support and strengthen pastoralist livelihoods.

Attributes	India	Rajasthan
Fodder Demand		
Green fodder	850.9	8.10
Dry fodder	530.2	5.00
Fodder Supply		
Green fodder	577.3	5.90
Dry fodder	471.9	3.21
Deficit (%)		
Green fodder	32.15	**27.16**
Dry fodder	10.99	**35.80**

Table 3: Estimated fodder demand-supply scenario (million tonnes)
Source: ICAR-IGFRI, 2021

Extensive pastoralism is a low-input, high-yield livelihood and can be lucrative, particularly if market linkages are strengthened through state support. Forage availability can be addressed through the conservation, restoration, and co-planned management of Rajasthan's ONEs.

ANIRUDDH SHETH

2.1.4. *ONEs* ARE VITAL TO RAJASTHAN'S TOURISM ECONOMY

A significant proportion of Rajasthan's GDP (approximately 12%) is derived from tourism.[20] In addition to heritage tourism, desert and wildlife tourism also contribute to tourism in the state. For example, Sam and Khuri Sand Dunes and Desert National Park in Jaisalemer, Rao Jodha Park in Jodhpur, the wildlife of Sariska and Ranthambore Tiger Reserves attract lakhs of tourists every year. Rajasthan is also important for several migratory birds such as the flocks of Demoiselle cranes, the Steppe Eagle and the Tawny eagle. Rajasthan's built heritage, such as *baolis* or step-wells, has also emerged from the need to conserve water in these arid landscapes, and draw in thousands of visitors.

Rajasthan has a comprehensive eco-tourism policy which focuses on nature-based forms of tourism in order to "encourage conservation and appreciation of nature in Rajasthan as well as traditional cultures in natural areas". Conserving ONEs well can help boost tourism by improving habitat for wildlife species and the aesthetic value of these landscapes.

SANAT ANGHAN

2.2. *ONEs* HOST A VARIETY OF WILDLIFE AND BIODIVERSITY IN THE STATE

The state of Rajasthan is home to a variety of flora and fauna including ~2000 plant species, 87 mammals, approximately 500 birds, and around 81 reptiles. Most significantly, ONEs are the natural habitat for the **highly endangered Great Indian bustard (*Ardeotis nigriceps*), Rajasthan's state bird, whose population is now primarily confined to Rajasthan.**

They also form the habitat of other flagship species, such as the Indian grey wolf, the culturally revered Blackbuck antelope (*Antilope cervicapra*) and the Indian gazelle (*Gazella bennettii*), significant for the Bishnoi community. Other significant wildlife found in Rajasthan's ONEs include the Striped hyena (*Hyaena hyaena*), and the Desert fox (*Vulpes vulpes pusilla*) and birds such as the Demoiselle crane (*Grus virgo*) and a number of types of vultures.

Flora found in the ONEs of the state includes the Khejri tree (*Prosopis cineraria*), Desi Babool or Kikar (*Acacia nilotica*), Rohida (*Tecomella undulata*), Ber (*Ziziphus mauritiana*), Ker (*Capparis decidua*), and Thor (*Euphorbia caducifolia*), as well as a few varieties of bushes like Phog (*Calligonum polygonoides*), Akra (*Calotropis procera*), Lana Arna (*Lannea coromandelica*), which grow in these areas.

Figure 7: Revered as the "kalpavriksha" of the desert", the Khejri tree sustains Rajasthan's communities by providing fodder, food, fuelwood, and shade, making life possible in arid regions.
Photo credit: KARANI SINGH BITHOO

Figure 8: Known as the "desert teak," the Rohida tree is prized by communities for its strong timber and medicinal value, forming a vital part of their livelihood and culture. *Photo credit: KARANI SINGH BITHOO*

The Great Indian Bustard (GIB), Rajasthan's state bird, is critically endangered and survives primarily in the state's Open Natural Ecosystems (ONEs), including grasslands and scrublands. The Sudasari Breeding Centre in Jaisalmer, located within the Desert National Park and managed by the Rajasthan Forest Department and the Wildlife Institute of India, has made notable scientific progress, such as successful artificial insemination.[21] Conserving Rajasthan's ONEs is essential to prevent habitat loss, enable successful rewilding, and secure the GIB's long-term survival. Rewilding becomes increasingly complex as habitat fragmentation and conversion put these birds and other wildlife under growing pressure.

KALYAN VARMA






Figure 9: Fauna that roam the grasslands of Rajasthan. Clockwise from top-left: Desert fox/*Vulpes vulpes pusilla* (*KARANI SINGH BITHOO*), Indian gazelle/*Gazella bennettii* (*ABI T VANAK*), Demoiselle crane/*Grus virgo* (*CREATIVE COMMONS*), Sociable lapwing/*Vanellus gregarius* (*KARANI SINGH BITHOO*), Hardwicke's spiny tailed lizard/*Saara hardwickii* (*THE GRASSLANDS TRUST*), Desert cat/*Felis silvestris ornata* (*THE GRASSLANDS TRUST*)

2.3. *ONEs* IN RAJASTHAN STORE SIGNIFICANT CARBON BELOW-GROUND MAKING IT CRITICAL FOR INDIA'S CLIMATE GOALS

The common understanding is often that afforestation is necessary to promote carbon sequestration. However, studies show that management of ONEs through appropriate interventions such as grassland restoration can play a crucial role in mitigating climate change by acting as natural carbon sinks. Native grasslands for example, sequester carbon below ground and improve groundwater conservation.[22] [23] [24] Current estimates suggest these biomes store over a third of the global terrestrial carbon stocks. About 90% of it is stored below ground in root biomass and as SOC – a more stable and relatively permanent form of carbon storage than above-ground standing stock in forests, which can be prone to fire and pest attacks.[25] [26] Restoring these landscapes can go a long way in realising this potential.

ONEs thus offer a pathway to India's ambitious climate goals and water security in the state, particularly India's Land Degradation Neutrality targets and Nationally Determined Contributions of creating an additional carbon sink of 2.5 to 3 billion tonnes of CO2 and Rajasthan's State Action Plan for Climate Change.

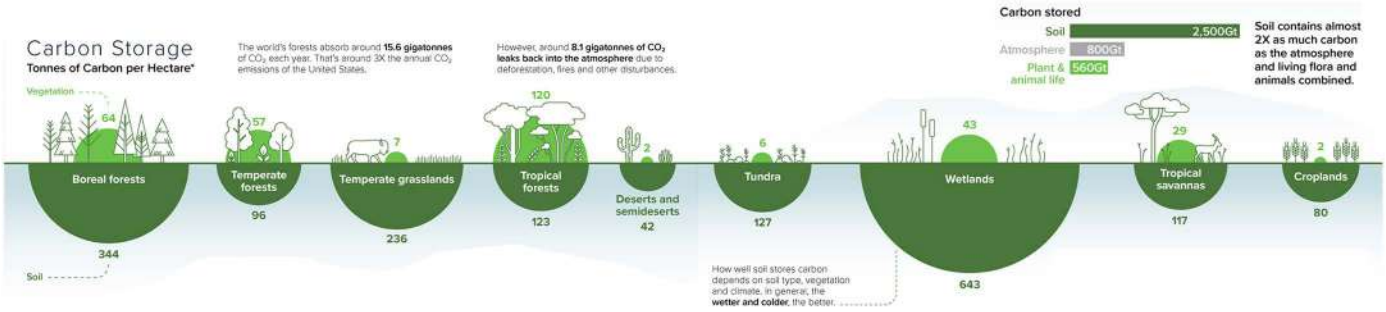

Figure 10: Carbon storage in tonnes of carbon per hectare at the ground depth of one metre. *Source: IPCC, NASA, VISUAL CAPITALIST (2023)*

MYTH: AFFORESTATION ALONE = GROUNDWATER RECHARGE

One common justification for large-scale tree planting is that trees eventually increase rainfall. This, however, is highly context-specific. Only a tiny fraction (~<1%) of the water trees take up is stored in their biomass; the rest is released back into the atmosphere as transpiration and can be recycled, eventually falling back to the ground as rain. But there are caveats. The change in vegetation must be on a large scale (of the order of hundreds of square kilometers) to make any appreciable difference to local rainfall patterns, and there is no guarantee that the rainfall will occur in the exact location.

Rainfall could occur downwind, and the local watershed where trees are planted could still dry out, as a recent global modelling study showed.[27] Furthermore, increasing tree cover does not necessarily lead to an increase in groundwater. In some systems, it diminishes groundwater recharge because evapotranspiration rates exceed infiltration rates. Therefore, the belief that "afforestation = groundwater recharge" is not always valid.

KARANI SINGH BITHOO

Due to the focus on above-ground carbon and greening, ONEs in Rajasthan are often targeted for mass tree-planting programmes, which have proven detrimental to local hydrological cycles and biodiversity. Such efforts, rather than contributing to effective land-based climate action, endanger the long-term integrity and viability of these ecosystems and the people and biodiversity that depend on them. Rajasthan, with its vast, open landscapes, could help sequester carbon below-ground. Native grasses and dryland plants are adapted to use low water, consistent with local rainfall patterns. In these landscapes, indiscriminate tree planting can disrupt this balance by increasing water uptake, reducing recharge, and depleting the water table.

SANJANA NAIR

RESTORING GRASSLANDS TO IMPROVE SOIL ORGANIC CARBON REQUIRES SUITABLE METHODS

Just three years of grassland restoration have the potential to increase SOC by 53% compared to the unrestored baseline. However, the method of restoration is critical.[28] *In the Deshnok Oran of Bikaner, Rajasthan, the negative impact of improper restoration using agricultural methods was highlighted by a study done by scientists from ATREE. Here, a grazed "old growth" grassland had 11tC/ha, whereas an attempted restoration plot, which had been ploughed and then sown with native grasses 10 years ago, had a lower carbon of 8tC/ha. Notably, the effects of soil disturbance persisted for over a decade. This demonstrates that designing the correct interventions is crucial for the sustainable management of these vital ecosystems with least soil disturbance and ploughing.*

2.4. PROTECTING RAJASTHAN'S SACRED *ORAN* IS FUNDAMENTAL TO PRESERVING ITS CULTURAL AND SOCIAL HERITAGE

Oran or sacred groves are an essential part of the fabric of Rajasthan's cultural and social heritage.

In Rajasthan, traditions emphasise respect for water sources, sacred groves, and wildlife. Oran, conserved for centuries by communities like the Bishnoi and Garasia embody this heritage. They serve as cultural and spiritual sites while protecting biodiversity and sustaining ecosystem services. A 2024 Supreme Court judgment has directed the state to formally protect oran in Rajasthan.[29] This must however, be done in consultation with the very communities that look after them.

CONSERVING ORAN ALSO HELPS CONSERVE BIODIVERSITY

The Deshnok Oran provides grazing land for communities and habitat for species such as the Desert fox, Desert cat, Monitor lizard, Spiny-tailed lizard, Sociable lapwing, Jungle cat, porcupines, hedgehogs, jackals, and the Houbara bustard.

For over six centuries, the community has safeguarded the 2,151-hectare area of the oran to support both the local livelihoods and the surrounding biodiversity. However, increased privatisation and agricultural expansion have led to a decrease in the availability of common grazing land around the oran area, putting additional grazing pressure on the land. Deshnok and the surrounding seven villages currently rely on this oran for their fodder requirements. Moreover, large areas like the Deshnok Oran play a crucial role in biodiversity conservation, as they connect various small grassland areas, facilitating the free movement of critically endangered wildlife, such as the Spiny-tailed lizard and the Sociable lapwing.

ATREE in collaboration with Karni Mata Trust is restoring 80 hectares of grasslands. By doing so, it provides a model for community-based restoration and protection of oran that combine scientific methods and traditional patronage of these lands.

RE projects have the potential to be implemented responsibly and sustainably through mitigation measures, by facilitating wildlife conservation and following socially just processes that provide access to local communities. These include excluding land used by wildlife as well as pastoralists, use of marginal agricultural land, fair and equitable land leasing models, and decentralised RE systems. Additionally, agrivoltaics, which combines grazing, solar energy, and agriculture, may be deployed on marginal agricultural and fallow lands, thus providing benefits to multiple stakeholders.

ONEs can thus act as a dual mechanism for climate mitigation by promoting socio-ecological health and resilience, and renewable energy.

KARANI SINGH BITHOO

3. RE-FRAMING POLICY NARRATIVES AND MANAGEMENT ACTIONS FOR RAJASTHAN'S UNIQUE *ONEs*

Despite their importance, ONEs face critical challenges such as diversion, degradation, and biodiversity loss. They are frequently undervalued and mismanaged due to their misidentification as 'wastelands', an emphasis on "greening", and an unscientific understanding of degradation and desertification processes.[30] These processes enable and facilitate the conversion of ONEs to alternative land use and land cover, resulting in a net detrimental impact. From 2001 to 2021, ONEs in Rajasthan have reduced by 8%.[31] As land-use pressures and climate change impacts intensify, ONEs — and the communities and species that depend on them — will become increasingly vulnerable, without adequate conservation and restoration measures.

KARANI SINGH BITHOO

3.1. KEY ACTIONS FOR RAJASTHAN'S OPEN NATURAL ECOSYSTEMS (*ONEs*)

1 *RECOGNISING that ONEs provide multiple benefits to various stakeholders*

ONEs are fragmented across land-use categories and administrative classifications such as "barren land" or "degraded forest" leading to underreporting and poor management. With only 4.84% forest cover, despite a recorded forest area of 9.60%,[32] many ONEs are misclassified, which hinders the development of ecosystem-specific policies.

2 *RE-CLASSIFYING "wastelands" to grasslands, deserts and other ONEs*

25% of Rajasthan's land is labelled as wastelands,[33] making these areas vulnerable to diversion for agriculture, infrastructure, and afforestation, ignoring their ecological and socio-economic value.

3 *EMPHASISING land restoration programmes over afforestation*

Afforestation efforts under GIM, CAMPA, and DDP target 43.9% of ONEs for a 28.4% tree cover increase.[34] These efforts disrupt native ecosystems, strain groundwater resources, and incur high financial and ecological costs. Restoration of ONEs is essential to optimise the benefits from natural grasslands and desert ecosystems.

4 *ENSURING sustainable use of groundwater in environmental and development interventions*

Development activities and climate change are straining groundwater, especially in arid regions. For example, projects like the Indira Gandhi Nahar Project (IGNP) have improved irrigation but led to dune loss. CAZRI notes a 16% loss of dunes between 1970 and 2013[35], due to waterlogging, and salinization. Greening and agricultural expansion often ignore local hydro-ecological conditions, threatening long-term water security. Accounting for water management in all interventions is essential.

5 *IMPROVING invasive species management to prevent loss of native biodiversity*

Species like *Neltuma juliflora* have spread rapidly, outcompeting native flora and degrading habitats. Further, a range of non-woody invasive species such as *Cassia angustifolia, Parthenium hysterophorus* has also occupied vast expanse of commons and fallow lands. Removal and prevention of further spread of invasive species can lead to restored, healthy ecosystems that benefit the socio-ecological landscape. For example, water recovery is possible through grassland restoration and removal of invasive species and non-native trees that extract high amounts of groundwater.

6 *FOSTERING frameworks that promote socio-ecological health of ONEs*

Rajasthan is India's highest renewable energy-producing state. Large-scale renewable energy (RE) projects are increasingly being set up in ONEs due to ideal conditions and low rainfall. However, large-scale RE projects have particularly come under criticism in Rajasthan due to environmental challenges such as loss of habitat and deaths of birds, notably the GIB, whose population is declining at an extremely rapid rate, as well as their effects on livelihoods such as loss of pastoralist routes and grazing access, Innovative solutions such as agrivoltaics, solar grazing, decentralised RE systems, are necessary when it comes to climate action projects. Renewable energy as well as afforestation projects need to be context-sensitive and employ nature-positive frameworks.

7 *CREATING a nodal agency to navigate cross-sectoral governance of ONEs*

ONEs span common lands, private holdings, and forest or revenue lands, creating fragmented ownership. Also, they are governed by various sectors. This complexity contributes to overuse, degradation, and poor implementation of conservation or grazing regulations. Multiple departments, such as Forest, Animal Husbandry, and Rural Development, operate with limited coordination and overlapping mandates. Creating a nodal agency or integrated framework can lead to a unified approach to effective management.

3.2. POLICY RECOMMENDATIONS FOR THE SUSTAINABLE MANAGEMENT OF RAJASTHAN'S *ONEs*

While some institutional and policy frameworks can contribute to the conservation and improved management of ONEs, some policies have directly or indirectly increased pressure on ONEs, leading to their degradation or conversion. Figure 11 reflects examples of policies, schemes, programmes and guidelines by distinct departments that can influence the management of ONEs. Relevant line departments such as the Forest Department, Animal Husbandry Department, and Rural Development Department need to tailor their management actions for ONEs.

Figure 11: Departmental mapping of policies influencing ONE management
Source: ATREE

KEY ACTIONS FOR STATE DEPARTMENTS

Implementing the key actions identified in the previous section requires a cross-stakeholder approach. To address the challenges faced by Rajasthan's ONEs, the following table presents policy recommendations for relevant line departments to enhance the management of ONEs.

FOREST DEPARTMENT

KEY FOCUS AREAS: *Grassland/Shrubland/ Degradation, Biodiversity Conservation; Habitat Restoration across ONEs*

1. MOVING FROM AFFORESTATION PROGRAMMES TO LAND RESTORATION PROGRAMMES

Current afforestation schemes focus heavily on unscientific tree plantations, often leading to the degradation of ONEs, as well as placing undue stress on groundwater in Rajasthan.[36 37] Grassland restoration pilots can be launched under the Green India Mission and related programs for degraded grasslands in districts like Udaipur, Bikaner, Jaisalmer, Rajasmand, and Karauli, restoring native biodiversity, habitat, and carbon sequestration capacities. Existing schemes that include project components on grassland restoration, such as the Rajasthan Forestry and Biodiversity Development Project (RFBDP) by AFD, should be utilized, focusing on incorporating Village Forest Protection and Management Committees (VFPMCs) or Eco-Development Committees (EDCs) formed at the village level to implement project activities.

2. PRIORITISING DISTRICTS FOR GRASSLAND RESTORATION, AND PROTECTING HABITATS FOR WILDLIFE

It is crucial to prioritise land amongst various competing uses. To initiate state-wide grassland restoration projects, priority landscapes for grassland restoration must be identified, focusing on degraded rangelands, buffer zones of protected areas, and community grazing lands. ATREE has created biodiversity prioritization maps that can be leveraged and further developed by incorporating parameters such as climate risk and grazing requirements. This is essential for making decisions regarding the conversion of land, as well as the restoration and conservation of high-priority areas.

THE GRASSLANDS TRUST

FOREST DEPARTMENT

KEY FOCUS AREAS: *Grassland/Shrubland/ Degradation, Biodiversity Conservation; Habitat Restoration across ONEs*

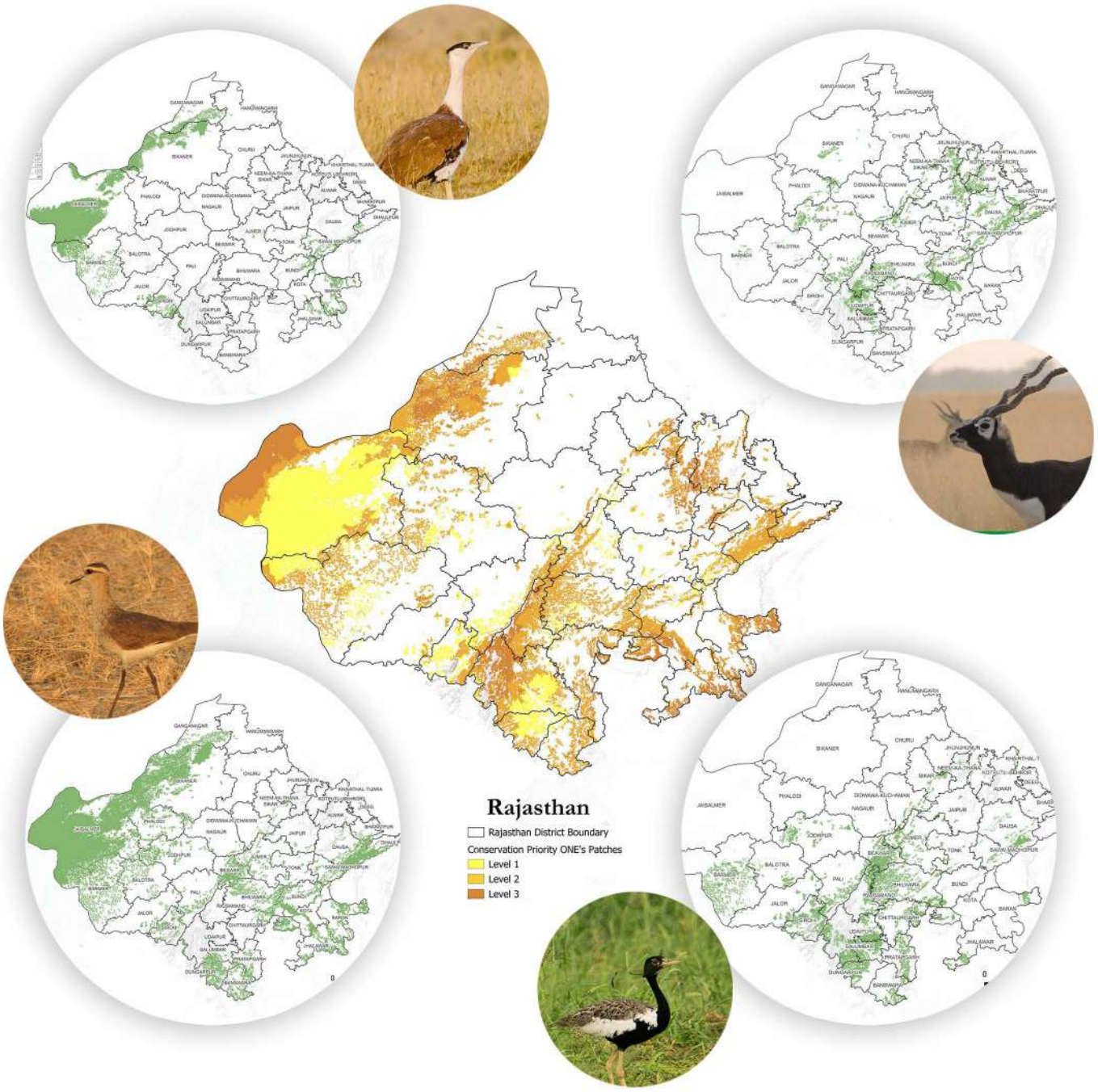

Figure 12: Area-based prioritisation maps with Level 1, 2, and 3. Biodiversity prioritisation enables policymakers to visualise districts that require higher conservation priority and targeted interventions to enhance conservation. Level 2 and 3 biodiversity prioritisation indicate areas that can be balanced with other anthropogenic activities. The link between biodiversity and anthropogenic activities can be studied in greater depth to understand the impacts and navigate pressures accordingly. Key species maps: Top-Great Indian bustard, Right-Indian wolf, Bottom-Lesser florican, Left-Sociable lapwing
Source: ATREE

KEY ACTIONS FOR STATE DEPARTMENTS

FOREST DEPARTMENT

KEY FOCUS AREAS: *Grassland/Shrubland/ Degradation, Biodiversity Conservation; Habitat Restoration across ONEs*

3. CREATING A NETWORK OF NURSERIES AND SEED BANKS FOR GRASSLAND RESTORATION

In specific subregions, especially around areas of continuous grasslands, a network of restoration pilots, constant monitoring, nurseries, and seed banks is needed to rejuvenate Common Property Resources (CPRs) and grasslands.[38] Projects and programmes, particularly those undertaken by government research institutions such as ICAR, CAZRI, and AFRI, enable the cultivation of seedlings and nurseries for distribution to the general public, government departments, civil society, and private sector projects at subsidized rates, and can be further enhanced towards this end.

4. CREATING A STATE-LEVEL INVASIVE SPECIES MANAGEMENT PLAN

Rajasthan's grasslands and deserts have seen the expansive spread of invasive species such as *Neltuma juliflora* (also known as *Baavlia* or *Vilayati kikar*), and *Lantana camara*. While there have been independent or sporadic efforts and attempts to control the spread of invasives and manage them at the level of different divisions of the forest department, a state -level management plan for invasive species that can address and regulate the introduction, spread and management of invasives in the state is an essential step towards preserving ONEs and the natural ecology of Rajasthan's grasslands, forests, and desert.

5. CREATING COMMUNITY GRAZING ZONES IN BUFFER AREAS

Expansion of protected areas, afforestation programs, and changes in land use have reduced grazing spaces. To balance livelihood needs with conservation, Community Grazing Zones can be established in buffer areas of protected landscapes.

6. DEMOCRATISING AND EMPOWERING VILLAGE-LEVEL BODIES

In the case of grassland management, studies indicate that grazing and community-based management practices, such as fire management, are crucial for grassland ecology productivity.[39] Additionally, communities are incentivised to conserve and better protect grassland patches. Local bodies must be institutionalised to coordinate with the FD via JFM models such as Village Forest Committees (VFCs), Eco-Development Committees (EDCs) and be empowered to create, undertake, and implement management plans. This will ensure more downward accountability and decentralised decision-making powers.

7. CONSERVING ORAN WITH STATE SUPPORT AND COMMUNITY STEWARDSHIP

Oran, or sacred groves, for example, are protected by local communities in Rajasthan. They are spiritually significant for various communities, which has resulted in their conservation. The Supreme Court, in a judgement dated December 18, 2024,[40] states that oran be declared as forests or community reserves, highlighting the need for their preservation. However, such measures should ensure that they spearhead community stewardship, maintaining a balance of power with local governance structures rather than with the forest department itself.

DEPARTMENT OF ANIMAL HUSBANDRY

KEY FOCUS AREAS: *Fodder Deficit, Livestock Health and Productivity; Fodder Security*

8. PRIORITISING AREAS WITH LOW GRAZING SUSTAINABILITY FOR GRASSLAND AND FODDER SPECIES DEVELOPMENT

Grazing pressures may differ based on the number of livestock and the availability of grasslands. Mapping out grazing sustainability in districts can provide a deeper understanding of areas important for grazing, ensuring the restoration and conservation of degraded grassland patches, inclusive management planning, and preventing the conversion of lands in areas with high livestock dependence. Area-based planning can encourage and strengthen livelihoods, thereby contributing to Rajasthan's economy, and is an essential step in managing ONEs. The Forest Department can collaborate with the Animal Husbandry and Rural Development Departments to promote convergence of funds and management of high-grazing priority areas. **The map indicates a high need for preserving grasslands in western Rajasthan, namely in the districts of Jaisalmer, Bikaner, Jodhpur, Barmer, particularly for livelihoods**, by ensuring restoration and conservation of degraded grassland patches, inclusive management planning, and restricting conversion of lands in areas with a high livestock dependence.

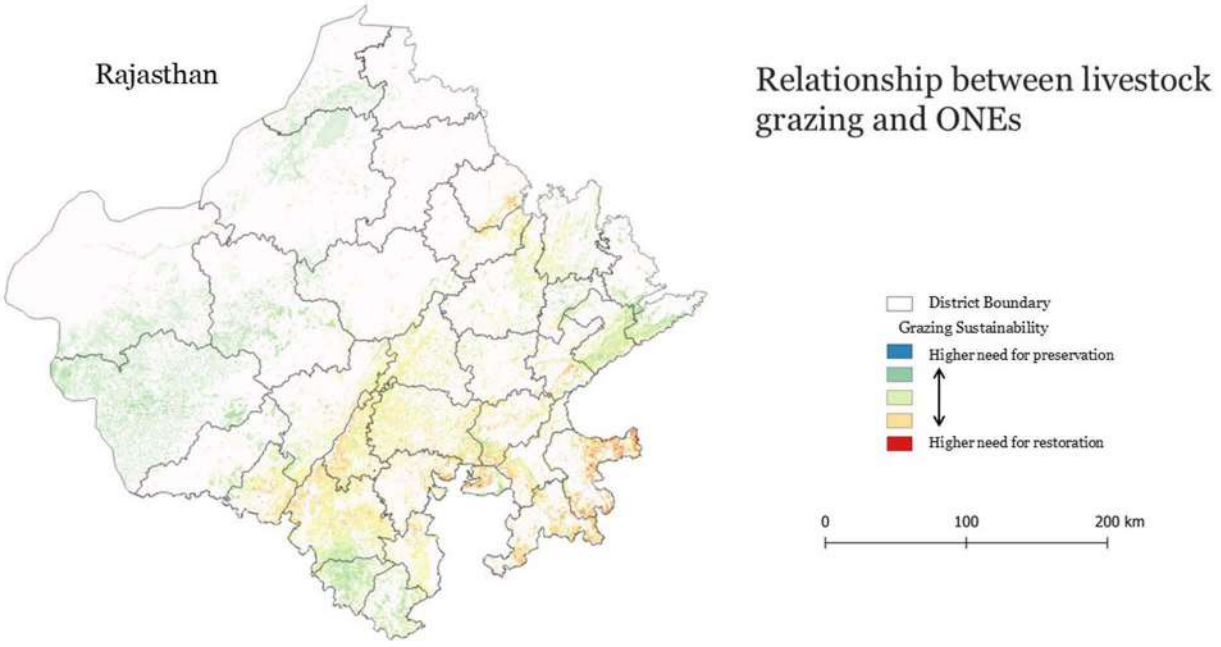

Figure 13: Grazing sustainability map for ONEs in Rajasthan."Grazing sustainability" denotes how much grassland productivity is available for every livestock head in that respective district. It is represented as a ratio of land productivity (Gross Primary Productivity in grams of carbon) and tropical livestock units (TLU). The higher the ratio, the higher the sustainability of livestock grazing and vice versa.
Source: ATREE

DEPARTMENT OF ANIMAL HUSBANDRY

KEY FOCUS AREAS: *Fodder Deficit, Livestock Health and Productivity; Fodder Security*

9. FODDER-BASED AGROFORESTRY AND GRASSLAND DEVELOPMENT IN COMMON LANDS

Fodder conservation strategies must meet the fodder requirements and subsistence needs of resource-dependent communities, while also incorporating the carrying capacity of common grazing lands into their plans. Currently, Rajasthan is facing a green fodder deficit of 27% and a dry fodder deficit of 35.80%.[41] Rajasthan's Fodder Development Plan highlights challenges such as the reduction of fodder resources from forest areas and 'wastelands' due to decreasing rainfall, increasing pressure from stray animals, and a lack of seeding of grass/legumes. In the arid and semi-arid zones, silvopastoral and horti-pastoral practices could be promoted to create community-led fodder reserves on gauchar lands linked to the National Livestock Mission (NLM). Additionally, restoration of degraded pasture land through native species reseeding, legume seeding, and other soil moisture conservation techniques should be taken up to enhance fodder availability.

Many suitable fodder trees, grasses, and shrubs are native to grasslands and can be used as fodder, such as Khejri and Anjan, along with range grasses and legumes such as Sewan, Dhaman, Blue panic, etc.[42]

10. GRAZING AND PASTORALIST RIGHTS IN COORDINATION WITH DOTA AND DOPR

There is a need to map ecologically sensitive pastures and develop community-led rehabilitation packages for pastureland. Towards this official recognition of traditional pastoral rights of access and sustainable use, as outlined in acts such as the Provisions of the Panchayats (Extension to Scheduled Areas) Act (PESA), 1996, and the Forest Rights Act (FRA), 2006, is critical. In areas with acute grazing pressures, incentives should be provided for the adoption of rotational grazing practices to prevent overgrazing. In coordination with the revenue department, there is also an opportunity to designate revenue lands, gauchar, and other common lands as regulated grazing reserves marked for long-term fodder security of local livestock.

Areas where pastoralist communities have historical grazing rights can be prioritised, and where applicable, FRA implementation should be carried out. Panchayats, Gram Sabhas, and JFMCs can enter into stewardship agreements with the Forest Department to co-manage grazing zones. Village Forest Committees (VFCs) can be revitalised, and Eco-Development Committees (EDCs) can be used to facilitate these outcomes further.

THE GRASSLANDS TRUST

WATERSHED DEVELOPMENT AND SOIL CONSERVATION DEPT, RURAL DEVELOPMENT AND PANCHAYATI RAJ DEPT, DEPT OF WATER RESOURCES

KEY FOCUS AREAS: *Watershed Management, Groundwater Recharge, Enhanced Livelihoods*

11. UTILISING THE NATURE-BASED SOLUTIONS FRAMEWORK FOR DEVELOPING WATERSHED DEVELOPMENT PROJECTS UNDER PMKSY AND MGNREGA

Nature-based solutions (NbS) are crucial in watershed development plans that can address soil and water conservation, as well as fodder scarcity. Watershed development projects should explicitly list grassland restoration activities, including soil and moisture conservation (SMC) measures, such as contour bunding, check dams, and vegetative barriers, to prevent erosion. Participatory watershed management programs that incorporate ridge-to-valley design principles, assisted natural regeneration, and minimally disruptive techniques, such as the 'demi-lune' and 'cordon pierre', should be actively promoted.

Figure 14: Making a demi-lune
Photo credit: KARANI SINGH BITHOO

BOARD OF REVENUE

KEY FOCUS AREAS: *Land Tenure; Gauchar lands; Commons Protection; Disaster Relief*

12. GAUCHAR AND OTHER COMMON LAND RESTORATION & PROTECTION INITIATIVES

Large areas of common lands have undergone changes in land use due to the transfer for development projects, land grants, plantations on degraded pastures, and an increase in the net sown area. However, common lands also support many low-income agro-pastoral communities, nomadic communities, marginal farmers, and non-stall-fed livestock. Demarcating gauchars within revenue lands and developing sustainable-use-oriented management plans, in collaboration with existing resource users and neighbouring villages, will help strengthen this safety net. Village/cluster-level committees are key for the long-term stewardship of gauchar lands.

13. CLIMATE-RESILIENT LAND MANAGEMENT AND CLIMATE MITIGATION PROGRAMMES

There is a need for climate-adaptive programmes, particularly in Rajasthan, which is vulnerable to heat and changing climate patterns, as well as depleting groundwater. In coordination with the Department of Environment and Climate Change, the Rural Development and Panchayati Raj Department, and the Department of Land Resources, there is an urgent need to implement climate-adaptive land-use planning to safeguard against droughts and land degradation. Notably, during adverse climate events, common lands are critical for the subsistence of low-income communities. They can play a crucial role in the state's climate mitigation activities outlined in the Rajasthan Action Plan for Climate Change. Grasslands play a critical role in carbon sequestration, water retention, and climate adaptation. Designing monitoring protocols for grassland-based Soil Organic Carbon (SOC) can help significantly contribute to the NDC target of creating an additional carbon sink of 2.5 to 3 billion tonnes of CO2.

INTER-DEPARTMENTAL COLLABORATION: NODAL AGENCY

14. DEVELOPING A STATE-LEVEL GRASSLAND AND RANGELAND CONSERVATION POLICY

A lack of a comprehensive grazing-cum-fodder and pasture management policy, or even a grasslands management policy, at the national and state levels is the primary cause of the invisibilization, degradation, and diversion of ONEs. An important development for Rajasthan has been the Supreme Court's order in December 2024 to map *oran* in the state to classify them as deemed forest to ensure their protection. This must be done along with local communities to ensure community stewardship. Since governance is cross-sectoral, inter-departmental coordination is essential, which can be made possible through a state-level management policy and the establishment of an inter-departmental nodal agency. This is key for better management of Rajasthan's key ecosystems and to enhance the ecosystem services provided.

CONCLUSION

ONEs are integral to Rajasthan's biodiversity, economy, livelihoods and climate action goals. Additionally, they also hold deep cultural and spiritual value, particularly through the presence of oran (community-conserved sacred groves) that can be seen as emblematic of Rajasthan's ecological and cultural heritage.

These landscapes, managed by multiple departments with varying mandates, require socio-ecologically appropriate interventions to harness their value for fodder availability, carbon sequestration, organic and nutritious food production and food security, livelihoods and the state's economy. Additionally, the sustainable management of ONEs can help conserve groundwater, avoid resource wastage, and be cost-effective for the government.

A state-level roadmap for the conservation and management of ONEs is particularly significant, allowing for the development of policy and funding pathways and programmes. There is a pressing need for the government to intervene and improve the management of Rajasthan's ONEs, not just to safeguard them but also to improve the important ecosystem services they provide for people, biodiversity, and the climate.

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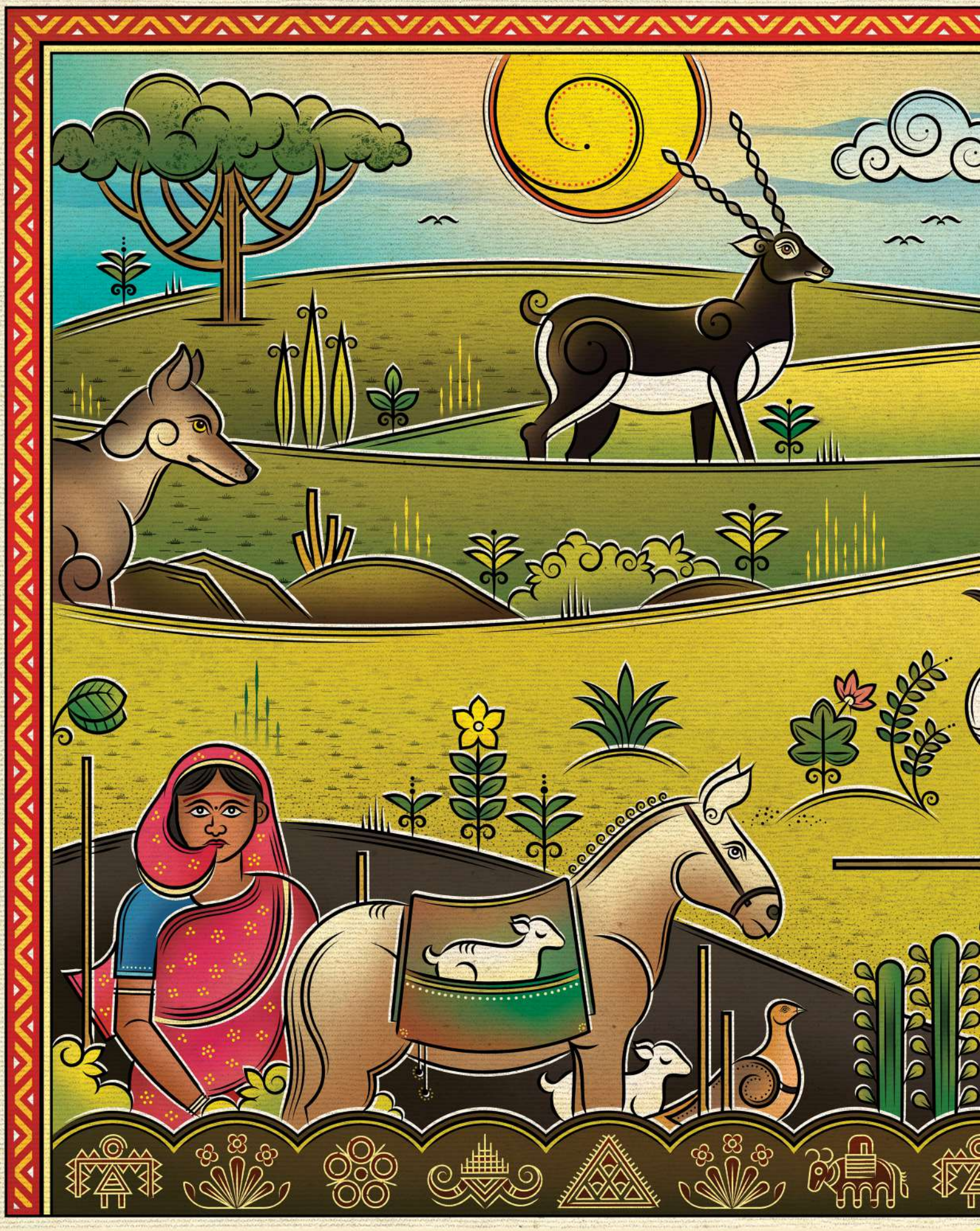
ANNEXURE

Actionables contributing to National Priorities :

Rajasthan's ONEs have the potential to act as considerable reserves of soil carbon stock, helping meet the Land Degradation Neutrality (LDN) and Nationally Determined Contributions (NDC) targets; some pathways for this are outlined below.

RECOMMENDATIONS	ALIGNMENT WITH CENTRAL PROGRAMMES AND POLICIES	CONTRIBUTIONS TO NATIONAL PRIORITIES	POTENTIAL FUNDING MECHANISMS
Grassland Regeneration and Carbon Sequestration Pilots	Green India Mission (GIM) under NAPCC; The Green Credit Rules, 2023, Eco-Sensitive Zone (ESZ)	NDC: Additional carbon sink of 2.5–3 billion tonnes CO2e by 2030 National REDD+ Strategy: Reducing emissions from land use	CAMPA Funds: Allocate for grassland restoration
Community Grazing Zones in Buffer Areas, Fodder Deficit Reduction	National Livestock Mission (NLM); Rashtriya Krishi Vikas Yojana (RKVY); The National Programme for Dairy Development (NPDM); Rashtriya Gokul Mission (RGM)	NDC: Sustainable rural livelihoods National Wildlife Action Plan (NWAP): Habitat management Reduce national fodder deficit.	NLM Fodder Development Funds: For grazing zones. Rashtriya Krishi Vikas Yojana (RKVY): Fund projects that
Fodder-Based Agroforestry in Common Lands	Sub-Mission on Agroforestry (SMAF) under NMSA; National Livestock Mission (NLM)	NDC: Climate resilience, emissions intensity reduction National Agroforestry Policy: Sustainable land use	SMAF Funds for silvopastoral systems
Nature-Based Solutions for Watershed Development	Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) Atal Bhujal Yojana (ABHY), Jal Shakti Abhiyan	NDC: Adaptation through water management National Water Mission: Sustainable water resources	PMKSY allocations for Grassland watershed works ABHY Funds: Groundwater recharge in grassland areas Externally Aided REWARD Project
GaucharLands Restoration & Protection Initiatives	MGNREGA; Paramparagat Krishi Vikas Yojana (PKVY); The Criteria and Guidelines for Identifying Other Effective Area-Based Conservation Measures (OECM)	NBAP: Biodiversity conservation NDC: Climate resilience for rural communities	MGNREGA Funds: Labor for restoration
State-Level Rajasthan Grassland and Rangeland Conservation Policy	National Biodiversity Action Plan (NBAP) Wildlife Habitat Development Scheme; Digital India Land Records Modernization Programme (DILRMP)	NDC: Ecosystem resilience, biodiversity Global Biodiversity Framework: Post-2020 targets	NBA Grants: Policy development Externally Aided Projects (e.g., GEF): Climate and biodiversity funds



ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT
Royal Enclave, Srirampura, Jakkur, Bengaluru, Karnataka 560064

Phone: +91-80-2363-5555 (EPABX) | Email: director.cpd@atree.org