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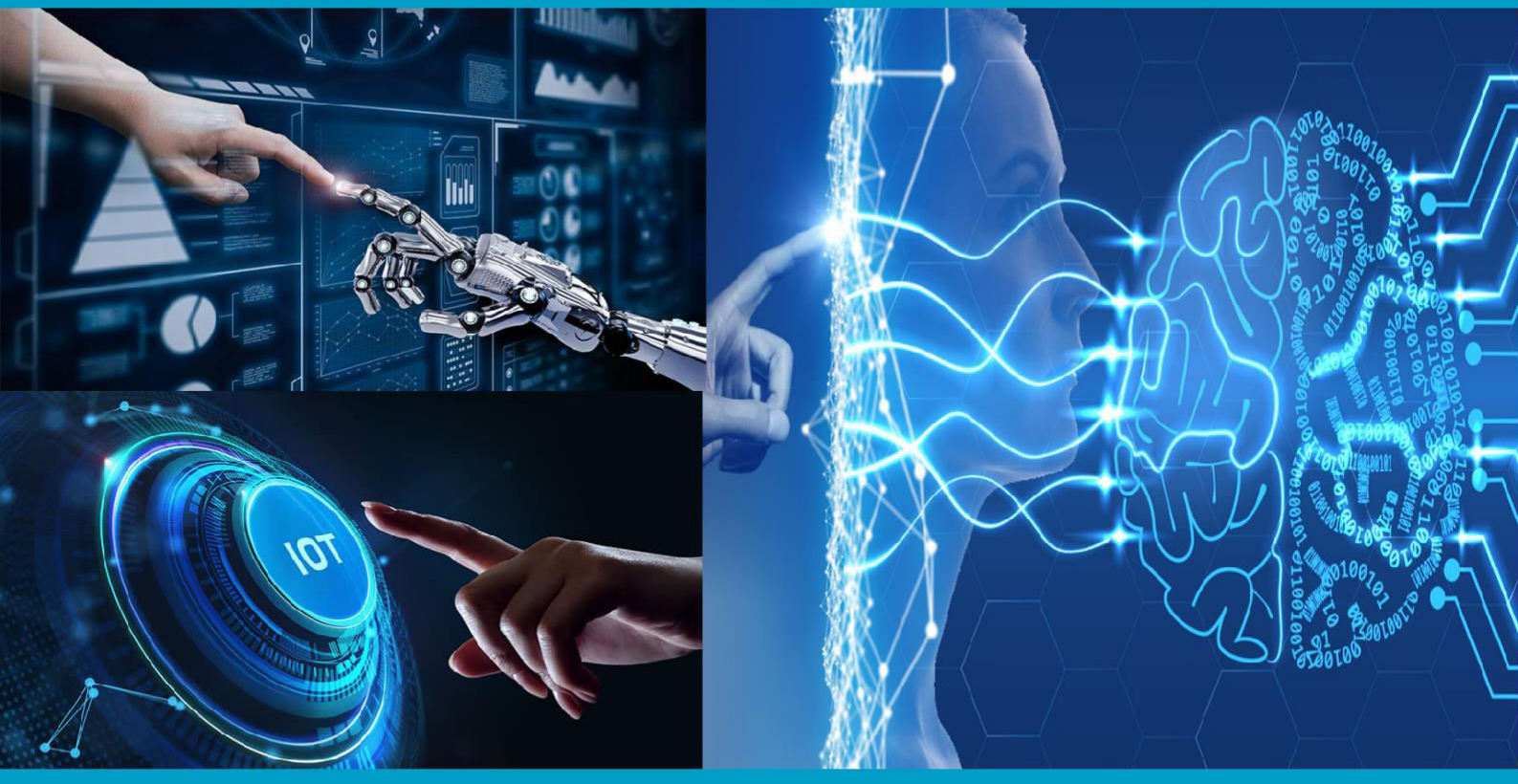

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A Study on Impact of Ecoclimatic Condition on the Flora of the Indian Thar Desert

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ABSTRACT: Thar desert region of India, which extends in more than 2.0 lakh sq. km area, experiences variable rainfall from 100 mm to 450 mm in a year. Frequent drought, which occurs once in 2 or 3 years in the region, causes extreme stress to fauna due to limited seasonal grazing resources. Besides xerophytic type of ecosystem, the fauna in Thar desert is subjected to extreme diurnal and seasonal variation in temperatures ranging as low as-5 ^{O} C in winter to a high of +49 ^{O} C in summer, causing thermal stress to the fauna. The Inter Governmental Panel on Climate Change (IPCC, 2007) projected for hotter days and warm nights and a reduction in rainfall in Thar region by 21 st century. Such projected climate change results in shifting rainfall pattern, higher temperatures, more demand for water and will be significant driver of biodiversity with changing life cycles, loss, migration and invasion of new habitat in Thar region. The present study on annual rainfall and temperature for Thar region showed by the end of 21 st century, an increase in temperature by +3.8 ^{O} C at Bikaner, +3.6 ^{O} C at Jaisalmer, +2.8 ^{O} C at Jodhpur and +2.3 ^{O} C at Pali, if the present rate of warming continues. Similarly, though there was no significant rise (@ 0.56 mm/year) in the annual rainfall of 12 arid districts of western Rajasthan, the annual rainfall is likely to be increased by +40 mm at Bikaner, +119 mm at Jaisalmer,-13 mm at Jodhpur and +43 mm at Pali. The spatial and temporal variation in potential evapotranspiration requirement of Thar region ranged from 2.1 mm/day to 12.2 mm/day and on an annual basis between 1500 mm to 2220 mm. During monsoon season, the impact of elevated temperatures on water demand is expected to increase by 0.1 to 0.5 mm/day for 1 ^{O} C rise, 0.3 to 1.1 mm/day for 2 ^{O} C, 0.4 to 1.6 mm/day for 3 ^{O} C rise and 0.6 to 2.1 mm/day for a 4 ^{O} C rise in temperature. Such increased demand of water due to global warming will reduce the scarce water and feed resources of Thar region.

KEYWORDS: desert, Thar, ecoclimatic, flora, Indian, Rajasthan, resources, rainfall, scarce, water, migration

I.INTRODUCTION

The Great Indian desert, famously known as the Thar Desert is the primary objective of this article. Additionally[1], the word Thar is derived from the word thul, meaning “sand ridges.”Therefore, the desert is much more than arid lands unsuitable for habitation. Similar to other land and aquatic forms, deserts also play a pivotal function for the Indian population. This article shall unravel the importance of deserts in the Indian subcontinent.The Thar Desert is located to the north-west of the Aravallis, in western Rajasthan with certain parts in Punjab and Sindh[2]. A concrete and arid land of mass, the desert came into existence in the Pleistocene age.Moreover, known by names like Marustali (the dead land) and Bagar, the desert features:

- Area coverage of 77,000 square km.
- Comprises of aeolian wind deposits
- Witnessed the run of Kachchh to its south
- Indus River flows west to the desert
- Dry climate and alluvial deposits
- Low vegetation cover
- Sand dunes with an elevation of 150 m
- Composed of Metamorphic Rocks
- Short seasonal streams originating from Aravallis
- Oasis in its southern part[3]

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Originally a part of the Peninsular plateau, but it still looks like a dry piece of unprotected and unpopulated land.During the ancient era, most of the desert area lay submerged under the sea. However, this region got uplifted due to heavy deposits of wood fossils some 180 million years back.More to this, there was a time when this region was fertile for growing food and cash crops. The presence of a dry river bed, especially of the river Saraswati validates this fact.Composed of sedimentary (2.5 billion 50 540 million years old) and metamorphic (4 billion to 2.5 million years old) rocks, the great Indian desert has aeolian sand deposits as old as 1.8 million years ago.Having an undulated surface, the desert land witnesses sand dunes moving in considerable shapes and sizes. The average elevation of these dunes remains 150 cm over the surface area. These dunes are also referred to by the name of dhands spread widely throughout the region.The Thar Desert experiences a subtropical desert climate and high pressure. However, the monsoon winds in the southwest bring rainfall in the summer seasons.But still, this arid region receives a low annual rainfall (4-20 inches) as compared to the other parts of India. Also, July to September feature as the likely monsoon months for the Indian desert.The coldest month of the year is January while May and June are the hottest[4].In short, the average temperature in the desert ranges between 75-70 degrees Celsius in summers and 39-50 degrees Celsius in winters.The Thar Desert comprises of different divisions of soil such as:

- Desert soil
- Red desertic soil
- Sierozems (brownish-gray soil)
- Red and yellow soils
- Saline soils
- Lithosols (shallow weathered soils)
- Regosols (soft loose soils)

Additionally, all the aforementioned soils are predominantly coarse, well-drained, and intense in calcium and lime. However, these soils are infertile and easily vulnerable to erosion due to overblown sands.Despite its concrete surface, the Indian Desert still constitutes decent biodiversity and vegetation. Some of its features pertaining to vegetation and biodiversity are hereby mentioned:

- Drought-resistant scrub trees like khajri and proposis
- Animals like blackbucks, gazelle, and partridges
- Migratory birds such as ducks, geese, and grouse[5]

The Thar desert has a fairly high population density of 83 persons per square km. Overall, it has a total population of 16,600,000.Most of the people residing in the desert area practice Islam and Hinduism. Besides, these people speak Sindhi, Marwari, and lahnda and Rajasthani as their primary languages.Next, the population preoccupies itself in animal husbandry, trade, and crafts. Rajputs and Marwaris are the two most prominent groups in this area.The grass in the desert has multi-purpose medicinal features. Further, there are five key breeds of cattle in this desert and each breed is used for a different purpose. Basically, camels are used for ferrying people for one place to another.The terrain of Thar desert facilitates the growth of cotton and wheat. Despite water scarcity, the desert utilizes ground water to fulfill its domestic, agricultural and energy needs. For example, the Indira Gandhi canal is used for irrigation in this desert area.Moreover, the convergence of rivers Satluj and Beas is used for generating hydropower in the desert region.Finally, there are few roadways and railway transports available in this portion connecting people within and beyond Rajasthan.[6]

- On 18 May 1974, India carried out its first nuclear weapon explosion test in the Thar Desert
- The desert is the 18 largest subtropical desert on Earth
- It is also the largest wool-producing region of India.
- Lakhs of tourists visit the desert each year.
- Famous for its camel safari around the world[7]

II.DISCUSSION AND RESULTS

The desert vegetation is mostly herbaceous or stunted scrub; drought-resistant trees occasionally dot the landscape, especially in the east. On the hills, gum arabic acacia and euphorbia may be found. The *khajri* (or *khejri*) tree (*Prosopis cineraria*) grows throughout the plains. The thinly populated grasslands support blackbucks, chikara (gazelles), and some

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feathered game, notably francolins (partridges) and quail. Among the migratory birds, sand grouse, ducks, and geese are common. The desert is also the home of the endangered great bustard. Most of the desert's inhabitants reside in rural areas and are distributed in varying densities. The harsh landscape of the Thar Desert supports a surprisingly large number of hardy, drought-resistant plant species. These plants have adapted to the desert conditions of sandy soil, scarce water and long hours of strong sunlight. Some have deep root systems to tap into low groundwater levels, others have smaller or no leaves, and spiky thorns to save on water loss through transpiration. Some species, particularly grasses, and small herbaceous plants are ephemerals in that they live in short seasonal cycles; they germinate in the first rains in July and die out by the time the soil dries up by December, leaving behind seeds that will bloom again next year.The vegetation of the desert remains crucial to the survival of the nomadic pastoral and agricultural communities, providing them with food, fodder, fuel, traditional medicines and a host of other derivatives.[8]

Name: **Khejri**/jhand/sangri
Scientific name: *Prosopis cineraria*

Features

- Medium sized, deciduous
- Small leaves, thorny branches
- Deep root system penetrating up to 30 metres
- Tiny yellow flowers in spikes
- Bunches of slender fruit pods

Uses/Significance to Community

- State tree of Rajasthan
- Pods gathered as vegetable when green
- Provides timber
- Range of traditional medicine
- Fodder for livestock[9]

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Name: **Rohira**/luar/desert teak
Scientific name: *Tecomella undulata*

Features

- Small to medium deciduous tree
- Trumpet-shaped flowers in red, yellow or orange clusters
- Seed pods are long and thin, gently curved

Uses/Significance to Community

- State flower of Rajasthan
- Excellent wood used to make furniture, tools and printing blocks
- Traditional medicine

Name: **Kumatiyo**/gum arabic[10]
Scientific name: *Acacia senegal*

Features

- Small deciduous tree
- Shiny dark red spines in sets of three, with one thorn hooked like a parrot's beak
- Creamy white flowers in cylindrical spikes
- Flat brown seed pods, gently curved or straight

Uses/Significance to Community

- Source of the true gum arabic, once used in the printing industry as an adhesive
- Also used in processed food
- Seeds collected when green to make a traditional Marwari vegetable dish

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Name: **Hingot**/hingoto/hingua/hingorni/desert date[11]
Scientific name: *Balanites roxburghii*

Features

- Small tree or deciduous bush with thin branches
- Small leaves
- Long green thorns
- Egg-shaped woody fruit

Uses/Significance to Community

- Seeds, fruit, leaves and bark have medicinal and detergent use
- Fruit is a natural dewormer eaten by pigs, porcupines, ruminants and jackals

Name: **Jaal**/peelu/dhalu/toothbrush/mustard tree[12]
Scientific name: *Salvadora persica*

Features

- Resilient tree with evergreen foliage of fleshy leaves
- Knobbly trunk
- Tiny white flowers in branching clusters
- Small translucent berries in red or cream

Uses/Significance to Community

- Many traditional medicines
- Small creatures like rodents and birds nest in the trunk

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Name: **Kharo jaal**/bada peelu
Scientific name: *Salvadora oleoides*

Features

- Small evergreen tree
- Dense canopy of green leaves
- Branches may droop down to ground
- Trunk more gnarled than peelu

Uses/Significance to Community

- Small creatures like rodents and birds nest in the trunk

Name: **Neem**[13]
Scientific name: *Azadirachta indica*

Features

- Semi evergreen, medium to large, grows to 15 metres
- Not native to region but well adapted to it
- Honey-scented flowers

Uses/Significance to Community

- All parts have many medicinal uses
- Timber used for planking

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Name: **Ber**/Indian jujube[14]
Scientific name: *Zizyphus mauritiana*

Features

- Short hardy tree with evergreen canopy
- Spines in pairs with one hooked
- Variable leaf sizes from medium to small
- Pale greenish flowers in small clusters
- Fruit is round or oblong

Uses/Significance to Community

- Rich in Vitamin C, the fruit provides a commercial crop, fodder for livestock and food for wild animals
- Shellac is made from the resin on ber leaves
- Bark and fruit yield a dye and tanning material
- Roots, bark and fruit are used in traditional medicine
- Wood is used for farm implements, beams, oilseed crushers
- Wood makes fuel and high-grade charcoal[15]

Name: **Googal**/mukul myrhh
Scientific name: *Commiphora wightii*

Features

- A low stout thorny shrub, sometimes a tree
- Small, scanty leaves
- Shiny, peeling bark
- Small red flowers
- Exudes a resin called ‘Indian bedellium’ or ‘gum googal’ in the cold season

Uses/Significance

- Most valuable medical plant
- The resin releases a myrhh-like fragrance when burned and is used as incense

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- In the Red Data list of endangered plants

Name: **Kankera**/red spike-thorn[16]
Scientific name: *Maytelus senegalesis*

Features

- Small deciduous crooked tree or bush
- Branches with solitary long spines, often leaf and flower bearing
- Tiny white scented flowers in bunches
- Tiny dark red fruit

Name: **Dhau**/dhawra/gum ghati/button tree
Scientific name: *Anogeissus latifolia*

Features

- Tall, slender deciduous tree growing upto 24 metres
- Clusters of tiny flowers
- Tiny spiky red fruits
- A honey-coloured resin called *gum ghati* is tapped from its trunk

Uses/Significance to Community

- The resin is used as binding agent in foods, drugs and skincare products
- The leaves and bark are used for dyeing and tanning
- Tussar silkworms are reared on its leaves
- The timber is used in construction, and for charcoal and fuelwood

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Name: **Badh**/Indian banyan/east Indian fig tree[17]
Scientific name: *Ficus bengalensis*

Features

- Spreading, almost evergreen tree with prop roots. Can grow to astonishing sizes in height and width
- Not a species of the arid region, but grown all over India
- Glossy oval leaves
- Fruit are red round figs

Uses/Significance to Community

- The fruit and the shady environs of the branches sustain bats, monkeys and birds
- Leaves and twigs are excellent fodder
- Bark, leaves, latex and root fibres have medicinal uses
- Worshipped by Hindus as the consort of the pipal tree[18]

Name: **Pipal**/sacred fig

Scientific name: *Ficus religiosa*
Features

- Large deciduous tree, up to 27 metres high
- Sinewed trunk
- Heart-shaped leaves with prominent pointed tips
- New leaves are very colourful in shades of rust and yellow
- Fruit is round, in pairs, and changes from unripe yellow-green to deep red-black when ripe
- Not an arid species, but cultivated across India

Uses/Significance to Community

- Most sacred of Indian trees. Often there is a shrine at the base
- Root, latex, bark, fruits and new shoots are used as medicines
- Fruits eaten by birds, and leaves are fodder for buffaloes and elephants

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Name: **Shisham**/chirhol[19]
Scientific name: *Dalbergia sissoo*

Features

- Middle-sized deciduous tree
- Oval leaves with pointed tips
- Small flowers in creamy clusters
- Long flat fruit pods
- Not an arid species but adapts to dry conditions

Uses/Significance to Community

- The best quality timber
- The wood 'raspings' and bark are used for medicine
- Leaves are used for fodder
- Often planted as a windbreak to prevent erosion

Name: **Sargado**/bitter drumstick
Scientific name: *Moringa concanesis* [20]

Features

- Similar to the soajna or drumstick
- Small tree with feathery leaves
- Enormous roots to anchor in the sandy soil
- Clusters of fragrant cream flowers
- Long striated fruit pods

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Name: **Lasura**/risalla/Indian cherry
Scientific name: *Cordia myxa*

Features

- Hardy, middle-sized deciduous tree
- Broadly oval leaves
- Round yellow fruit with smooth skin and sticky pulp
- In dry areas, grows around depressions and water margins

Uses/Significance to Community

- Fruit and leaves have multiple medicinal uses
- Fruit is eaten as vegetable and pickled
- Leaves used as fodder
- Wood is light but usable for boats and farming tools

Name: **Imli**/tamarind[21]
Scientific name: *Tamarindus indica*

Features

- Large deciduous tree
- Compound leaves with pairs of leaflets
- Yellow three-petal flowers
- Fruit are green bean-like pods that ripen to brown, with a soft downy texture
- Cultivated across India

Uses/Significance to Community

- The tart fruit is used in cooking and has many medicinal properties
- Imli seeds provide an oil varnish
- The bark is used in tanning and dyeing

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Shrubs

Name: **Kair**/ker/kareel

Scientific name: *Capparis decidua*

Features

- Spiny bush or small tree, deciduous
- Dense clump of leafless branches
- Tiny leaves, shed quickly in less than a month
- Bright red/orange flowers twice a year
- Round dark pink fruit

Uses/Significance to Community

- The flowers and fruit are pickled or cooked as a vegetable dish
- Is a sand binder that stabilises sand dunes
- Used in traditional medicines

Name: **Aakado**/aakra/giant milkweed[22]

Scientific name: *Caliotropis procera*

.

Features

- A large bush with big fleshy leaves
- Small pink/purple flowers in clusters
- Ubiquitous in dry sandy areas and along roads and highways

Uses/Significance to Community

- All parts of the plant are poisonous
- The aakra flower is sacred to Hindus and is offered in prayers to Shiva

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Name: **Kheemp**/broom brush
Scientific name: *Leptadenia pyrotechnica*

Features

- Grows up to two and a half metres
- Wiry stems and leaves
- Tiny star-shaped flowers

Uses/Significance to Community

- A sand binder
- The dried stems are used for thatching and to make brooms
- Fruit is collected and cooked as a vegetable dish
- Traditional medicine for sheep

Name: **Phog**
Scientific name: *Calligonum polygonides*[21]
Features

- Small shrub that grows up to one or two metres

Uses/Significance to Community

- Edible flowers called *phogalo*
- Provides fodder
- Its charcoal is used to melt iron

Name: **Bui**/desert cotton
Scientific name: *Aerva javanica*

Features

- Most common desert bush
- Produces thick white inflorescence
- Grows up to a metre high

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Uses/Significance to Community

- A sand binder
- The fluffy flowers are used as filling for bedding
- Anti-inflammatory in traditional medicine
- Fodder for goats[20]

Name: **Thhor**/danda thor/leafless spurge
Scientific name: *Euphorbia caducifolia*

Features

- Multi-stemmed succulent that grow to a large circumference
- Small red or green flowers

Uses/Significance to Community

- It creates a mini protected zone within its stems where rodents, small animals and a host of plants prosper in shade and safety[19]

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Name: **Baonli**
Scientific name: *Acacia jacquemontii*

Features

- Hardy shrub with multiple shoots
- Up to two metres tall

Uses/Significance to Community

- Sand binder
- Used in traditional medicine
- Provides fodder and fuelwood

Name: **Sinniya**/senna/swarna patri
Scientific name: *Cassia augustiflora*[18]

Features

- Small perennial shrub
- Yellow flowers

Uses/Significance to Community

- Leaves and seed used in medicine as laxative and blood purifier

Name: **Tulsi**/holy basil/ sweet basil[17]
Scientific name: *Ocimum tenuiflorum*

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Features

- Small aromatic shrub
- Green and purple leaves, small purplish flowers

Uses/Significance to Community

- Seeds and leaves used in traditional medicine to cure bronchitis, stress, acne and leucoderma
- Significant in Hindu rituals

Name: **Dhatura**/thorn apple/devil's trumpet
Scientific name: *Datura stramonium*

Features

- Foul-smelling bush
- Up to two metres tall
- Bell-shaped white-violet flowers
- Highly toxic plant

Uses/Significance to Community

- Traditional medicine for asthma, as an analgesic and as an anaesthetic

Name: **Kaner**/desert rose[16]
Scientific name: *Nerium indicum*

Features

- Tall evergreen shrub that rises up to five metres
- Pale to bright pink scented flowers

Uses/Significance to Community

- Traditional medicine for malaria, ulcers, piles, skin diseases
- Also used to induce abortions[22]

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