



Garden in the Thar Desert Stays Green Despite Climate Crisis

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ABSTRACT: The Thar Desert, also known as the Great Indian Desert, is an arid region in the north-western part of the Indian subcontinent that covers an area of 200,000 km² (77,000 sq mi) in India and Pakistan. It is the world's 18th-largest desert, and the world's 9th-largest hot subtropical desert.

About 85% of the Thar Desert is in India, and about 15% is in Pakistan.^[3] The Thar Desert is about 4.56% of the total geographical area of India. More than 60% of the desert lies in the Indian state of Rajasthan; the portion in India also extends into Gujarat, Punjab, and Haryana. The portion in Pakistan extends into the provinces of Sindh^[4] and Punjab (the portion in the latter province is referred to as the Cholistan Desert). The Indo-Gangetic Plain lies to the north, west and northeast of the Thar desert, the Rann of Kutch lies to its south, and the Aravali Range borders the desert to the east.

The most recent paleontological discovery in 2019 from the Thar Desert in India, dating back to 167 million years ago, pertains to a herbivorous dinosaur group known as dicraeosaurids. This discovery marks the first of its kind to be unearthed in India and is also the oldest specimen of the group ever recorded in the global fossil record

KEYWORDS: Thar desert, garden, green, climate, crisis, India

I. INTRODUCTION

Sand Dunes are western Rajasthan's essential iconographies. They capture the courage of people living here for aeons under the harshness of the summer sun. They also make the Thar magical in winter.

In the vastness of this undulating desert, anything green such as a tree is rare. But Jaisalmer's Bada Bagh – dotted with giant green trees – is a spectacular rarity. The trees in the sprawling garden are centuries old. Many of them bear fruits. The others shine in their green splendour, making the garden a sight to behold.

It is a treasure in an otherwise arid landscape. Owned by the royal family of Jaisalmer, Bada Bagh, spread around 75 acres, boasts of 36 varieties of trees – some three to four centuries old.

“The oldest of them is a mango tree,” points out Parth Jagani, a local conservationist tasked with taking care of the garden.

That the trees have survived and flourished in such a harsh environment is a noticeable manifestation of natural wonder. Standing proudly tall and jostling for space within its premises are Khejri, Jamun, Arjun, Peepal, Neem, Gunda and Babool among others.

Where the grass is greener

A distinct oddity in a desert, the garden comes in for gushing praise from nature lovers.

“The existence of these trees in the garden is no less than a miracle,” insisted Sumit Dookia, a member of the faculty at Delhi's IP University.

But then Bada Bagh is not famous for its trees alone. It, in fact, also mothers some 15 varieties of grass – from Sewan (*Lasiurus scindicus*), and Dhaman (*Cenchrus ciliaris*) to Moorath (*Brachiaria romosa* or browntop millet). It also has some medicinal plants such as Turmeric.

Amplifying its fame also has been the fact that no fertiliser has ever been used in the garden. For that matter, Bada Bagh has been organic over the centuries of its surprising existence.



According to historian Nandkishore Sharma, now 87, the garden is about 400 years old. Its history though is a bit fuzzy and none really has a clue about who planted the seeds of the trees here first.

But folklore has it that the royal family was the primary force behind it and they might have received the seeds as some sort of gift – a part of diplomacy.

“Seeds were brought from different parts of the world as presents to the then Maharaja,” Sharma added. He also pointed out that the mango tree – the oldest – could have possibly been planted around 1650 CE.

That the trees bore extremely sweet mangoes further helped the cause of diplomacy. They served as mediators for peace and business.

Dookia agreed that diplomacy could have played a prominent part in the establishment of the garden. One, they grew in Jaisalmer, seen largely to be a sandy waste. Two, they were considered God’s gift.

But that’s a thing of the past now.

A lurking crisis

The present is beset with problems, including a worsening climate crisis that is endangering the unique garden.

Only recently, one of the oldest trees died. It possibly could no longer withstand the challenges of a fast-changing climate.

“The climate in the desert is changing. It is impacting desert life,” Jagani, the conservationist, explained.

Those in charge of managing the garden, however, are acting to protect the trees. “We are ensuring no other tree has to face what this old one had to undergo,” one of them said.

Fortunately for Bada Bagh, there is a khadeen (local natural aquifer) that lies next to it. The rainwater collected is used to diligently water the garden daily.

The garden, therefore, continues to be green. The royal family asked local conservationists to step in and conserve the garden organically. It’s been two years since then they have been taking care of it.[1,2,3]

As roses, marigolds, and jasmine bloom in full splendour, Bada Bagh echoes with the constant chirping of birds, from mynas and koyals to parrots. They collectively tell us that there exists a miracle in Thar, in the shape of the verdant Bada Bagh garden right in the middle of a desert.

II. DISCUSSION

Ice-age desertification

During the Last Glacial Maximum 20,000 before present, an approximately 2,400,000 square kilometres (930,000 sq mi) ice sheet covered the Tibetan Plateau,^{[6][7][8]} causing excessive radiative forcing i.e. the ice in Tibet reflected at least four times more radiation energy per unit area into space than ice at higher latitudes, which further cooled overlying atmosphere at that time.^[9] This impacted the regional climate. Without the thermal low pressure caused by the heating, there was no monsoon over the Indian subcontinent. This lack of monsoon caused extensive rainfall over the Sahara, expansion of the Thar Desert, more dust deposited into the Arabian Sea, a lowering of the biotic life zones on the Indian subcontinent, and animals responded to this shift in climate with the Javan rusa deer migrating into India.^[10]



Desertification due to drying up of Sarasvati river



Vedic and present-day Ghaggar-Hakra river-course, with Aryavarta/Kuru Kingdom, and (pre-)Harappan Hakkra/Sutlej-Yamuna paleochannels as proposed by Clift et al. (2012) and Khonde et al. (2017).^[a] See also this satellite image.

- 1 = ancient river
- 2 = today's river
- 3 = today's Thar desert^[4,5,6]
- 4 = ancient shore
- 5 = today's shore
- 6 = today's town
- 7 = dried-up Harappan Hakkra course, and pre-Harappan Sutlej paleochannels (Clift et al. (2012)).

10,000-8,000 years ago a paleo channel of Ghaggar-Hakra River - identified with the paleo Sarasvati River, after confluence with Sutlej flowed into the Nara river - a delta channel of the Indus River, changed its course, leaving the Ghaggar-Hakra as a system of monsoon-fed rivers which did not reach the sea and now ends in the Thar desert.^{[11][12][13][14]}

Around 5,000 years ago when the monsoons that fed the rivers diminished further, the Indus Valley Civilisation (IVC) prospered in this area,^{[11][13][14][b]} with the rise of numerous IVC urban sites at Kalibangan (Rajasthan), Banawali and Rakhigarhi (Haryana), Dholavira and Lothal (Gujarat) along this course.^{[15][web 1]}

4,000 years ago when monsoons diminished even further, the dried-up Hakkra become an intermittent river, and the urban Harappan civilisation declined, becoming localized in smaller agricultural communities.^{[11][c][13][12][14]}

Geography



A NASA satellite image of the Thar Desert, with the India–Pakistan border



View of the Thar Desert

The northeastern part of the Thar Desert lies between the Aravalli Hills. The desert^[7,8,9] stretches to Punjab and Haryana in the north, to the Great Rann of Kutch along the coast, and to the alluvial plains of the Indus River in the west and northwest. Much of the desert area is covered by huge, shifting sand dunes that receive sediments from the alluvial plains and the coast. The sand is highly mobile due to the strong winds that rise each year before the onset of the monsoon. The Luni River is the only river in the desert.^[16] Rainfall is 100 to 500 mm (4 to 20 in) per year, almost all of it between June and September.^[3]

Saltwater lakes within the Thar Desert include the Sambhar, Kuchaman, Didwana, Pachpadra, and Phalodi in Rajasthan and Kharaghoda in Gujarat. These lakes receive and collect rainwater during monsoon and evaporate during the dry season. The salt comes from the weathering of rocks in the region.^[17]

Lithic tools belonging to the prehistoric Aterian culture of the Maghreb have been discovered in Middle Paleolithic deposits in the Thar Desert.^[18]

Climate

The climate is arid and subtropical. Average temperature varies with season, and extremes can range from near-freezing in the winter to more than 50 °C in the summer months. Average annual rainfall ranges from 100 to 500 mm, and occurs during the short July-to-September southwest monsoon.^[1]

The desert has both a very dry part (the Marusthali region in the west) and a semidesert part (in the east) that has fewer sand dunes and slightly more precipitation.^[19]

Desertification control



Greening desert with plantations of jojoba at Fatehpur, Shekhawati Checking of shifting sand dunes through plantations of Acacia tortilis near Laxmangarh town



Indira Gandhi Canal flowing in Thar Desert [10,11,12]near Sattasar village, Bikaner district, Rajasthan



Due to severe weather conditions, few highways are in the Thar Desert. Shown here is a road in Tharparkar district of Sindh, Pakistan.

The soil of the Thar Desert remains dry for much of the year, so it is prone to wind erosion. High-velocity winds blow soil from the desert, depositing some of it on neighboring fertile lands, and causing sand dunes within the desert to shift. To counteract this problem, sand dunes are stabilised by first erecting micro windbreak barriers with scrub material and then by afforestation of the treated dunes—planting the seedlings of shrubs (such as phog, senna, and castor oil plant) and trees (such as gum acacia, Prosopis juliflora, and lebbek tree). The 649-km-long Indira Gandhi Canal brings fresh water to the Thar Desert.^[3] It was built to halt any spreading of the desert into fertile areas.

III. RESULTS

Protected areas

There are several protected areas in the Thar Desert:

- In India:[13,14,15]
- The Desert National Park, in Rajasthan, covers 3,162 km² (1,221 sq mi) and represents the Thar Desert ecosystem;^[20] it includes 44 villages.^[21] Its diverse fauna includes the great Indian bustard (Chirotis

nigricaps), blackbuck, chinkara, fox, Bengal fox, wolf, and caracal. Seashells and massive fossilized tree trunks in this park record the geological history of the desert.

- The Tal Chhapar Sanctuary covers 7 km² (2.7 sq mi) and is an Important Bird Area.^[21] It is located in the Churu district, 210 km (130 mi) from Jaipur, in the Shekhawati region of Rajasthan. This sanctuary is home to large populations of blackbuck, fox, caracal, partridge, and sand grouse.
- The Sundha Mata Conservation Reserve covers 117.49 km² (45.36 sq mi) and is located in the Jalore District of Rajasthan.^[22]
- In Pakistan:
- The Nara Desert Wildlife Sanctuary covers 6,300 km² (2,400 sq mi);^[23] it is located in is located in Mirpurkhas District.^[24] It contains the largest population of the endangered mugger crocodile in Pakistan.^[24]
- The Rann of Kutch Wildlife Sanctuary located in Badin District is an Important Bird Area and Ramsar Site, with 30 species of mammals, 112 bird species, 20 reptiles, and 22 important plant species.^[25]
- The Lal Suhanra Biosphere Reserve and National Park is a UNESCO declared biosphere reserve,^[26] which covers 65,791 hectares (254.02 sq mi) the Cholistan region of the Greater Thar Desert.^[27]

Biodiversity

Fauna

Some wildlife species that are fast vanishing in other parts of India are found in the desert in large numbers, including the blackbuck (*Antelope cervicapra*), chinkara (*Gazella bennettii*), and Indian wild ass (*Equus hemionus khur*) in the Rann of Kutch. This may be partly because they are well adapted to this environment: they are smaller than similar animals that live in other environments, and they are mainly nocturnal. It may also be because grasslands in this region have not been transformed into cropland as fast as in other regions, and because a local community, the Bishnois, has made special efforts to protect them.

Other mammals in the Thar Desert include a subspecies of red fox (*Vulpes vulpes pusilla*) and the caracal, and a number of reptiles dwell there too^[16,17,18].

The region is a haven for 141 species of migratory and resident desert birds, including harriers, falcons, buzzards, kestrels, vultures, short-toed eagles (*Circaetus gallicus*), tawny eagles (*Aquila rapax*), greater spotted eagles (*Aquila clanga*), and laggar falcons (*Falco jugger*).

The Indian peafowl is a resident breeder in the Thar region. The peacock is designated as the national bird of India and the provincial bird of the Punjab (Pakistan). It can be seen sitting on khejri or pipal trees in villages or Deblina.



Peacock on a khejri tree



Peafowl eating pieces of chapati in Tharparkar District, Sindh



Blackbuck male and female



The chinkara or Indian gazelle is found across the Thar Desert.

Flora



Local mushrooms (khumbi) from Tharparkar, Sindh



Prosopis cineraria or khejri or kandi

The natural vegetation of this dry area is classified as northwestern thorn scrub forest (i.e. small, loosely-scattered patches of greenery).^{[28][29]} The densities and sizes of these green patches increase from west to east, following an increase in rainfall. The primary vegetation of the Thar Desert is composed of trees, shrubs, and perennial herb species, including:^[30]

- Trees and shrubs: *Aerva javanica*[19,20], *Balanites roxburghii*, *Calotropis procera*, *Capparis decidua*, *Clerodendrum multiflorum*, *Commiphora mukul*, *Cordia sinensis*, *Crotalaria burhia*, *Euphorbia caducifolia*, *Euphorbia neriifolia*, *Grewia tenax*, *Leptadenia pyrotechnica*, *Lycium barbarum*, *Maytenus emarginata*, *Mimosa hamata*, *Suaeda fruticosa*, *Vachellia jacquemontii*, *Ziziphus nummularia* and *Z. zizyphus*.
- Herbs and grasses: *Ochthochloa compressa*, *Dactyloctenium scindicum*, *Cenchrus biflorus*, *Cenchrus setiger*, *Lasiurus scindicus*, *Cynodon dactylon*, *Panicum turgidum*, *Panicum antidotale*, *Dichanthium annulatum*, *Sporobolus marginatus*, *Saccharum spontaneum*, *Cenchrus ciliaris*, *Desmostachya bipinnata*, *Eragrostis* species, *Eragmopagan* species, *Phragmites* species, *Tribulus terrestris*, *Typha* species, *Sorghum halepense*, *Citrullus colocynthis*

The endemic floral species include *Calligonum polygonoides*, *Prosopis cineraria*, *Acacia nilotica*, *Tamarix aphylla*, and *Cenchrus biflorus*.^[31]

IV. CONCLUSION

People

The Thar people are the natives of the area. The Thar Desert is the most widely populated desert in the world, with a population density of 83 people per km².^[21] In India, the inhabitants comprise Hindus, Jains, Sikhs,^[21,22] and Muslims. In Pakistan, inhabitants include both Muslims and Hindus.^[32]

About 40% of the total population of Rajasthan lives in the Thar Desert.^[33] The main occupations of the inhabitants are agriculture and animal husbandry.

Jodhpur, the largest city in the region, lies in the scrub forest zone at the desert's perimeter. Bikaner and Jaisalmer are the largest cities located entirely in the desert.



A girl from the Gadia Lohars nomadic tribe of Marwar, cooking her food.



Thar life



Desert tribes near Jaisalmer, India

Water and housing in the desert

In the true desert areas, the only sources of water for animals or humans are small, scattered ponds - some that are natural (tobas) and some that are human-made (johads). The persistence of water scarcity heavily influences life in all areas of the Thar, prompting many inhabitants to adopt a nomadic lifestyle.^[citation needed] Most of the permanent human settlements are located near the two seasonal streams of the Karon-Jhar hills. Potable groundwater is also rare in the Thar Desert. Much of it tastes sour due to dissolved minerals. Potable water is mostly available only deep underground. When wells are dug that happen to yield sweet tasting water, people tend to settle near them, but such wells are difficult and dangerous to dig, sometimes claiming the lives of the well-diggers.^[citation needed]

Crowded housing conditions are common in some areas.



Huts in the Thar Desert



Johads are common water sources



Tanks for drinking water[21]

Agriculture

The Thar is one of the most heavily populated desert areas in the world with the main occupations of its inhabitants being agriculture and animal husbandry.

Agricultural production is mainly from kharif crops, which are grown in the summer season and seeded in June and July. These are then harvested in September and October and include bajra, pulses such as guar, jowar (Sorghum vulgare), maize (zea mays), sesame and groundnuts.

The Thar region of Rajasthan is a major opium production and consumption area.^{[34][35]}



Bajra is the main kharif crop in Thar.



Mustard fields in a village of Shri Ganganagar district (Rajasthan, India).

Livestock



Thari cow breed originating from Tharparkar, Sindh, popular since World War I^[36]



Cattle in the Thar Desert

Agroforestry



Lopping of khejri tree for fodder and fuel in Harsawa village

P. cineraria wood is reported to contain high calorific value and provide high-quality fuel wood. The lopped branches are good as fencing material. Its roots also encourage nitrogen fixation, which produces higher crop yields.



Tecomella undulata tree in the village of Harsawa

Ecotourism

Desert safaris on camels have become increasingly popular around Jaisalmer. Domestic and international tourists frequent the desert seeking adventure on camels for one to several days. This ecotourism industry ranges from cheaper backpacker treks to plush Arabian night-style campsites replete with banquets and cultural performances. During the treks, tourists are able to view the fragile and beautiful ecosystem of the Thar Desert. This form of tourism provides income to many operators and camel owners in Jaisalmer, as well as employment for many camel trekkers in the desert villages nearby. People from various parts of the world come to see the Pushkar ka Mela (Pushkar Fair) and oases.



Camel ride in the Thar Desert near Jaisalmer, India



Sunrise in the desert

Industry

The government of India initiated departmental exploration for oil in 1955 and 1956 in the Jaisalmer area,^[37] Oil India Limited discovered natural gas in 1988 in the Jaisalmer basin.^[38]

The Desert National Park in Jaisalmer district has a collection of 180-million-year- old animal and plant fossils.



Jaisalmer State's historical foundations are in the large empire ruled by the Bhati dynasty. The empire stretched from what is now Ghazni^[39] in modern-day Afghanistan to what is Sialkot, Lahore and Rawalpindi in modern-day Pakistan^[40] to the region that is Bhatinda and Hanumangarh in modern-day India.^[41] The empire crumbled over time because of continuous invasions from central Asia. According to Satish Chandra, the Hindu Shahis of Afghanistan made an alliance with the Bhatti rulers of Multan because they wanted to end the slave raids that were made by the Turkic ruler of Ghazni, but the alliance was broken apart by Alp Tigin in 977 CE. Bhati dominions continued to shift southwards: they ruled Multan, then finally got pushed into Cholistan and Jaisalmer, where Rawal Devaraja built Dera Rawal / Derawar.^[42] Jaisalmer was founded as the new capital in 1156 by Maharawal Jaisal Singh and the state took its name from the capital. On 11 December 1818 Jaisalmer became a British protectorate through the Rajputana Agency.^{[43][44]}

Because the kingdom's main source of income had long been levies on caravans, its economy suffered after Bombay became a major port, and sea trade largely replaced trade along the traditional land routes. Maharawals Ranjit Singh and Bairi Sal Singh tried to reverse the economic decline, but the kingdom nevertheless became impoverished. To make matters worse, there was a severe drought and a resulting famine from 1895 to 1900, during the reign of Maharawal Salivahan Singh, which caused the widespread loss of the livestock upon which the increasingly agriculturally based kingdom had come to rely.

In 1965 and 1971, population exchanges took place in the Thar between India and Pakistan; 3,500 Muslims shifted from the Indian section of the Thar to Pakistani Thar, whilst thousands of Hindu families also migrated from Pakistani Thar to the Indian section.^[22]

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