Micro-climatic changes in Thar Desert in India: Development and challenges

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Deserts, irrespective of their location and nature - cold or warm, are known for scarcity of water and rare vegetation. However, warm / tropical deserts also own their specific characteristics such as long prevailing summers with scorching weather under the influence of local winds system, dust storms, scattered xerophytes, and rare human settlements. Besides, deserts are now an area of interest for research activities, both due to their criticality from a climate change point of view and also, because of the natural wealth, stored underneath.

More than 15 million square kilometer lands in the world are under deserts. The Thar Desert, which ranks seventh in size, is unique in the world as it is quite densely populous and rich in mineral wealth. It is known for sandstorms and loos (hot dry winds). The origin of this desert is not confirmed, but some sources expect it to be about 4000 years old. Presence of marine fossils underneath the sandy cover indicates the retreat of sea, an evidence of climatic change. The desert is extended over 446,000 square kilometers, both in India and Pakistan. About 208,111 square kilometer of which lies in India. Almost 61 percent of this Indian Desert lies in Rajasthan alone and covers about three-fifth of its area. The rest lies in Gujarat, Haryana and Punjab states. Abundance of mineral resources in the desert has accelerated the economic growth of this traditionally deprived area. Potential of resources hidden underneath is a reason responsible for its continued economic importance. Being expanded along the Indo- Pak international border, it has its military and strategic importance too.

This Desert in Rajasthan was earlier known for sandstorms and loos (hot dry winds), scarcity of water, sand dunes, sparsely distributed population, low economic development, hard living conditions and repeated occurrence of drought and famine. But now, it is undergoing both natural and cultural changes as precipitation is on the rise since last two

decades along with increase in land available for agro practices. Contrarily, barren land and typical xerophytes are shrinking. This desert experienced a severe flood in year 2006 which left its imprints in the area in the form of rise in the underground water table and expansion of green natural vegetation, even of a perennial nature. In addition, Indira Gandhi Canal (IGNP) and a lift canal from river Narmada have further facilitated the area in terms of availability of water for irrigation, drinking and underground recharge. Despite sandstorms and the loos, remarkable increase in agricultural activities and livestock wealth is recorded.

Observing rainfall data of the last two decades, it is noticed that the western area is getting more rainfall than the eastern part of the state. The magnitude of rainfall in the western desert districts is increasing, whereas it is decreasing in the eastern districts. Except for the years when rainfall was low throughout the country, there is an increase in rainfall in the desert area, especially Barmer and Jaisalmer districts. Thus the actual or observed average rainfall is almost 7 mm higher than the expected average in Barmer and almost 3 mm higher in Jaisalmer. Contrarily, the observed averages in both Alwar and Bharatpur districts are getting down.

Table 1: Expected and Observed averages of rainfall in four districts in Rajasthan; 1990 – 2011

District	**Rainfall (mm)**		
Names	Maximum Observed	Average	Expected
Barmer	70.98	27.75	38.52
Jaisalmer	30.1	16.4	19.21
Alwar	84.68	61.1	55.16
Bharatpur	86.2	67.5	60.67

Source: Statistical Year Book of the aforesaid districts for the year 1993, 1997, 2001 and 2005, published by the Department of Statistics, Govt. of Rajasthan, Jaipur; and India Meteorology Department (IMD); Govt. of India.

Floods occurred in Barmer district in years 2006 and 2007 and were followed by fairly good rainfall in 2011 which may be viewed as one of the indicators of micro climatic changes taking place in the area. There was wide-spread damage to crops and loss of property because of flood. The flood havoc in Jaisalmer district is certainly an addition in the history

of the desert, which was never witnessed by the inhabitants earlier. However, the magnitude of rainfall that occurred in 2006 in Barmer was not new; it had received higher rainfall half a century earlier too, but there was no loss of life and property at that time. According to the meteorology department, heavy rainfall in the desert is a periodic phenomenon, which strengthens the argument that the area is undergoing micro climatic changes. The consequent higher moisture content of the soil is supporting the growth of wild breeds of fauna as well as cultivation. The area is undergoing a kind of environmental change, especially related to rapid succession in vegetation, increase in green cover, non-movement of sand dunes, and increasing magnitude of rainfall. No studies have been made to estimate or understand the nature of environmental change and no efforts have been initiated for the management of challenges introduced by the environmental changes to the established settlements, like saving of lives during dust storms and heavy rainfall episodes. The overall changes are so complicated that they need intense studies to understand and come up with remedies.

Due to growing facilities for agriculture, two crops Rabi and Kharif are being sown in the area, with special focus on Rabi, in which mustard, cumin and Ishavgol (a medicinal crop) are grown over larger area. Being suitable for aforesaid cash crops, the area is attracting people from within the state and from outside, resulting in very high population growth in the two districts – Jaisalmer and Barmer. This increasing population and growing agro practices are enough evidence of the area undergoing positive changes which are favorable to humans.

Challenge to development: The changing environmental situation in the desert area certainly needs attention. The changes are not only in rainfall but also in flora, fauna, soil moisture content, and economic occupations, including a fast growth of tertiary occupations in the area. Agriculture which was hardly practiced earlier is growing rapidly. Barmer, Chohtan, Shiv, Baitu, and Pachpadra are leading agro-producing tehsils in the district. Cumin, Ishavgol, mustard, and oilseeds are now important Rabi crops.

Floods not only impacted settlements but also their sources of livelihood. Most of the reserves of the natural oil recently discovered are in Barmer. The district is a leading supplier of masonry stone, a building material known as Barmer stone. It is an emerging center in trade of typical Rajasthani bed-sheets (manufactured at Chohtan), leather and wooden goods, dry vegetables and special types of turbans. All these

economic activities are the effort of the people themselves with no substantial support of the government.

Floods have raised many challenges. There is only one point approach for the development of the area i.e. the arid zone development approach; therefore, the efforts and budgetary allocations are to be made accordingly. Some such efforts are provision of annual budgets for water supply through tankers and railways, fodder management, plantation, and compensation to farmers, but there isn't much effort to store rain water for drinking and irrigation. Some related challenges are:

1. To locate the original / ancient drainage systems and find out their viability in the present
2. To locate such depressions where rainwater may agglomerate naturally
3. Construct check ponds along / around big depressions and connect them to develop local inland water circulation to minimize runoff to ensure optimum use of rain water
4. Prepare plans for water harvesting and optimize the use of rain water whenever it rains
5. Provision of annual budgets for maintenance for the water reservoirs

Agriculture is progressing in the district. Efforts for its development will surely further contribute in its development. ICAER, Agricultural University Bikaner and State Agricultural Department are engaged in monitoring this region. However, the approach and methodology of monitoring are uneconomic and ineffective. Focus is more on identifying misuse of subsidies and other grants rather than their effective utilization. This is not in favor of sustainable development of this area. The related challenges are:

1. To draft a separate policy for the agricultural sector of the desert area and to ensure its effective implementation
2. Proper enumeration of the original cultivators of the area so that misuse of the funds is reduced and also relief is assured to the needy during any calamity
3. To optimize agro-productivity of the area without distributing cash as subsidies
4. To select suitable crops and increase their productivity

The flood calamity of 2006 has questioned settlement patterns of the area. There is no such policy that may direct settlement growth and locations except the Zero Line zone along the international border with Pakistan. Unplanned expansion and location of settlements has also been a reason for huge damages. The related challenges are:

1. To draft a settlement policy for the area. It's a great challenge. The locations of settlements must be appropriate to withstand both dust storms and heavy rainfall events. It is also a necessity from a national security point of view
2. To ensure infrastructural facilities in the area to increase the comfort of living
3. Keep eye watch on immigrants from a developmental and security point of view

Conclusion: It is time to learn from the recent incidents and reframe our planning approach and also, increase our efforts on a priority basis. When it is being planned to extend the Indira Gandhi Canal to the Thar Desert districts, it is essential to construct outlets so that during any emergency outflow of excess water is assured. There are evidences of the existence of some ancient channels along with some extinct rivers like the Leek and the Sheepasaria linking the area with the seasonal river Luni. There is an urgent need to study the terrain and topography of the area to develop its drainage system and for it rehabilitation.

Some of the changes taking place in the area, especially increasing moisture content in the soil, growing foreign breeds of natural vegetation which are adversely affecting the growth of originally inhabited breeds, growing vegetation cover along with rapid succession, and anatomical adaptations in plants are indicating that there is a need to review the developmental efforts and planning approach along with re-enlisting of priorities on real basis, rather than political. Despite all these indicators spatial planning is still desert oriented. Substantial funds every year under the Desert Development Program are consumed without considering the geographical changes taking place in the area. Casual meetings to frame and review development plans for the desert can't be appropriate unless the occurring changes and challenges are also taken into care and utilization of funds and grants are judiciously consumed. The following are some suggestions in this regard:

1. There is an urgent need to begin a new draft of planning, deciding priorities and limitations. For this purpose it is again necessary to involve local people to strengthen the outputs of the plans.

2. Spatial studies are to be promoted through state, national and international funding agencies highlighting the issues, capabilities and challenges.
3. Drainage development should be a priority to channel forthcoming canal water as well as to minimize the losses due to heavy rain.
4. Though it's contradictory to suggest establishment of new settlements on top of sand dunes as heavy rain is still occasional, but dust storms are very often in the area, which hit more on the top than the depressions. However new safe areas for settlement should be searched in order to balance the two adverse situations.
5. Involvement of local experts, academicians and scholars is to be appreciated so that the work in their respective fields may be helpful to strengthen local planning.
6. There must be planned and limited intervention in the ecosystem in the area, especially in the field of forestry.
7. The planners are advised to study the adverse consequences of IGNP at Suratgarh, Badopal and Hanumangarh (all in Hanumangarh district), and Lunkaransar (Bikaner district), where fertile soil has turned into barren because of the presence of excess water in the desert ecosystem. There is gypsum stone layer in Barmer and Jaisalmer districts, underlying the soil cover, which does not allow water to percolate. Hence, water logging and salts deposition in bulk have spoiled the fertile land.
8. The desert already has extreme conditions in terms of productivity which may be aggravated through the introduction of canals in the area. Hence, technical planning and careful identification of locations / paths for the construction of canal(s) is essential. There was an incident in Jaisalmer on Nov. 24, 2006 when the embankment of the IGNP canal got damaged due to overflow of water resulting in a flood like situation in the nearby areas. It may get repeated if there is lack of proper planning and regular maintenance.
9. Regular monitoring of development plans is a necessity.
10. Short term planning with long term goals required to strengthen development of the area.

There is an urgent need to review the developmental strategy to strengthen productivity and to optimize the use of ongoing natural and manmade changes in the area.