

CLIMATE CHANGE DUE TO HUMAN INTERFERENCE IN SOUTH ARAVALI HILL MOUNTAIN AREA OF INDIA

Prof. Narpat Singh Rathore

Principal, Guru Nanak Girls' P.G. College, Udaipur-313002, Rajasthan, India.

Nsrathore53@rediffmail.com No.+91 9414164030

Devyani Rathore

Research scholar, Dept. of Economics, UCSSH,

M.L.Sukhadia University, Udaipur-313001, Rajasthan, India

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ABSTRACT: The Aravalli hills form the sky-line of north-west India i.e. Gujarat, Rajasthan, Haryana states and Delhi union territory stretching from south-west and north-east direction. Extending for about 692 km. from Palanpur in Gujarat upto Delhi union territory through Rajasthan and Haryana states, this range forms the main water divide of the north Indian drainage system. At few places in the Aravalli range, the hills are discontinuous and gaps exist. In the absence of the adequate forest stock on the Aravalli hills, these gaps turned active and caused drifting of desert sand towards fertile plains engulfing parts of 'Haryana of India' consisting of eastern Rajasthan, Punjab, Haryana, Delhi union territory, western Uttar Pradesh. The Aravalli hills, one of the oldest hill systems of the world, form most dominant geological structure in the formation of the north Indian terrain and drainage system. It intersects Rajasthan into two major geographical units on its two sides. The western part occupying about two third of the state, is almost and the eastern part is comparatively well drained and fertile. The Aravalli hills spread in 12.65 per cent area of Rajasthan, influencing ecological equilibrium in 29.92 per cent of the state area directly whereas climatically and hydrologically influence much large area in the state and the surrounding regions indirectly. The Aravalli hill region extend in parts of eighteen districts and covers fully or partly 120 Developing Blocks of the Rajasthan State.

MATERIALS AND METHODS:

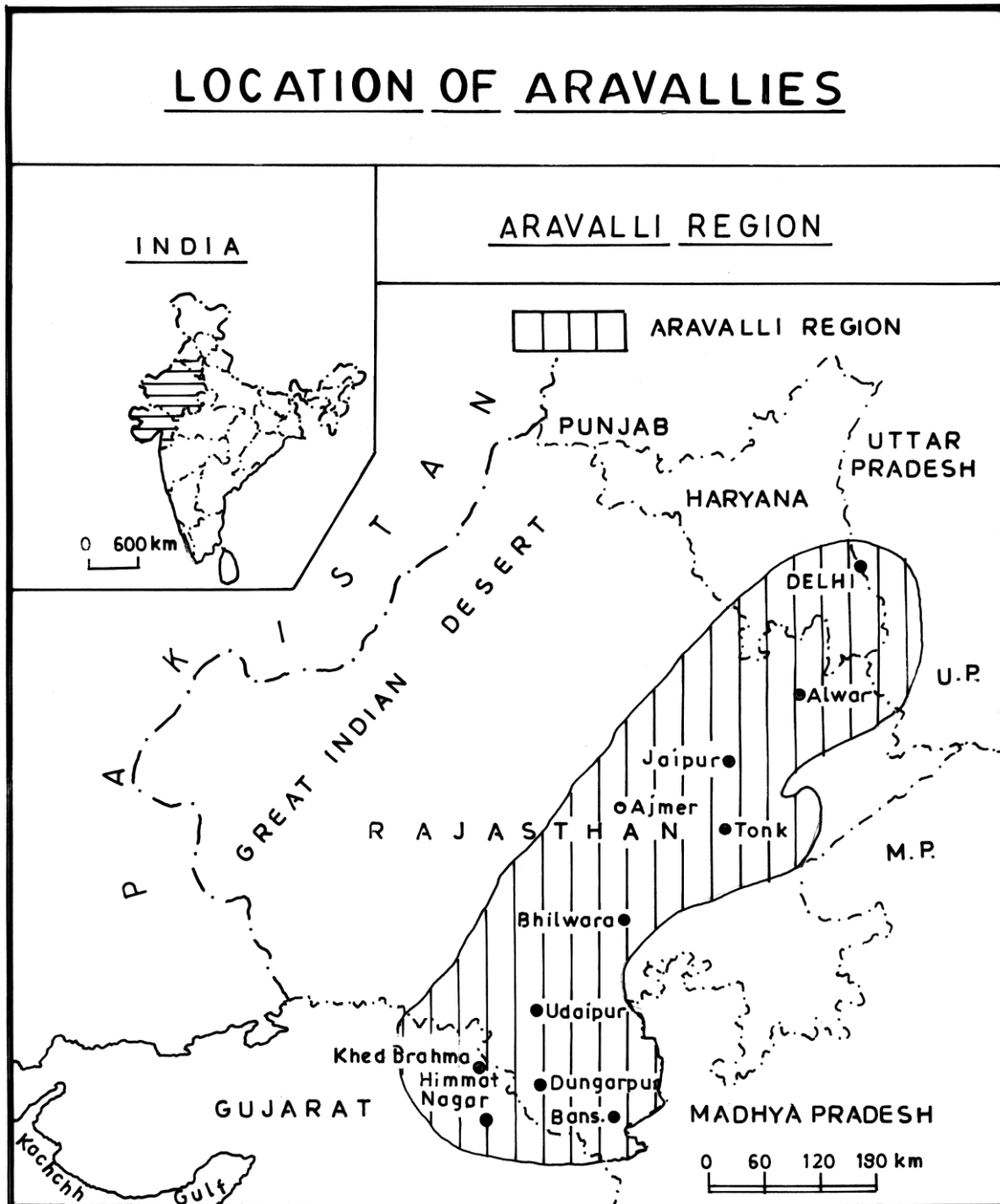
The present study has been undertaken with the help of Survey of India topo-sheets on scale 1:25000 and 1:50000 survey in the year 1959-60 and 1973. Satellite images of varying resolutions for different years viz. Landsat MSS, IRS and SPOT Satellite Picture. For this study three broad methods have been used viz. the visual interpretation of remotely sensed data, mathematical analysis and field survey. The satellite data have been geo referenced. The Government data is also taken for this study.

Table-1: The Aravalli Hills at a Glance

A.	RAJASTHAN ARAVALLIS	
1.	Number of Aravalli Districts in Rajasthan	18
2.	Number of Aravalli Hill Blocks	130
3.	Area of Aravalli Development Blocks [in Sq.km.]	1,02,404.88
4.	Percentage of Area of Aravalli Hill Blocks to total Geographical Area of the State [Total Area of Rajasthan: 3,42,239 sq.km.]	29.92
5.	Total area of Aravalli Hill Tract based on the Area of Hill Villages [in sq.km.]	43,315.31
B	HARYANA ARAVALLIS	
1	Total number of Aravalli Districts	3
2	Total number of Aravalli Tehsils	8
C	DELHI ARAVALLIS	
1	Delhi Ridge Area	560 sq.km.

NATIONAL SIGNIFICANCE OF ARAVALI HILLS

- Constraint in the way of the March of Indian Desert:-** The Aravalli Hills all-through acted as a constraint and checked the spread of Indian Desert towards eastern Rajasthan and Indo-Gangetic plains, till it remained green and well forested. It used to act effectively as (1) terrain, (2) moisture and (3) vegetation constraint when it had ecological balance and rich natural resource base in the form of lush green forests and luxuriant forage cover generating sufficient evapotranspiration to attract normal rainfall with three to four months usual rainy reason and sixty to eighty rainy days each year.



The ruthless deforestation and degeneration of natural pastures on the Aravalli hills and their slopes, increasing occurrence of erratic rainfall has resulted into excessive surface run-off, soil erosion and soil transportation. All these recently generated ecological

hazards have turned Aravallis less effective as terrain, moisture and vegetation constraint in the way of the march of Sandy Indian Desert. The worst impact is observed in its conversion into rocky structures and consequently into 'Rocky Desert'.

By developing 'Green Wall; 'Shelter belts' and Forest Cover', over the degraded hills and gaps in the Aravalli Hill Region, it may again be converted into an effective terrain, vegetation and moisture constraint which will help increase agricultural productivity in the 'Granary of India' and create ecological balance to check the march of the Indian Desert north-east ward.

2. **Water-divide between the Indus and the Ganga Basins:-** It acts as a water-divide between the Indus basin in the north-west and Ganga basin in the east covering extensive areas of the plains of north India. Hence, any disturbance in the ecological equilibrium in the Aravalli region may result into degradation of environment in wider and extensive areas of north Indian plains comprising eastern Rajasthan, Haryana, Western Uttar Pradesh, Malwa region of Madhya Pradesh, north-west and north-east Gujarat and Delhi union territory. The occurrence of normal rainfall in north-west India much depends on the preservation of lush green forest cover and resultant normal evapo-transpiration process over the Aravalli hills.
3. **Craddle of Civilization:-** Many civilizations have flourished in the lap of the Aravallis. The Ahar civilization on the banks of the River Ahar which is the tributary of Banas river were contemporaneous with the Indus Valley civilization. References are available in the 'Upanishads' and 'Mahabharat' to the cities of this region, such as Virat [present Bairath of Jaipur], Pushkaranya [Pushkar], Dhundhmas [Dhundhar of Sikar district] and Salvapur [Modern Alwar].
4. **Source of Rich Mineral Wealth:-** The Aravalli hill region is an important mineral resource area of the country having almost complete monopoly in the mining of non-ferrous minerals like Zinc, Gold, Silver and having large reserves of ferrous minerals such as Iron-ore and Manganese; Non-ferrous minerals like Copper ore and Lead; non-metallic minerals such as Dolomite, Calcite, Emerald, Felspar, Garnet, Mica, Rock Phosphate, Magnesite and building stones like Marble, Lime stone etc. There is an immediate need for carrying out scientific mining, protecting the hill environment and redeveloping mining blights during the process and after the completion of the mining activity, for keeping the ecological balance intact.
5. **Safeguarded Productivity in the 'Granary of India':-** Till Aravalli Hill System acted as an effective constraint, the Indian Desert remained in its limits west of the Aravalli hills. With the intensification of desertification hazard in the Indian Desert and alarming deforestation and degradation of environment on the desert fringe i.e. on the Aravalli Hills and the adjoining eastern flowing river basins; the Indian desert started adversely affecting productivity in the plains in the neighbouring states. The resultant impact has very clearly been observed in the form of increased occurrence and intensity of drought and famine hazards in all the districts of eastern Rajasthan and parts of the adjoining states including south-western parts of Haryana and Punjab, western Uttar Pradesh; Malwa in Madhya Pradesh; Kutch, Saurashtra and north part of Gujarat. For safeguarding the 'Granary of India' from the March of the Sandy Indian Desert and occurrence of chronic droughts and famines, the Aravallis should be reforested on war-footing. The significance of the Aravalli hills in controlling and checking the march of the Indian Desert should be appreciated in the larger interest of achieving higher agricultural productivity in the 'Granary of north India'.

6. **Significant Resource Area:-** The Aravalli hill region all through remained a significant resource area of the country. It used to have rich forest area having timber, fuelwood, fodder, minor forest products and above all, a very rich 'gene bank' with variety of vegetation and animal species, profusely available in the region. Unfortunately, the situation has changed significantly during last four decades and depletion of its resource base is causing concern to even one.
7. **Adversely affected the Weather and the Climate:-** The Aravalli hill region, extending over an area of about 50,000 sq.km. in Gujarat, Rajasthan, Haryana and Delhi union territory from south-west to north-east direction attracted both the Arabian and the Bay of Bengal monsoon currents and acted as a region where both the currents meet. These monsoon currents after entering the coastal areas used to blow right upto the foothills of the Aravallis and start ascending the green and the moisture laden hill slopes causing effective condensation process followed with normal or excess rainfall. With the alarming deforestation over the slopes, the transevaporation process has altered and caused uncertainty of normal rainfall. The effectiveness of the Aravalli hills as a source of structural control for normal weather and climate can be revived by restoring its ecological status mainly by reforesting its barren peaks, slopes and foothills. The analysis of rainfall data for 50 years, from 1961 to 2015 has revealed that the total number of days in the rainy season from the day of onset of monsoon to the day of withdrawal of monsoon has declined sharply from 101 days in 1973 (2nd July, '73 to 10th October' 73) to only 64 days in 1985 (13th July' 85 to 15th Sep., '85) , 48 days in 2011 (5th July' 2011 to 20th Sept'2011),and 45 days in 2015(12th July to 25th Sept). In fact, the physical transformation of the habitat of hill areas has critically and adversely influenced the socio-economic life style of the hill people.
8. **Rich Habitat for Wild-life:-** The Aravalli hills used to provide very rich habitat to wide spectrum of wild-life including avifauna comprising Tigers, Leopards, Wolves, Black Bucks, Chinkaras, Desert Fox, Great Indian Bustard, Migratory common Cranes, Ducks, Coots, Pelicans etc. in its lush green forests. Now, only the relicts are found at Ranthambhar, Siriska, Sita Mata, Jai Samand, Kumbhalgarh etc. whereas the similar habitat was available earlier in the northern, the central and the southern Aravallis in extensive tracts. The lost wild-life resources can be recreated by preserving and developing Aravalli habitat in large tracts by following suitable and appropriate conservation and development strategy.
9. **Checked the Occurrence of Drought:-** The Aravalli Hills used to act as an effective constraint in the way of occurrence of chronic droughts, till it has eco-balance. With the indiscriminate telling of trees from the forest areas, followed with soil erosion and emergence of rocky structures, the nucleus of drought has extended from the Indian Desert towards its fringe i.e. the Aravalli hills. Its insulating characteristic against the occurrence of drought has turned ineffective resulting into spread of desertification and drought hazards upto the Granary of India. All through the history, the green Aravalli hills not only checked the march of Indian Desert but it also effectively checked the extension of drought hazard across it. The occurrence of recurrent droughts of higher intensity in and across the Aravallis, on account of change in its ecological status is a new phenomena which may be averted by restoration of its earlier ecological status.
10. **Decline in the Actual Forest Area:-** Earlier, the Aravalli hills had dense forests and higher density of tree cover alongwith a rich habitat for wild-life extending in the vast tracts of higher hills and valleys. However, massive felling of trees, on account of greed of human beings and increasing demand for timber, fuel wood, fodder, etc., had caused

severe strain on the eco-system, affecting all the river valleys situated down the hills. The forests in the Aravallis are mostly degraded one and require enormous efforts for the restoration of ecological balance. The interpretation of multi-date RS data products had revealed that the parts of sixteen Aravalli districts recorded only 10,462 sq.km. of area under various categories of forest cover during 1972-75. The actual forest area left was only 6,116 sq.km., in 1982-84 period as per RS data products of the Aravalli hill region.

Changing Environmental Status:- The Aravalli hill region served its area and the people as a rich resource area providing forest products; fuel wood; fodder; timber; water through springs, streams and rivers; minerals, rich forest clad habitat; safe and secured locations to former rulers and their public and above all dependable and timely rainfall and healthy environment with more moisture and much less temperature in comparison to present higher radiation. The water reservoirs and ground aquifers used to remain full with water and the hills green and well stocked. The environmental status has changed alarmingly during last four decades with ruthless destruction of forest cover over the hills followed with increase in soil erosion, sediment transportation, siltation, drying-up of lakes, dams and surface water sources, lowering of water table from 5 to 10 metres to 50 to 100 metres with increasing mining of ground water without considering recharge capacity of the ground water aquifers. Now, the last resort of deep mining of ground water is being initiated without any consideration for maintenance of discharge-recharge balance.

To diagnose the actual disease and prescribed correct treatment for recovery, the analysis of the altering environmental status in the Aravalli hill region has been undertaken.

- 1. Emergence of Rocky Structures and Conversion of Aravalli Hills into Rocky Desert:-** The Aravalli hill region had thick forest cover during earlier decades. It helped in protecting the soil cover and water aquifers and provided favourable conditions for the regeneration of tree-stock and pastures. The massive deforestation in the central and the northern Aravalli region and in the Tribal Sub-Plan [T.S.P.] area in Banswara, Dungarpur, Udaipur, Rajsamand, Pratapgarh, Sirohi and Chittaurgarh districts has accelerated the process of soil erosion causing emergence of rocky structures. Consequently, the major parts of the central and the northern Aravalli hill region in the steeper slope tracts have already converted into Rocky Desert and the process is still active on the lower slope foothill tracts. To check the process of formation of 'Rocky Desert' in the southern Aravalli region, particularly in the Tribal Sub-Plan [T.S.P.] area where a thin soil cover still exist, all efforts should be made to reforest the barren hills and conserving existing forest cover.
- 2. Drifting of Sand through Aravalli Gaps:-** The Aravalli hills checked the expansion of 'Sandy Desert' towards the parts of Indo-Gangetic plain in eastern Rajasthan, Haryana, Punjab, Delhi union territory etc. till it remained densely forested. Due to massive deforestation, the Aravalli hills are no longer now effectively acting as a green barrier. Earlier, it acted as (i) terrain, (ii) moisture and (iii) vegetation constraint in the way of the March of the sandy deserty. The removal of forest and pasture cover from the central and the northern Aravalli tracts, particularly in the gap area, had caused drifting of desert sand towards north-eastern plains with dust-storms of higher intensity and frequency. Furthermore, the excessive deforestation has intensified the process of soil erosion, causing siltation in the river channels and water reservoirs. The interpretation of remotely sensed data products of 1972-75, 1982-84, 1994-96 and 2005-07 has revealed that the desert sand is drifting towards north-eastern plains through twelve identified gaps on the Aravalli hills extending from Magra hills in Ajmer district to Khetri-Madhogarh hills in Jhunjhunu district and northern most hillocks in Mahendragarh district of Haryana.

Ecologically Vulnerable Area:- With the intensification of degradation of environment in the Aravalli Hills, the fragile and vulnerable areas have emerged and expanded at a faster rate which require proper identification, assessment, mapping and monitoring for the restoration of ecological balance. Dungarpur-Banswar, Gap area on the Aravalli Range, Upper Banganga Vally, Magra Area, Girwa-Gogunda Tract, Jaisamand Lake Area, Daragarh-Banara-Maja-Dariba Area, Abu-Sirohi and Chappan Hills of South Aravali areas are extremely most vulnerable area in the Aravalli. Possible Strategy for the Development of Aravalli Hills: It would be worth while to analyses the existing strategy, followed during different plan periods for the development of hill areas in the country. So far, only two major hill areas: (i) the Himalayan region, and (ii) the Western Ghats region have been declared as hill areas for granting central assistance under centrally sponsored 'Hill Area Development Programme [HADDP]'.

The need based environmental improvement programmes taking care of the local requirements of India's and hill people should be evolved for the Aravalli hill region. The basic needs of the people of Aravalli region such as food, fodder, water, shelter, clothing and employment should be fully met by pre-serving and redeveloping the resource base of the hills. The reforestation, soil and water conservation, animal husbandary and hill environment restoration programmes may fulfill the basic needs of the people of this area.

Possible Development Programmes:- The possible programmes and schemes for (i) the preservation of existing rich forest and wild-life areas and (ii) for the regeneration of low density forest area (iii) forest blank areas (iv) rocky degraded hills (v) sand dune tracts in the hills (vi) ecologically fragile Gap Area (vii) vulnerable areas (viii) wasteland areas and (ix) degenerated wild like areas may be broadly formulated as follows: (1) Preservation of existing and left-over rich wild life areas such as Siriska and Ranthambhor Tiger Reserves in the Aravallis, (2) Protection and conservation of existing rich forest areas such as (a) Sita Mata Forest area in Pratapgarh District (b) lush green forest tracts in southern Aravallis (c) forests areas in Alwar Hills (d) forest areas in the Sawai Madhopur-Khandar areas etc. (3) Afforestation programmes (4) Water and soil conservation programmes on Watershed basis. (5) Planning, conservation and management of resource base at the level of river basins and their sub-catchments. (6) Livestock development, improvement in Animal Breeds, expansion in Animal Health Cover, age, forage development, establishment of Dairy net-work etc. (7) wild-life preservation and development programmes may be formulated and implemented. (8) Energy conservation programmes (9) Creation of infrastructural facilities (10) Resource raising programmes (11) Desertification control programmes (12) Development of wastelands (13) Establishment of Aravalli hills area research and development research institute.

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