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ECOLOGICAL CHANGES IN CENTRAL ARAVALLI HILLY RANGE: A CASE STUDY OF TONK DISTRICT, RAJASTHAN, INDIA

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ABSTRACT

Ecosystems are the basis of life itself! Ecosystems are frequently disturbed by natural factors and humans actions leading to the degradation of land and also lead to the extinction of species of plants and animals called "Keystone" species. Extinction occurs due to changes in landuse. This paper proposes a conceptual model that integrates physical and ecological aspects with human aspects of land degradation through multidisplinary approach. The study area is located in central Aravalli in state of Rajasthan. The climate on the whole is semi arid. This study examines the nature, spatial pattern, degree and causes of land degradation in central Aravalli hilly tract, which has ultimately disturbed and affected the ecology of the area. Here, degradation of forest resources, scarcity of water resources, decreasing underground water level, and decrease in arable land has put an immense pressure on the ecosystem. Main objectives are to analyze the factors responsible for ecological imbalances enforced through land degradation in the area, to diagnose the spatial distributional pattern of flora and fauna at different level and last to suggest action plan the ecological balance in the study area. Further, the sustainable development has been putforth, which is the development without destruction and deterioration of natural resources. Socio-economic development also must be sustainable both ecologically and economically and should be pursued without jeopardizing natural resources quality and availability for future generations. There is a need to harmonize development activities with integrated ecological management.

KEYWORDS: Keystone, Ecosystem, Sustainable

INTRODUCTION

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, bisects the Rajasthan and also divides Rajasthan into three climatic regions. Extending for about 692 kms the Aravallis, most distinctive and ancient mountain chain of peninsular India, mark the site of one of the oldest geological formations in the worldfrom Palanpur in Gjuaratupto Delhi union territory passing through Rajasthan and Haryana states. At few places in the Aravalli range, the hills are discontinuous and gaps exist. 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 arid 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 extends in parts of eighteen districts and covers fully or partly 120 Development Blocks of the Rajasthan State.

Heavily eroded and with exposed outcrops of slate rock and granite, it has summits reaching 4850 feet above sea level. It bisects the State of Rajasthan. (figure 1)TheAravalli range, stretching from Palanpur in Gujarat to Delhi, divides Rajasthan into three distinct climatic regions. It is, therefore, not surprising that the range is a unique amphitheatre of biological diversity. But with the man-animal conflict on the increase, it is feared that the spectacular biodiversity of the Aravallis may be totally lost by the mid-21stcentury.With the passage of time aravali has been on continous degradation. Due to its geographical location, rangeharbours, a mix of Saharan, Ethiopian, peninsular, oriental and even Malayan elements of flora and fauna. However, very few studies have been carried out on the ecology of this mountain system.

National Significance of Aravalli Hills

- Constraint in the way of the March of Indian Desert:The Aravalli Hills all-through acted as 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 evapo-transpiration to attract normal rainfall with three to four months usual rainy reason and sixty to eighty rainy days each year.
- 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. 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.
- Craddle of Civilization: Many civilizations have florished in the lap of the Aravallis. The Ahar civilization on the banks of the River Ahar which is the tributary of BanasRiverwas 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], Pushkararanya [Pushkar], Dhundhmas [Dhundhar of Sikar district] and Salvapur [Modern Alwar].
- Adversely affected the Weather and the Climate:The Aravalli hill region, extending over an area of about 50,000 sq.km. In Gjuarat, 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 trans evaporation process has altered and caused uncertainty of normal rainfall.
- 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, etc. in its lush green forests.

- 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.

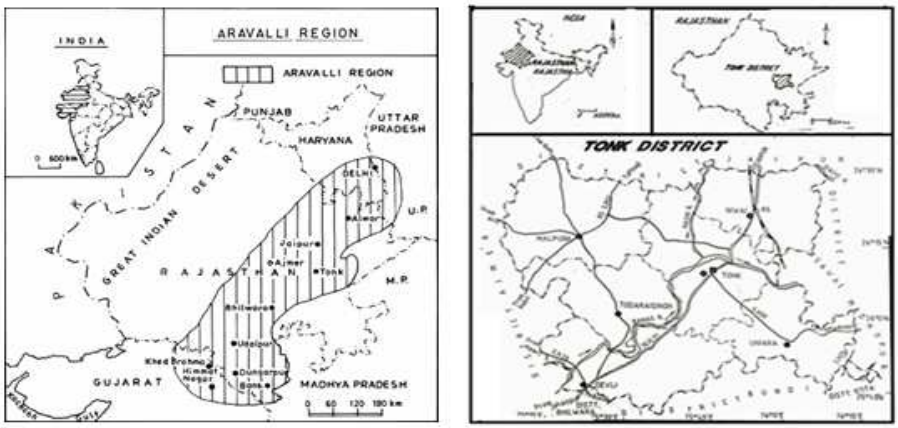

Figure 1: Location of Aravallis and the Study Area

The main aim of this study is to show the degradation and changing Ecosystem of Central Aravalli region. Scarcity in rainfall and degradation of forest is proving to be a great disaster for biological diversity of this region and this makes the subject relevant. By studying the impacts on ecosystem of the study area we can understand the need assessment for endangered flora and fauna. Also this study will focus on the sustainable development in the study area. Due to variable habitats and climate Rajasthan had rich mammalian fauna before independence. The increasing biotic interference after independence has not only reduced mammalian frame between a changes in the distribution ranges have been noticed.

METHODOLOGY

In this study is conducted specially for forest ecology to evaluate the changing pattern of the ecosystem and also to correlate the frequency of the rainfall with forest ecology under the influence of physical and cultural factors. Study focuses on analysis of the rainfall occurrence and forestecology especially flora and fauna of the study area. These factors are basically responsible for changing ecosystem in the study area.

The study is based on primary and secondary sources of data.

Data has been collected at various sources.Choropleth mapping techniques and statistical method like arithmetic mean have also been used to show the distribution pattern of the forest ecology. The areas and laces were visited to collect latest information on fauna. Their census records were procured from the Rajasthan State Forest Department,Jaipur (Anonymous, 2011).

Study Area

The study area is located in The Central Aravalli Region (20,919 sq. km.). The upland with scattered ridges in the western part is bounded by Sambhar basin in the west, Alwar hills and plains in the north, the Karauli Table land in the east and the Banas plain in the south with a total population of 1,421,711 (2011).The approximate level of valley is 550m and of hills 700 m.

Factors Affecting Land Degradation in the Study Area

Land degradation is a human induced or natural process which negatively affects the land to function effectively within an ecosystem, by accepting, storing and recycling water, energy, and nutrients.

Severe land degradation affects a significant portion of the central Aravalli region. Species diversity is lessened and often lost as lands are cleared and converted to agriculture. Thus a downward eco-social spiral is created when marginal lands are nutrient depleted by unsustainable land management practices resulting in lost soil stability leading to permanent damage. Various causes have led to the degradation of land in the study area but the major ones are the forest deterioration. Natural and human factors are held responsible for that e.g. rainfall, overgrazing etc.

Changing Pattern of the Rainfall

The amount of received rainfall has shown declined during the last few years. From 816.2mm in the year 2002 it has decreased to 450 mm in 2010 .This trend has resulted antagostically in the study area by adversely affecting forest cover.(figure 2).

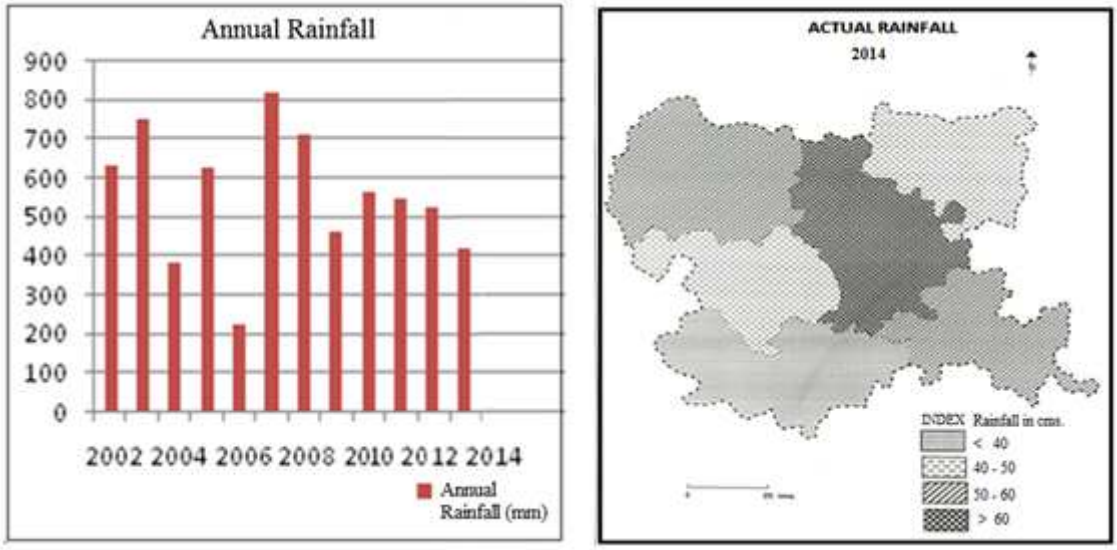

Figure 2: Annual Rainfall and Actual Rainfall

The duration of rainy season from the day of onset of monsoon to the day of withdrawal of monsoon has shrunk from 101 days in 1973 to only 64 days in 1985 and 55 days in 1987, 45 day in 1998 and this year (2014) rainy days was only 25 days. Similarly, the total number of rainy days had declined to 18-30 days from earlier 60 to 80 days per year. 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.

Ecological Set-up

Flora in the Region

The main economically valuable species are *dhok (Anogeissuespendula*), *Salar (Boswellinserrata),* and *bamboo (Dendrocalamusstrictus*). The most common and gregariously occurringspecies of these forests is *dhok (Anogeissuspendula*), which is generally found on all hillyareas and forms almost pure stands of uniform density on good sites. *Dhok*is generally slowgrowing, but trees upto one metre girth and upto 12 metres height are not uncommon

infavourable localities. At places, where the species has been continuously hacked and grazed,it is found as scrambling bush. Over large areas, the *dhok*forests have been maltreated in thepast, leaving them in degraded condition and in extreme cases, the areas have been rendered completely blank. Boswelliaserrata forest (Salar) is found in the upper ridges of the Aravalli hills and covers about 5%of the total forest cover area.This type of forests covers an area of 10,360 sq. km. and occurs in Central Aravalli range.

Ecological Status-Degradation of Forests

Large areas of dhok forests have degenerated due to continued mal treatment meted duringthe past. Most of these areas are ex-jagir and zamindari forests, some of which wereirregularly felled and subjected to unrestricted grazing during the past. The growing stockmainly comprises of dhok and its associates. Dhok is generally found in the bushy form.Ronj, goyakhair, thor, grewias, capparis and dasan are gradually replacing the dhok, dueto continued hacking, lopping, grazing and browsing. Regeneration is particularly absentand the topsoil has been washed away due to continued exposure.

Salar forest is distinctly an edaphic climax. They are least disturbed by the local people, due to their situation and limited use of salar wood. The proportion of salar and gurjan in theseforests is progressively increasing due to felling of other species. But near habitations salaris also heavily pollarded.

Decreasing Trend of Forest in Central Aravalli Region

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. It has decreased in almost all tehsils during past ten years (table 1), which directly shows impact. The forests in the Aravallis are mostly degraded one and require enormous efforts for the restoration of ecological balance. In the district, the percentage of goats and sheep is significant in the livestock population. The fodder consumption for these animals are eithercomparable (in case of sheep) or more (in case of goat). The herd of goat andsheep are commonly seen on the Aravali hills. They consume substantialamount of fodder and thus reduce the vegetation on the hills.

Table 1: Distribution of Forest Area, Tonk District, 2000-2001 to 2010-2011

Sr. No.	Tehsil	Year 2000-2001		Year 2010-2011		Decade Changes
		Area(ha)	Percentage	Area(ha)	Percentage	Percentage - +
1	Tonk	12193	8.32	9529	6.5	-1.82
2	Niwai	13379	13	11871	11.52	-1.48
3	Uniyara	9631	9.76	9248	9.4	-0.36
4	Dewali	20786	16.8	15810	12.87	-3.93
5	Malpura	17203	16.6	16057	10.84	-5.76
6	Todaraisingh	16858	15.6	14208	11.8	-4.42

Source: District statistical handbook, 2011

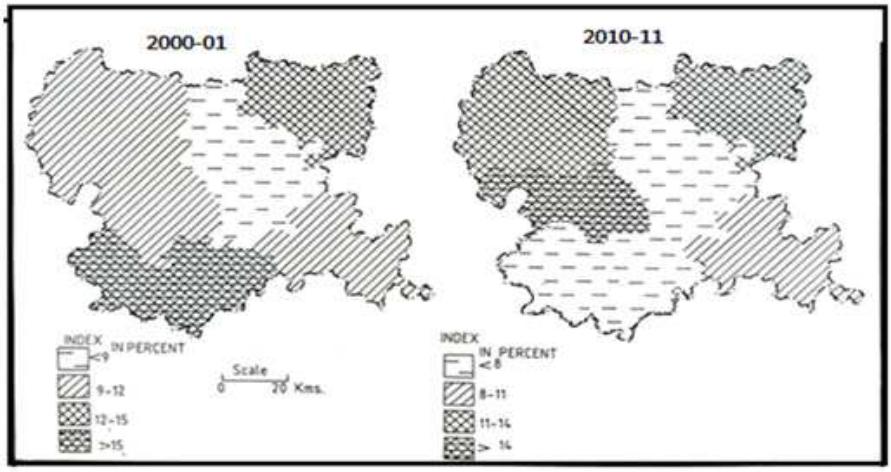

Figure 3: Distribution of Forest Area, Tonk District, 2000-01 and 2010-11

It is seen from the distribution of forest area in the study area over different tehsils that the area under forest has been decreased upto 1-6% during last ten years (figure 3).The highest decrease has been found in malpura (5.76%) and lowest in uniyara(0.36%) in uniyara tehsil.. southern part is getting more deteriorated. Owing to decreasing tend of rainfall and deterioration of resources forest area is decreasing day by day. Due to continuous erosion of topsoil and undue biotic pressure, the valuable and useful trees are cut and thus reducing their proportion year after year.

The Fauna of the Tract

Due to variable habitats and climate Rajasthan had rich mammalian fauna before independence. The increasing biotic interference after independence has only reduced mammalian fauna, but even changes in the distribution ranges have been noticed.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.

Cervus unicolor is mainly concentrated in the dense forest areas in the southern parts of the study area. Both common Mangose(*Herpestesedwardssf*) and small Indian mangoose (Herpestesauropunctatus) are still found abundantly in the fields .(Table 2)*Herpestesedwardssf*ispresent in wooded areas of Rajasthanespecilially in the forests in the forests of Nahargarh , Jamwa, Ramgarh, Sariska,andRanthambore.

Rare Animals

As per 1901, the total tiger population in the state was 3500, now it is reduced it is reduced to 34. Once “nahargarhkanaka” – a water hole in Nahargarh , Jaipur was a home to tighers and other large cats(Joshi 1984) It is now restricted to the dense deciduous forest of sariska, Ranthambore, karaui and bundi. The population of Jungle cat *Felts chaus*has also declined considerably as compared to the past (table 3). *Caracol* once commonly found near Jaipur is now extremely rare (Sankhala. 1979). *Melursusursinus*(Sloth bear) once found most commonly in the wooded part of tonkis confined to rantahombore ,karauli, kumbhalgarh, Mt. abu and phulwari.

Locally Exinct Mammals

Axis porcinus, once reported from tehsil in the western part, is not recorded from the area in the recent past (saxena , 1975).From the table 4,it can be seen that ,some fauna has been almost extinct .

Table 2: Common Mammlas of Tonk District

Name of Species	Common Name	Present Status	Census	
			2001	2011
Felischaus	Jungle cat	Northern part	N.A.	N.A.
Felissylvestris	Desert cat	North-western part	N.A.	N.A.
Paradoxurushemaphroditus	Toddy cat	Centaral part	1500	1200
Herpestesjavanicus	Small Indian mongoose	Central part, western part	800	600
Herpestesbrachyurus	Brown mangoose	Western part	412	301
Herpestessmithii	Ruddymangoose	Wesrern and north-western part	300	200
Herpestesedwardsii	Common mangoose	South-western part	500	400
Hayenahyaena	Stripedhyaena	Whole district	60	40
Canisaureus	Jackal;	Whole district	400	300
Suncusmunnus	Grey musk shrew	Western part	10	nil
Pteropusgiganteus	Flying fox	Western part	30	10
Gazellabennettii	Chinkara	Whole district	125	140
Antilopecervicapra	Black buck	Whole district	500	600
Boselaphustragocamelus	Nilgai	Whole district	400	300

Source: Forest Department,Tonk

Table 3: Rare Animals of Tonk

Name of Species	Common Name	Present Status
caracal caracal	Caracal	Nil
Canis lupus	Wolf	North western part
Vulpesvulpes	Red fox	Whole area
Vulpesbengalenis	Indian fox	Whole area
Maniscrssicaudata	Indian pangolin	Whole area

Source: Forest Department, Tonk

Table 4: Locally Extinct Mammals of Tonk

Name of Species	Common Name	Previously Distributed	Census	
			2001	2011
Axis procinus	Hog deer	Once reported from central part	N.A.	N.A.
Pantheraleo	Lion	Whole district	N.A.	N.A.
Acinonyxjubatus	Cheetah	Species was common in vicinity of tonk tehsil	N.A.	N.A.
Equusonager	Asiatic wild ass	Malpura, todaraisingh tehsils	N.A.	N.A.

Source: Forest Department, Tonk

Changing Pattern of Ecosystem

The tiger, panther, leopard and sloth bear were very common, too. Middle sized carnivoreslike the jungle cat, civet, carcal, wolf, jackal and mongoose were found in abundance.Herbivorous large mammals like the wild boar, *sambhar*and spotted deer were plentiful.The *chinkara*, black buck and the blue bull were found in the foothills. The jungle fowl wasthe pride of Abu hill.

Today the region presents a vastly different scenario. Tigers, medium sized carnivores andthe herbivores have all vanished. Panthers are invading villages for food. The remainingpopulation of sloth bears is thriving on *lantana* berries. The only species untouched is theprimates, which are protected by religious sentiment.

The British had promulgated legislation — Abu Wildlife Protection Act in 1889 — whichwas followed till the Raj existed. Thereafter, the common man took to indiscriminate fellingof trees and killing of wild animals, firstly for food and then for trade. Wildlife can sustainregulated *shikar*but certainly not wanton killing for trade.

CONCLUSIONS

At the time of independence, the Aravalli hills were densely forested and rich in wildlife. Due to excessive felling of trees to meet the increasing demand for fuel, fodder, the ecosystem of the region has come under severe stress. This has resulted in extensive soil erosion, loss of topsoil, silting up of river channels and reservoirs, reduced land fertility and lowering of groundwater water table. The unprecented deforestation has reportedly resulted in decline in monsoon rains from 101 days in 1973 to only 55 days in 1987 .The entire Aravalli range has become ecologically sensitive and critically fragile. In the early part of this century, the Aravallis were well wooded. Today, the changes in the environmental at Aravallis are severe.

On the basis of the above study the rainfall is decreasing day by day therefore the forest area is also decreasing, Before 20 years most of the area was occupied by grassland and thick forest in valley region, but presently the grassland and forest area on the top of hill is slowly and gradually becoming barren and semiarid type of vegetation is visible. Due to the lack of forest aravalli range is becoming just like a hot belt which is effecting total ecosystem of the area, consequently it also effect the climatic conditions of the area and it has been found that the way and trend of the summer monsoon is also changed, because of this central Aravalli region receives very less rainfall in rainy season. It has been found on the basis of observations that some species of flora and fauna are decreasing in the study area. It is also observed that at tehsil level the percentage of forest is decreasing 1-6 % from last 10 years. River Banas is the main river of study area, it is the only source of water in that region but this river is also facing some obstacles as Bisalpur dam is constructed on the river for the purpose of drinking and irrigation, because of this the lower side of the river is not getting proper water as water is been supplied to Jaipur, Ajmer and Bhilwara regions for drinking purpose, because of this blockage ecosystem in the lower region is dramatically changing resulting in change in species of flora and because of this a reverse impact has been analyzed on fauna also, not only this, in present scenario some birds are on the edge of extinction.

Further suggestions and planning has been put forth for the sustainable development of Aravallis.

In the Aravali Range, there exists open access system of the plant resources available which is used for fodder and fuel. As is evident from thatcommunity controlled regulated access system is required for sustainablecommon land system in the Aravalli Range, is inadequate.

Framework for Forestry

Forestry is one of the key ingredients in all the eco-restoration efforts of the Aravali hills. For this purpose, it should be emphasized that there is enough availability of fuel and fodder to the local people; only then, lesser dependence of the community on the forest produce could be ensured. In addition, the afforestation programme is required to be under taken on a massive scale so that greeneries on the hills are increased. For thispurpose, the State Forest Department should

come out long-term afforestation goals with yearly afforestation targets. Due consideration should be given to *ethno-forestry* practices in the district and emphasis should be to plant local species. The barren rockyland and the gullied land also require rehabilitation by growing vegetation and control of soil erosion. In addition, the afforestation targets fixed for the mining and other industrial projects should contribute to the broader framework of afforestation developed by the Forest Department. For this purpose, the State Government should provide sufficient start-up fund to initiate the afforestation efforts. Sufficiency of fund should be maintained in future to carry out the eco-restoration efforts by various departments smoothly.

Department of Forests

The following actions are required on the part of Department of Forests for eco-restoration of Aravali Hills:

- ***Action Plan for Afforestation*:** target should be fixed for afforestation and the same should be carried out in a phase wise manner. The plantation should be planned keeping in mind the following:
- Increasing the fertility of the soil to support vegetation
- Checking the soil erosion
- Increasing the vegetation
- Vegetating the barren rocking land
- At places, the consideration may be to make available fuel to thelocals and fodder to livestock. This will reduce the biotic pressure on the hills.
- ***Protection of the Vegetated Area:*** Efforts should be there to involve locals also to protect the existing vegetation and the plantation, which will be carried out under the afforestation programmes.
- ***Access to the Common Land*: The** regulated access to common land in lieu of open access system should be encouraged. For this purpose, involvement of village panchayat should be ensured.
- ***Farm Forestry:*** The recorded forest area in state is 9.56% only. In order to increase it to 20%, it is essential to plant areas outside recorded forests. This scheme provides scope for achieving aforesaid goal. Under this scheme, the seedlings are raised in nurseries and are sold on price fixed by the state to private people, farmers and industrial institutions etc. so that they may plant them on land available with them.

Development of Green Belt

The green belt1 shall be developed as per the following guidelines:

- A standards horticulture practice should be followed while planting saplings in pits of dimension 1m*1m*1m for large tress and almost half of these dimensions smaller trees and shrubs.
- A three-tier system should be followed in order to develop a canopy type greenbelt. Therefore, the plantation order shall follow shrubs, smaller trees and large trees from inside towards the boundary wall. Moreover, special care needs to be taken for planting shrubs/trees along the roadside. The height (1-1.5 meters for shrubs and 3-5 meters for trees) and the foliage areas shall be such that it does not affect the visibility.

- The selection of the plants at the boundary wall as well as along the road side should be based upon tolerance towards pollutants.
- Since the proposed area falls in the trans-gangetic .The pace of the afforestation programme in the district needs to be speededup. In the afforestation programme, unless due care is taken about the needof the people, the programme may not be successful. The pace of the social forestry programme, therefore, also needs to be speeded up. Following species shown in table 5,has been recommended :

Table 5: Suggested Species for Development of Ecosystem

Tree		Shrubs	
Common Name	Botanical Name	Common Name	Botanical Name
Silver wattle	*Acacia dealbata*	Kanghi	*Abutilon indicum*
Gandh	*Acacia*	Khair	*Acacia catechu*
Black wattle	*A. mearnsii*	Biswal	*A pennata*
Babool	*A. Nilotica*	Kanchan	*Bauhinia acuminate*
Beal	*Aeglemarmelos*	Bougainvillea	*Bougainvillea spectabilis*
Maharuk	*Alianthusexcels*	Bottle brush	*Collistemoncitrinus*

Source: Recommended by forest department during personal field survey.

Fauna Development

- With the human population on the increase, their demand from the forest hascorrespondingly gone up. Some serious thinking and implementation of laws has to beundertaken if the ecology of the Aravalli mountain system is to be saved.
- It is necessary to create inviolate spaces for the wild life so as tominimize human interference in the protected areas in the interest oftheir conservation. To achieve this, relocation of villages situated insidethese areas should be carried out amicably in phased and time boundmanner. Relocation package incorporates adequate means of livelihood,proper shelter and grazing needs of the people being relocated.
- Participatory eco development works will be taken up to securethe cooperation and participation of local people residing on the fringes ofprotected areas as well as inside the protected areas.
- In protected areas, emphasis will be on Famine Proofing ofSanctuaries, habitat improvement by way of natural regeneration, drainage line treatment and grassland development in gaps. Onlyselective planting should be proposed on minimum essential scale. It willenable treatment of more areas in given funds.

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 (ii) forest blank areas (iv) rocky degraded hills (vi) ecologically fragile Gap Area (vi) vulnerable areas (ix) degenerated wild like areas may be broadly fromulated as follows: (1) Preservation of existing and left-over rich wild life areas such as Sariska and Ranthambhor Tiger Reserves in the Aravallis, (2) Protection and conservation of existing rich forest areas such as (b) lush green forest tracts in southern Aravallis (c) forests areas in tonkHills (d) (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. (7) wild-life preservation and development programmes may be formulated and implemented. (9) Creation of infrastructural facilities (10) Resource raising programmes (11) Desertification control programmes (13) Establishment of Aravalli hills area research and development research institute.

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