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Revival Of Ramgarh, Jaipur, India Integrating Blue Green Infrastructure With Eco-Tourism Theme: Design And Environmental Protection

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Abstract:

Manch or Medhaji ka Gadi or Jamwa Ramgarh Fort is the highest stage for Meena Rao Nathu from Meena tribe (Sakha) since 1000 Century AD and was won by Raja Dulhe Rao Kacchawa Rajput from Dausa and established the Temple of Jamwa Mata. The Fort was built in 1612 by Maharaja Mansingh from Amber. It had separate location for Janana and Mardana with Veranda, Garden, Well, two square water bodies and two temples. These structures are required to be restored for Eco-tourism along with pilgrimage. Besides, the herds of sheep and goat are important animal to revive the vegetation at a very steep slope of 75^{o} because of the germination of vegetation from their poop as they climb the steep slope. Animal husbandry of Desi Cow will not only provide the livelihood to the community but also will help in organic farming like Lapodiya village dudu. As a result community participation will come to restore smaller water bodies to meet the water demands for the animals and increase the milk production. Smaller check dams, retention detention ponds are required to revive the forest cover and enhance eco-tourism with adventure sports. The foundation stone of Jamwa Ramgarh Dam was laid on 1897 with stone and lime masonry with lead joins which has survived the heavy rain fall leading to flood in 1924, 1975 and 1981, which means the structure is still capable holding large volume of water. Therefore, the re-establishment of dense forest cover like in Rao Jodha park, Jodhpur or Kishan Bagh Jaipur will enable to re-establish the water cycle to rain. Systematic, de- siltation of lake will increase the water depth in the smaller zones and will reduce the evaporation losses. Besides, lifting the soils up hills through animals will increase the vegetation cover on denuded hills. Treatment of grey water from existing hotel and resort properties and reusing them for native plantation will further reduce the water demand in landscape. The efficient storm water management through gully plugs and check dams will reduce the speed of water on steep hill slopes and further the slowing down of water through grass vegetated swales will increase the interception of rain water. Besides, the restoration of wells and step wells in the tehsil will reduce the wastage of water for drinking purpose. Introduction of cash crops like bamboo, mustard, sesame, Moong, Bajra will increase the economic prosperity of the tehsil with honey production with honey bee farming. When soil and water are saved, the first ecological succession of grass is bound to come and with the help of pollination of birds, butterflies and bees along with herds of sheep the whole ecosystem can be revived through public participation like lapodiya village of Dudu, Neemli Village, Alwar though traditional wisdom. Besides, the existing exotic invasive flora ***Prosopis Juliflora*** required be uprooting by stone masons and filling by the de-silted soil from the lake and native trees should be planted like the restoration of Rao Jodha Park Jodhpur to enhance the bio-diversity of the Eco sensitive zone.

Keywords: Governance, Finance, Urban Flooding, Drought, Blue Green Infrastructure, Eco-tourism

Research Questions:

- Why different agencies do not communicate to save water?
- Why is revival of Ramgarh reservoir important?
- What are the parameters to be analyzed and synthesize to revive Ramgarh reservoir?
- How can you revive the Ramgarh reservoir?
- Who are the important stakeholders responsible for the revival of Ramgarh reservoir?
- When is the right time for the revival of Ramgarh reservoir?
- Is desalting of existing Ramgarh reservoir required? As sometimes the desilting will open up the pores in the bed rock and water will percolate.
- What is the co-relation between geology (Fault, factures and fissures) and water holding capacity of the reservoir? As Fault and fissure will help to percolate water vertically and horizontally in the rocks.
- How do you increase the density of vegetation in the wild life sanctuaries of Jamwa Ramgarh?
- How much is the evaporative loss in ramgarh lake reservoir?
- If desilted how much water will come in the ramgarh reservoir?

- How will ecotourism help to revive the Ramgarh lake?
- How much water stress will be on Ramgarh lake if the ecotourism of religious, wildlife, Adventure tourism happens?
- What are the ecological issues associated with Ramgarh lake?
- How much money is required to revive Ramgarh lake?
- What is the governance supports required for the revival of Ramgarh lake?
- What are the road blocks in the revival of Ramgarh lake?
- What are the guidelines required for water sensitive farming in Ramgah lake? As Wheat will require 5-6 times irrigation while mustard and sesame requires 1-2 irrigations, Bajra is red fed
- How much financial budget is required to revive Jamwa Ramgarh Fort?
- How many people are visiting Ramgarh?
- What is the carrying capacity of Ramgarh?

Vision: Integrate blue green infrastructure and eco-tourism to revive Ramgarh.
Aim: Decentralize integrated water resource management in the catchment area through blue green infrastructure.

Objectives:

- To create awareness as in blue green infrastructure and ecotourism are two sides of a same coin
- To conduct water audit in catchment area of Ramgarh for big picture
- To treat grey water separately and use it for landscaping and reduce heat island effect
- To reduce the speed of storm water runoff through contour trenching, gabion wall, gully plug, retention and detention pond.
- To provide 12% organic content in the soil and increase interception of rain water
- Uproot the invasive species like ***Prosopis Juliflora*** and replace it by native vegetation

Methodology:

- Overlay Topography, Geology, Hydrology, Soil and Vegetation map and identify micro-watershed
- To explore existing blue green infrastructure as a way of re-negotiating the issue of ecotourism
- To use birds as a biodiversity indicator, and develop a methodology for integrating viable ecosystems and habitats into marginalized urban spaces to augment quality and connectivity across scales.
- Overlay synthesis map with governance boundaries of different authorities
- Analyze the financial implication of each decisions
- Multi-shareholders participation for feedback and decentralize action plans
- Create a vision document for operations and maintenance

Introduction:

Context of ramgarh lake

Catchment of ramgarh lake

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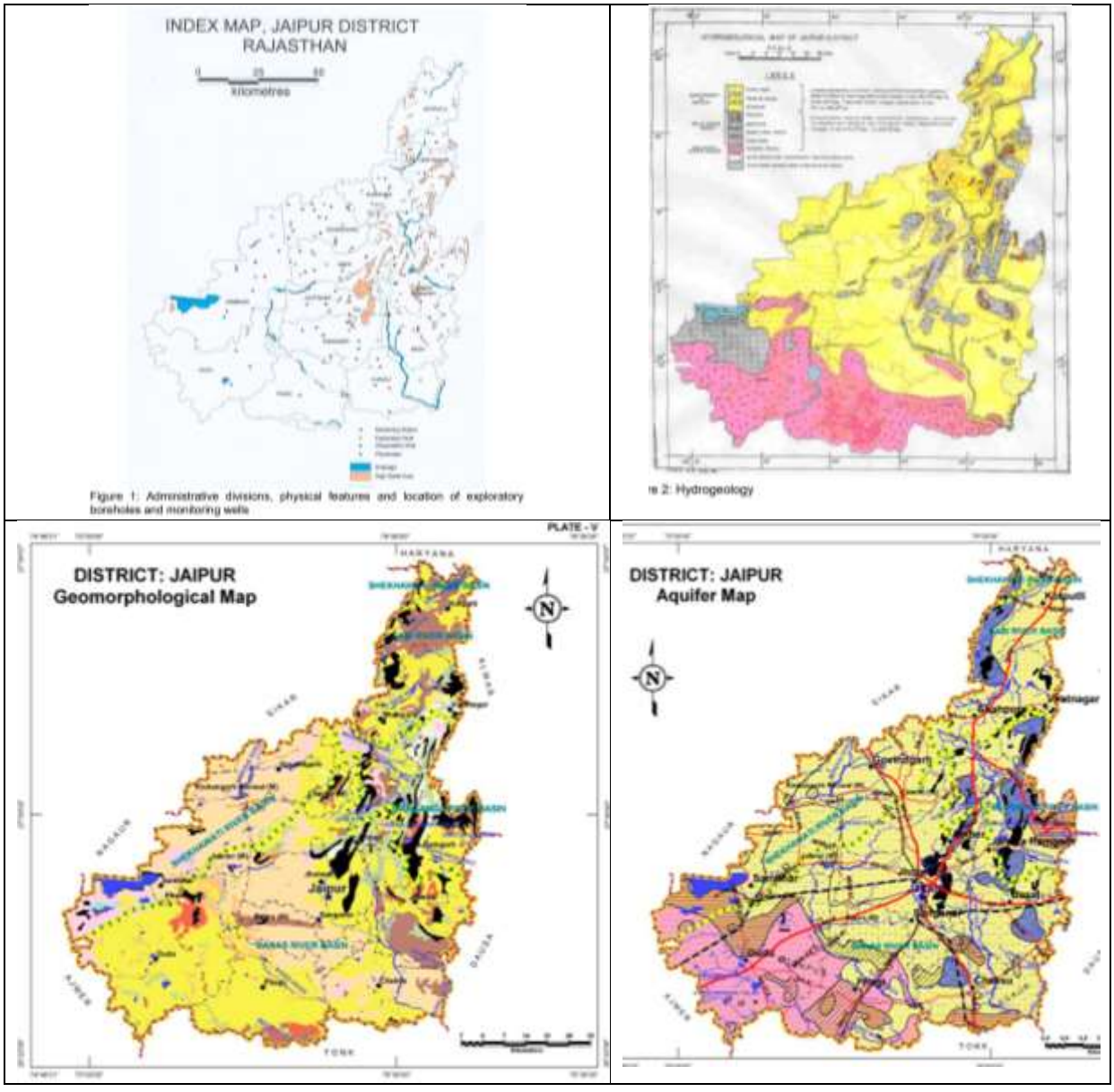
Ramgarh is comprised of four large catchment areas like Amber,Shahpura, Viratnagar and Jamwa Ramgarh having area of 15.5 Sq Km and surrounded by Jamwa Ramgarh vishdhari wild life sanctuary having area of 252 sq Km and Sarishka Tiger Reserve forest of 881 sq Km. Unfortunately the wildlife sanctuaries and reserve forest in Rajasthan are not having adequate plant density due to illegal anthropogenic activates. As a result, the evapotranspiration is less leading to lesser cloud formation for rainfall. Furthermore the maximum depth of water is 20m and maximum capacity of 2334641.226 cubic meters. The runoff generated in the catchment is 2259040.91 cubic meters of which only 18% to 20% water comes to the dam reservoir due to400 check dam anicuts , 200 legal and 800 illegal land use structure. Furthermore, 2m depth of water evaporates in a year in the hot and dry climate of Ramgarh, which means the depth of water must be more than that of area of water. Ramgarh used to supply 20 MLD of water to Jaipur and has reduced to 2.5 MLD. Since 1903 to 1931 water was used for irrigation, till 2000 the water was supplied to Jaipur. The major event of rowing happened in 1982 hosting Asiad Games after the flash flood on 1981at Jaipur. The average daily rainfall ranges from 2.5mm to 10mm which evaporates due to heat island effect of the rock our crop with open scrub vegetation. Furthermore, due to exploitation of water (100 to 500 m3/day) from underground bore wells 4.15 Mbgl post monsoon,2011, the water table has gone below 60m in Jaipur and the rain water harvesting is not being practiced from the every single house hold. Besides, operation and maintenance of rainwater harvesting structure and it's desilting is not a legal mandate, hence these are rain water harvesting structures working on paper and reports.



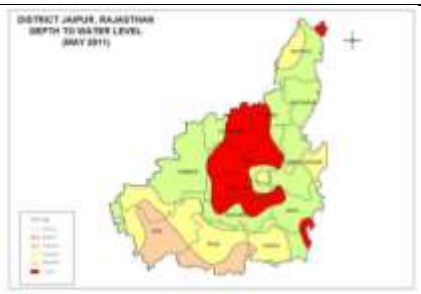


Figure 3: Depth to Water Level (Premonsoon- May 2011)

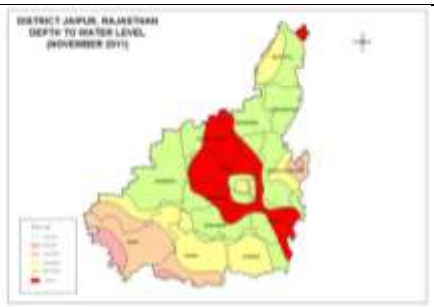


Figure 4:Depth to Water Level (Post-monsoon- November 2011)

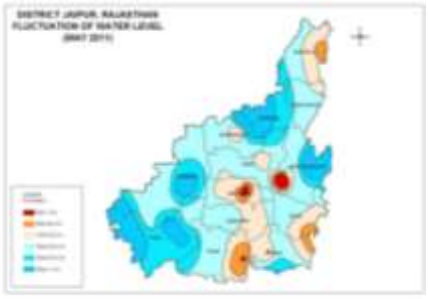


Figure 5: Seasonal water level fluctuation map (May - November, 2011)

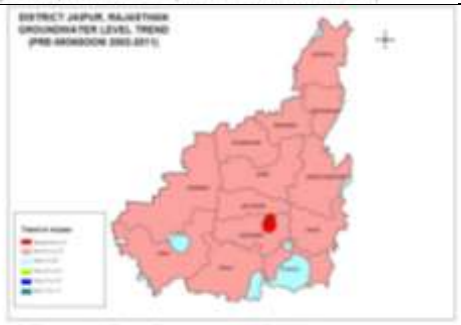


Figure 6: Water Level Trend (Premonsoon- 2002-2011)

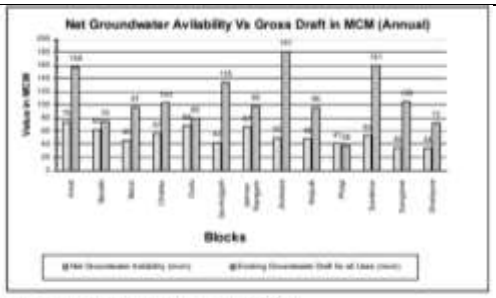


Figure 7: Ground Water Resources (March 2009)

Table 4: Block wise Ground Water Resources (March 2009)

Block	Total Annual Ground Water Recharge (mcm)	Net Annual Ground Water Availab-ility (mcm)	Gross Ground Water Draft For Irrigation (mcm)	Gross Ground Water Draft For Dom.& Ind. Use (mcm)	Gross Ground Water Draft For All Uses (mcm)	Stage of G.W. Develop-ment (%)	Category
Amer	82.8154	74.5339	137.3925	20.8352	158.2277	212.22	OE
Bairath	69.1987	62.2519	63.8759	11.1238	74.9996	120.48	OE
Basni	51.2634	46.1370	85.0095	11.2981	96.7076	209.31	OE
Chaksu	62.3681	56.1314	96.7102	8.1196	104.8298	187.45	OE
Dudu	76.0314	68.4283	80.7148	19.5307	99.2455	117.27	OE
Govindgarh	48.9764	42.2786	120.7710	13.8125	134.5835	318.32	OE
J. Ramgarh	73.3829	66.0446	93.1739	5.5819	98.7558	148.29	OE
Jothwara	48.9764	44.7750	72.4213	108.0141	181.4355	384.51	OE
Kotputli	53.0348	47.7313	85.8234	9.7675	95.5909	200.27	OE
Phagi	43.3884	41.2240	34.3176	3.3878	37.7054	91.46	Critical
Sambhar	58.9852	53.0867	149.0234	11.3878	160.9110	303.11	OE
Sanganer	36.3452	34.5280	82.7363	22.8021	105.3984	305.42	OE
Shahpura	37.5924	33.8332	63.4388	8.9117	72.3505	213.84	OE
TOTAL	742.1257	677.1407	1146.4086	253.1695	1399.5782	206.69	OE

Source: Ground water information Jaipur district Rajasthan, 2013

https://cgwb.gov.in/District_Profile/Rajasthan/Jaipur.pdf

Source: Unpublished Thesis **"**Rejuvenation of Jamwa Ramgarh lake, Jaipur, Rajasthan for the conservation of biodiversity" by Avanish Singh, M.Arch (Landscape) Manipal University Jaipur, Guided by Prof (Dr) Madhura Yadav

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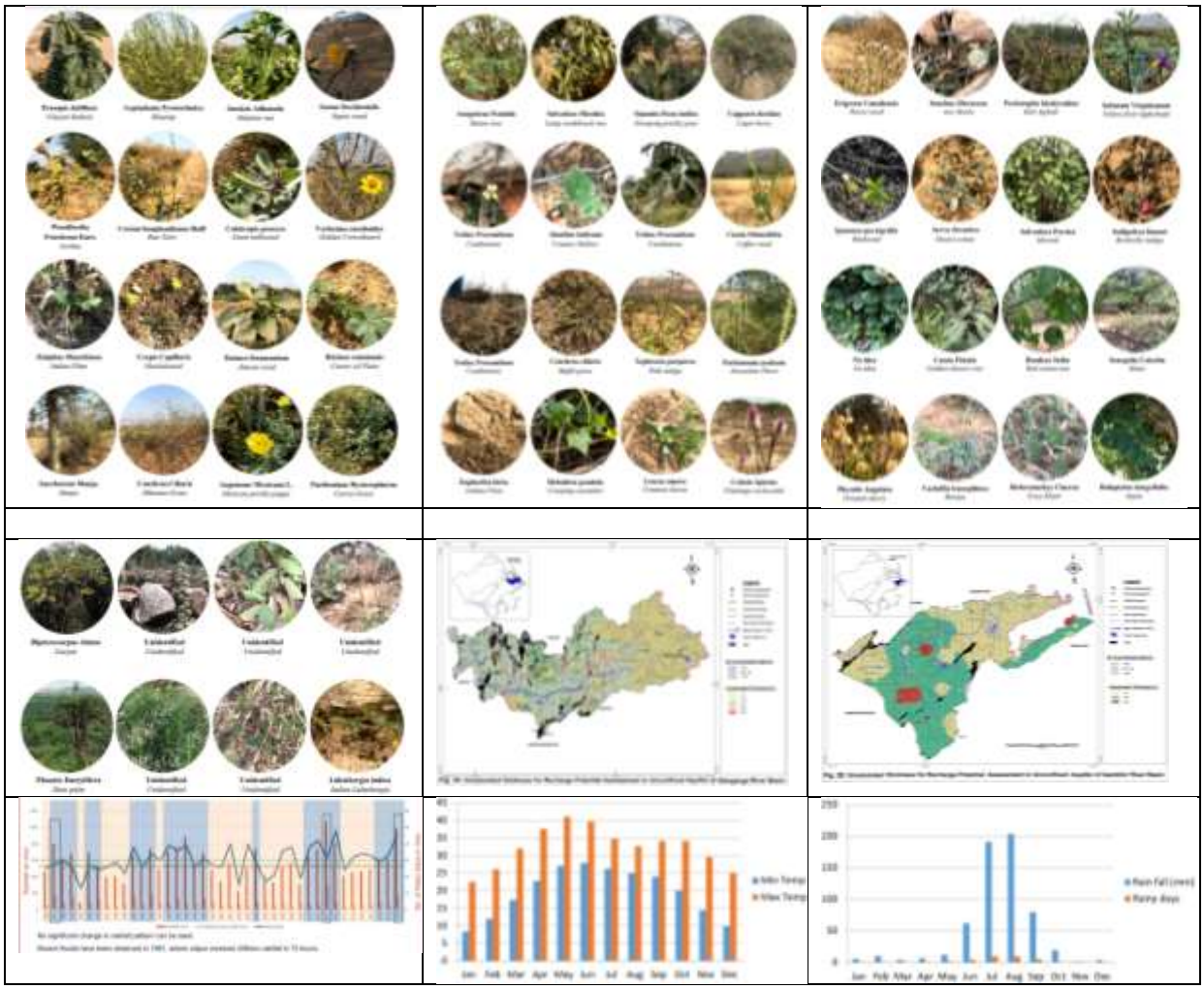

Forest Typology:

According to Champion and Seth's system (1968)1, the NCR Aravali forests belong to Major Group II Dry Tropical Forest. Two types of forests of this major group are present in the NCR Aravalis, namely Group 5 – Tropical Dry Deciduous Forests, and Group 6 – Tropical Thorn Forests. Within Group 5, the NCR Aravalis are categorised as Northern Tropical Dry Deciduous Forests (5B). The rocky terrain, steep slopes, thin soil, low nutrients and moisture regime have produced a peculiar kind of vegetation where the upper canopy of deciduous trees in such forests is light and a continuous canopy can only be seen in the best examples. Stunting is common and trees rarely grow over 15m high. In summer, these forests become leafless, bone-dry, and the soil is exposed. In May or June, these forests begin to leaf again and luxuriant greenery appears everywhere with the onset of the monsoon. These are other group of forests Tropical Thorn Forests (6) which occurs in the NCR Aravalis, and its sub-group Northern Tropical Thorn Forests. Various species of Acacia, Ziziphus, Capparis, Prosopis, Calotropis and Euphorbia are found in these forests. Tree growth is poor and they hardly grow to 10m in height, with only a singlestoreyed canopy, and are very prone to fires.

Issues Found from analysis:

Banganga is a seasonal river that brings water to the lake, after the construction of 800 anicuts throughout the catchment of the river, the water gets collected in the anicuts and rest overflow comes to the lake. These anicuts are curse to the lake, however to meet the water demands of the villages settled throughout the river catchment is vital. Encroachment is spreading like poison in the lake catchment, which is certainly harm to the native flora and fauna. Agrarian activities are promoting flattening of the existing landform of the catchment and demolishing native flora which apparently affects fauna. Also use of fertilizers and pesticides to the farming crops polluting the ground water. ***Prosopis Juliflora*** is non-native to the region and is enormously flourishing which doesn't allow other species to grow as under-story vegetation. Existing natural drains are highly degraded as there is no vegetation to prevent soil erosion. Medicinal species which are extremely rare to the catchment such as **Solanum Virginianum** is being neglected and are endangered to the catchment.

Livelihood of nearby villagers is being disturbed so far after the lake has become dried, as they had job opportunities and other sources of income when it was filled with water.

Suitable guidelines for the conservation of biodiversity in the catchment of the Ramgarh Lake:

First and foremost, the catchment area needs to be fenced to start the process of rejuvenation and check posts/watch towers needs to be located at certain interval to look after it on a regular basis. Buffer zone of minimum 100 Meters periphery should be created by dense plantations and maintained as green belt or no activity zone and no activity is allowed within the buffer zone by the concerned departments in the state. Within the buffer zone, no impervious cover is allowed and mainly plantation with a dense population of deeply rooted plants, trees, shrubs, and grasses should be created so as to recharge ground water in the events of rainfall. Periodic dredging (once in three months) of unwanted species like

Parthenium Hysterophorus and alike exotic species which is in profusion. Under no circumstances, existing landform should be changed for the development to conserve biodiversity. However, design guidelines respective to the existing landform shall be considered. Existing drains that help to fill the catchment with rainwater should be considered as essential and needs to advance by dense vegetation to prevent soil erosion. There has to have strict rules and amendments in the state laws against construction in the catchment zone and blocking the waterflow by means of temporary or permanent construction activities. Under no circumstances should it be allowed to interfere with naturally grown species of flora. There has to have a healthy communication and mutual understanding between a landscape architect, environmentalist, Urban planners, Civil engineers, and alike professionals with Development authorities to bridge the awareness gap even over small things between them. Detailed documentation of biodiversity has to be done by involving researchers, students, educational institutions, botanists, ornithologists and alike professionals under a regular supervision to help understanding and spreading awareness of the context to contribute to the pool of knowledge. Use of Herbicides and/or any chemical fertilizer should be banned in or/ near (within 1Km from the fenced boundary of the catchment) as it may contaminate ground water and/or subtle ecosystems.

Restoration Approach:

The dry rocky slopes are partial to stands of Salai (Boswellia serrata), Dhau (Anogeissus pendula) can withstand thin soils and rapid runoff, while the valleys support Kaim (Mitragyna parvifolia) that can withstand both waterlogging and a certain extent of drought, and Babool (Acacia nilotica) only where the soil is deep and of good quality, with water close to the surface. On the other hand, sand dunes that have come to rest at the feet of the Aravalis have a xeric or desert vegetation that is typically found much further west in the Thar Desert.

At the start of the restoration work, rootstocks of native plants were identified and given protection. We saw a resurgence of babool (Acacia nilotica), ronjh (Acacia leucopholea), hingot (Balanites roxburghii), kair (Capparis decidua), ghatbor (Fleuggea leucopyrus) and jungli karonda (Carissa spinarum) from these rootstocks. While we protected these native species, we eradicated alien invasives, such as Prosopis juliflora, Lantana camara, Xanthium stumarium, Parthenium hestrophorus and many others. The Park was a large canvas for us to paint with the diverse forests of the Northern Aravalis. Today these forest communities are established and many are recruiting individuals giving us hope that the Park is becoming a self-sustaining forest ecosystem. The forest community in the Park varies as per the terrain. The steep rocky outcrops are home to salai and dhau forests, gentle outcrops house kumath and khair forests. Dhak forest on gentle slopes and dry valleys, and distinct forests of kaim in the seasonal drainage channels. Then the patches where the soil is deep, you find babool and jhand forests, and seasonal wetlands have khajoor and saccharum grasslands

Hilltops and Rocky Outcrops:

Forest of Boswellia serrata, salai: On hilltops, ridges and spurs where soil is usually bouldery, pebbly, shallow and dry. Companion species are: Sterculia urens, kullu; Lannea coromendalica, gurjan; Anogeissus pendula, dhau; Gmelina arborea, gamhar; Crateava adansonii, barna; Wrightia tinctoria, doodhi; Ehretia laevis, chamrod; Flaucourtia indica, kakai; Bauhinia racemosa, jinjheri; and an understory of Holarhena pubscens, kuda; Helicteres isora, marodphali; and Grewia flavescens, pisangna. Forest of Anogeissus pendula, dhau: This forest exists on the ridges and slopes almost as a pure forest of dhau (about 90-95%). Often ridge tops are populated by salai and slopes with dhau. Companion species are: Acacia leucophloea, ronjh; Acacia senegal, kumath; Crateava adansonii, barna; Flaucourtia indica, kakai; Wrightia tinctoria, doodhi; Bauhinia racemosa, jinjheri. Forest of Acacia catechu, khair: Found on the gentler ridges and slopes of hills. Companion species are: Anogeissus pendula, dhau; Acacia leucophloea, ronjh; Acacia senegal, kumath; Crateava adansonii, barna; Wrightia tinctoria, doodhi; Ehretia laevis, chamrod; Bauhinia racemosa, jinjheri; Flueggea leucopyrus, ghatbor; Dichrostachys cinerea, goya khair. Forest of Acacia senegal, kumath: These forests are often a sign of degraded forest in the Aravali. Companion species are: Anogeissus pendula, dhau; Acacia leuchophloea, ronjh; Wrightia tinctoria, doodhi; Cordia gharaf, goondi; Ehretia laevis, chamrod; Flueggea leucopyrus, ghatbor; Dichrostachys cinerea, goya khair.

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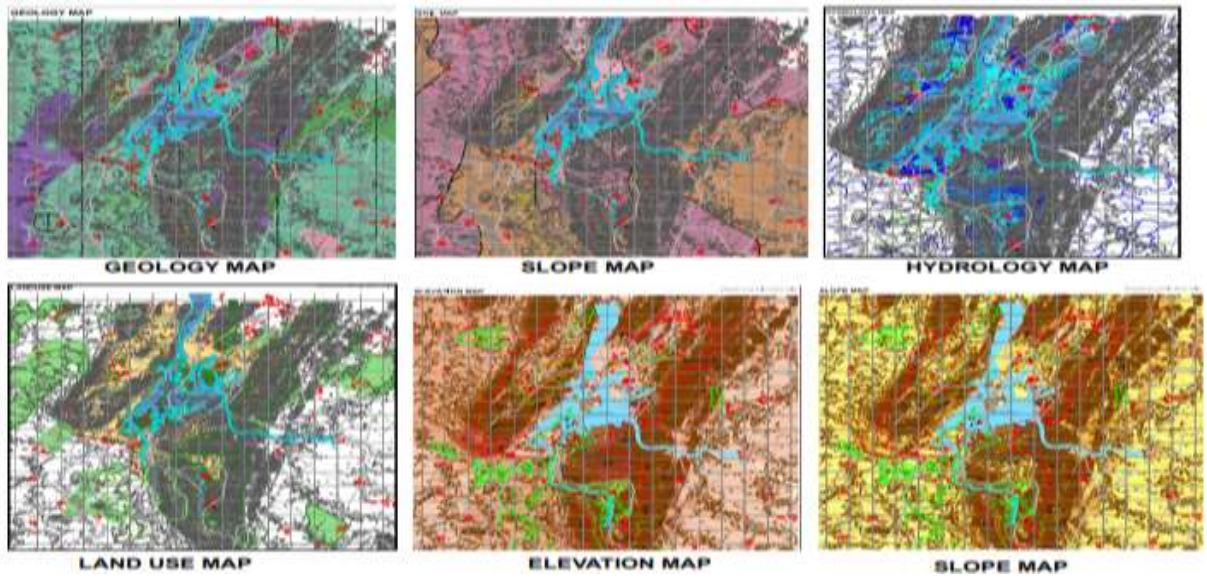
Forests in the Valleys:
Forest of Mitragyna parvifolia, kaim: These are often found in valleys of the salai or dhau forests where seasonal streams flow. Companion species are: Butea monosperma, dhak; Albizia odoratissima, basa; Diospyros cordifolia, bistendu; Bauhinia racemosa, jinjheri; Crateava adansonii, barna; Ficus religiosa, peepal; Ficus benghalensis, badh; Ficus racemosa, goolar. Forests of Butea monosperma, dhak: These are often found in the drier valleys or planes of the Aravalis. Companion species are: Acacia leucophloea, ronjh; Holoptelea integrifolia, chudail; Bauhinia racemosa, jinjheri; Flaucourtia indica, kakai; Cordia gharaf, goondi; Holarhena pubscens, kuda; Helicteres isora, marodphali; Adhatoda vasica, adulsa; Diospyros cordifolia, bistendu; Capparis sepiaria, hins; Flueggea leucopyrus, ghatbor; Dichrostachys cinerea, goya khair. Forest of Acacia nilotica, babool: Valley forests with deep soil deposits, often waterlogged during monsoon. Companion species are: Capparis decidua, kair; Capparis sepiaria, hins; Salvadora persica, jaal; Salvadora oleoides, methi jaal; Ziziphus mauritiana, ber

Grasslands
Savanna of Phoenix sylvestris and Saccharum: These occur in the wetlands and seasonal wetlands of the Aravalis. Companion species are: Ehretia laevis, chamrod; Salvadora persica, jaal; Acacia nilotica, babool; Tamarix dioica, farash; and the dominant grasses are Saccharum spontaneum; Saccharum benghalensis and Desmostachya bipinnata
What Artificial Intelligence thinks about revival of Jamwa Ramgarh?
Reviving a lake like Jamwa Ramgarh requires a multi-pronged approach involving various stakeholders such as local communities, government authorities, and environmental experts. Here are some steps that can be taken to revive Jamwa Ramgarh lake:

Conduct a thorough assessment: A comprehensive assessment of the lake's current state should be conducted to identify the key issues that are impacting the lake's health. This assessment can include aspects such as water quality, sedimentation, biodiversity, and land use.
Control pollution: Identify the sources of pollution and take steps to control them. This can include measures like treating wastewater, reducing industrial discharge, promoting eco-friendly farming practices, and raising awareness among the local community about the importance of reducing pollution.
Restore the lake's ecology: This can involve measures like removing invasive species, re-introducing native species, and creating artificial wetlands to promote biodiversity.
Manage water resources: Proper management of water resources is critical to the health of the lake. This can involve measures like rainwater harvesting, regulating the water flow, and reducing water usage in the catchment area.
Engage the local community: Community participation is crucial for the success of any lake restoration initiative. Engage with the local community to raise awareness about the importance of the lake, and involve them in the restoration process through activities like planting trees, cleaning up the lake, and monitoring water quality.
Monitor progress: Continuous monitoring is important to assess the effectiveness of the restoration efforts and to make any necessary adjustments. Regular water quality testing and biodiversity surveys can help track progress over time.
Reviving a lake like Jamwa Ramgarh requires a sustained effort from all stakeholders. By following these steps and working together, it is possible to restore the lake to its former glory.



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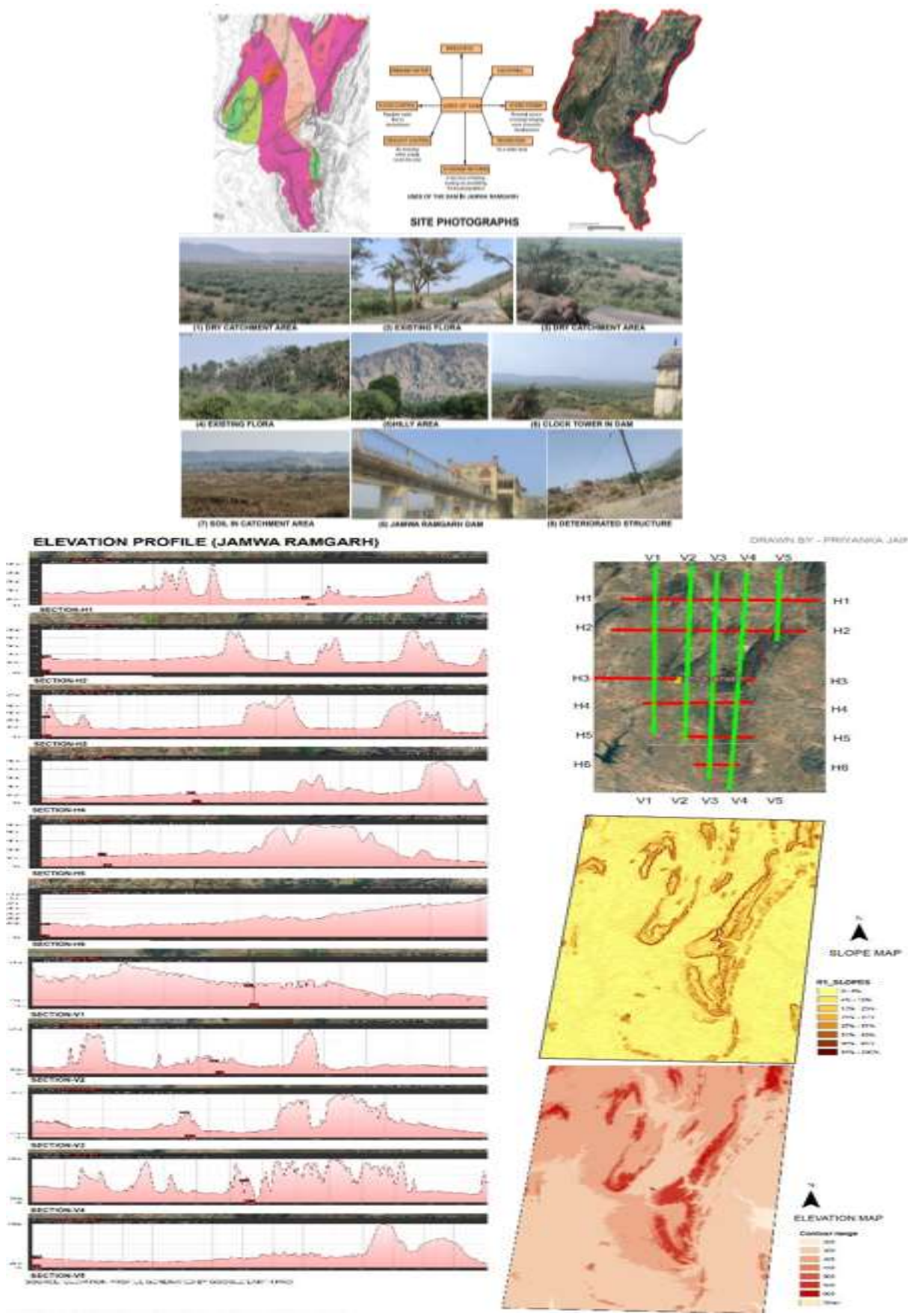

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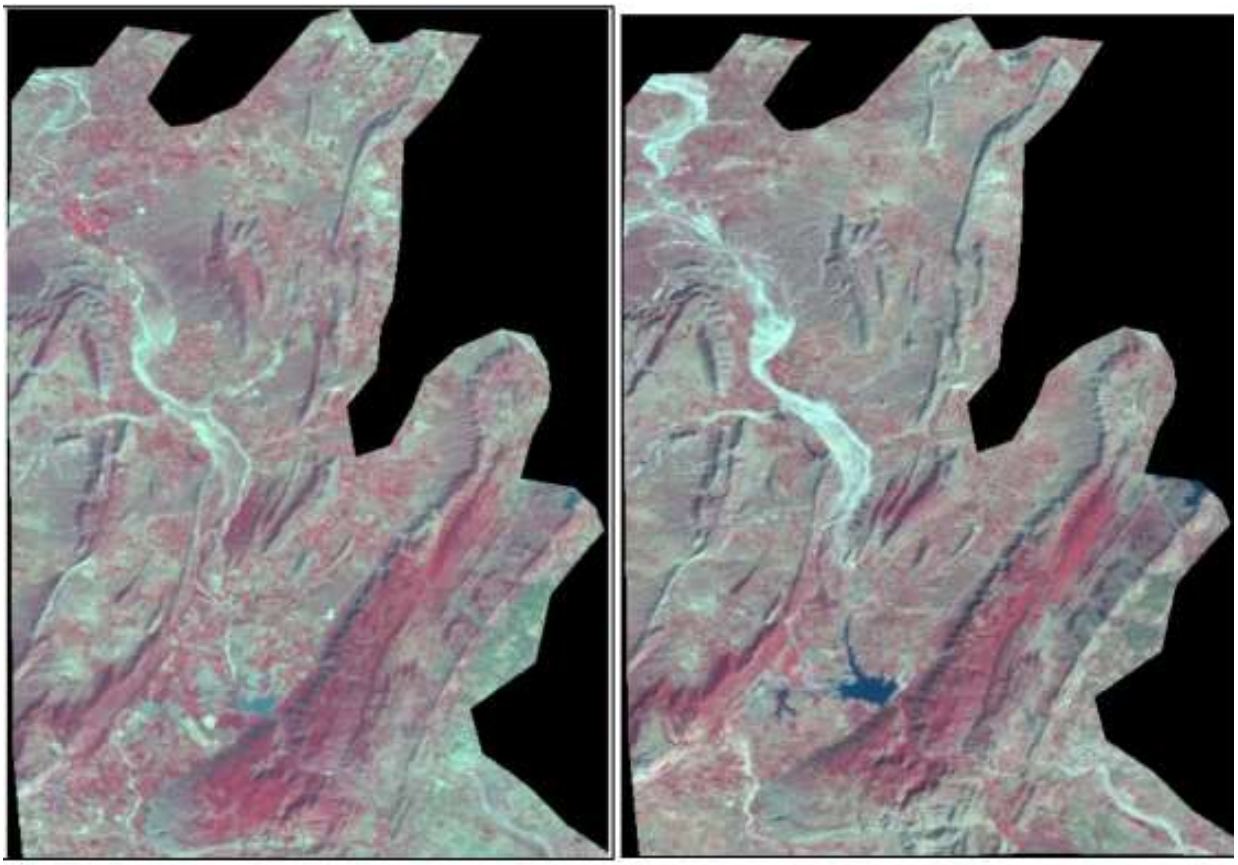
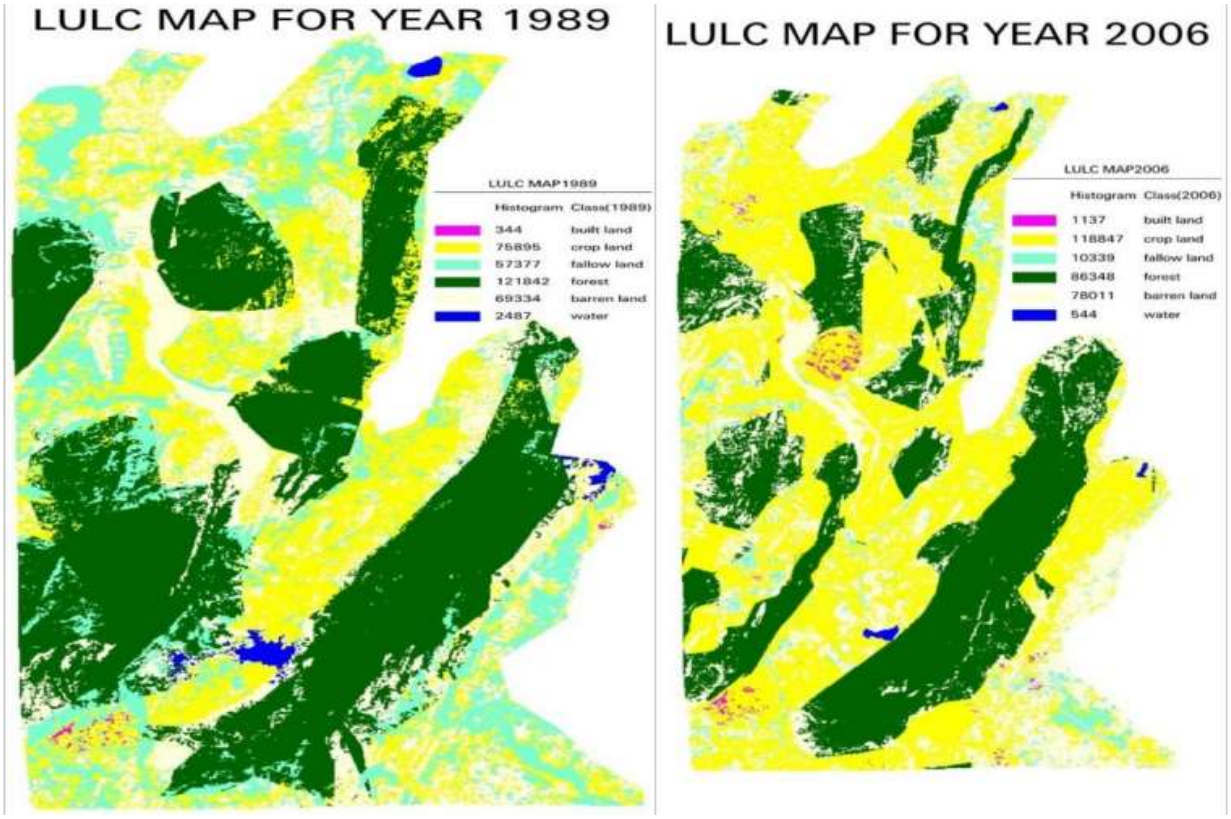


Figure 2.*Satellite image of year 1989 and 2006*



Land Use Class	1989 (Area-Ha.)	2006(Area-Ha.)
Built land	27.94	102.33
Crop land	6164.57	10696.23
Fallow land	4660.44	930.51
Forest	9896.61	7771.32
Barren land	5631.65	7020.99
Water	202.01	48.96

However, the result of the work during year 1989-2006, there is major change in built land, water body, and crop land. Land use change indicates that built area is increase by 74.3886 ha (266%), whereas forest and water are decreased by 21% and 76% during 1989-2006. The crop land in catchment area is increased enormously during this period as it was 6164.57ha in 1989 which increased to 10696.23ha in 2006. The total crop land is increase by 4531.6586(73%) ha. during study period. Fallow land is decrease by 3729.9368 (80%) ha. however; Forest area is decrease by 2125.2964(21%) ha. The barren land is increase by 1389.3356(20%) ha whereas the major change in water in due to decrease by153.0456 (75%) ha. If long-term solutions are to be found, the role of local participation, the influence of village elders, the involvement of researchers from both natural and social sciences, the commitment of policy makers, and coordination of activities among the relevant NGOs should be given due consideration.