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Ecological assessment of selected sites of Hadoti region with respect to economically (Medicinally) important species from SE Rajasthan, India

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Abstract
The world is trying to overcome the impact of pandemics, and expected continuous increase in the intensity with the pace of the time. The synthetic medicines also had the side-effects on the physiology of the humans. In this context it was deemed necessary for the ecologists to carry out research and explore the natural remedies through floral world. The present ethnobotanical investigation was carried out in the south-eastern parts of Rajasthan. The investigation sites fell in the districts of Baran (one site) and Jhalawar (three sites) of the Hadoti Region. Four sites, *viz.*, Rata Devi (I), Bagher Area (II), Jhirniya (III), Shahbad (IV), were undertaken as key sites along with other associated green spaces. The distributional patterns of dominant species and the Importance Value Index (IVI) were assessed for all the four sites. Two types of distribution patterns were observed, sites I, III and IV followed lognormal pattern whereas site II followed broken stic pattern. Site II was the most disturbed site. The maximum species diversity 2.62 was observed in the Rata Devi (Site I) and minimum species diversity 2.02 was observed in the Jhirniya (Site III). It could be concluded that low difference in species diversity (2.62 to 2.02) denoted the similarity in the habitat types of all the four key sites, i.e., tropical dry deciduous forest. The key floral species of medicinal values included *Anogeissus pendula*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Madhuca indica*, *Holarrhena antidysenterica*, *Lannea coromandelica*, *Tamarindus indica*, *Flacourtia indica*, *Cassia fistula*, *Butea monosperma*, *Aegle marmelos*, *Bombax ceiba*, *Terminalia tomentosa*, *Terminalia bellirica*, *Mitragyna parvifolia*, *Buchanania lanzan*, *Acacia catechu*, *Sterculia urens*, *Miliusa tomentosa*, *Nyctanthes arbortristis*, *Helicteres isora*, *Carissa carandas*, etc.

Keywords: Ecological, Hadoti, economically

Introduction
It is evident from the civilizations of the world that the humans made use of the flora to combat the ailments. The surrounding herbal wealth was being used for curative purpose all around the globe among the ancient ethnic communities. The urban sprawling had fragmented the natural forests and in the pace of development, the humans distanced from the floral wealth. Fortunately, India still holds over five thousand of the forest dominated villages which comprises near about 15% of the total geographic area (Choudhary and Kumar 2001) [1]. The traditional wisdom in form of customs, traditions, rituals descended from generation to generation through folklores and other domestic practices without systematic documentation. The traditional wisdom is a unique treasure and rich source of diversified ethno-botanical wealth. The present investigation was an attempt to assess the ecological attributes and their importance to the local communities.

Methodology
Study Area (Figure 1)
Kota division (Hadoti region) is situated at the edge of Malwa plateau at 23°45' to 25°53' North latitudes and 75°9' to 77°26' East longitudes in South Eastern corner of Rajasthan state. The district Jhalawar lies in the South-East corner of Rajasthan at the edge of the Malwa plateau between 23°45'20" N to 24°52'17" N latitudes and 75°27'35" E to 76°56'48" E longitudes. It is one of the rainiest parts of the state of Rajasthan where the average annual rainfall is 35 inches which keeps it cool and gentle breezes ward off the stifling humidity. Jhalawar is a rock-strewn, scrub-covered terrain, occasionally bright with fields of poppies and citrus-green groves of Oranges, lying in the South-Eastern region of Rajasthan at the edge of the Malwa plateau, Jhalawar has rocky but water-laden verdant landscape. The district Baran is situated at 25° 15' 40" North latitudes, 76° 30' 33" East longitudes it is located on the south-

east corner of Rajasthan. The total forest area in the district is 2.17 Lacs Ha. which is nearly equal to 31% of the total geographic area of the district, 4.22 Sq Km. is unclassified forest. Dry tropical forest consisting of sub type of Northern tropical dry deciduous forest, Northern dry mixed deciduous forest. Total number of seven sites including Kishanganj Bhund devera (Ramgarh Block), Jugdevpura (Banghaola Block) and Shahbad forest (Sitabari-Shahbad Range). Nagarkot (Sahrol Range), Kotra Mataji (Shahbad Range) and Jhora Tora (Sindukara Block) and their nearby villages in of Baran District were selected for study purpose.

Four major sites – three from Jhalawar (Rata Devi, Bagher and Jhirmiya) and one from Baran (Shahbad), were studied in details under the present investigation in different seasons for ethnobotanical study.

Method

The vegetation survey was carried out by the nested quadrate method with the quadrate size 10m x 10m for trees, determined using species area curve (Conway and Barbiet 1994) [2]. The DBH / CBH (1.35 m from the surface) and number of each tree in every quadrant were taken in to account whereas collar diameter was measured for shrubs and herbs.

$$\text{Basal area} = \frac{C^2}{4\pi}$$

where, C = Circumference at Breast Height

IVI (Importance Value Index) was analyzed to gain the knowledge of vegetation structure, composition and regeneration. The parameters for vegetation analysis include frequency, density, abundance and basal cover. Relative valued of frequency, density and dominance are analyzed according to Misra (1968) [6] and Curtis and Mclntosh (1950 – 1956) [3].

$$\text{Density (D)} = \frac{\text{Total number of individuals}}{\text{Total no.of quadrates studies}}$$

$$1).\quad \text{Abundance (Ab)} = \frac{\text{Total number of individuals}}{\text{No. of quadrates occurence}}$$

$$2).\quad \%\ \text{Frequency} = \frac{\text{No. of quadrates occurrence}}{\text{Total no.of quadrates studies}} \times 100$$

$$3).\quad \text{Relative density (RD)} = \frac{\text{No.of individuals of species}}{\text{No.of individuas of all species}} \times 100$$

$$4).\quad \text{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

$$5).\quad \text{Relative Dominance (R Dom)} = \frac{\text{Basal area of a spcies}}{\text{Basal area of all species}} \times 100$$

Importance Value Index = RD + RF + RDom

IVI values were drawn in graphical forms as dominance and diversity curve (D/D curve). Depending upon the competitive ability of organism in utilizing or sharing of the available resources, we get three types of distribution models, in general (Whittaker 1975, Hutchings 1983 and Gray 1987) [7, 5, 4].

Observations

Site I (Rata Devi, Jhalawar) (Table 1): It was a pure patch of *Anogeissus pendula* Edgew. (Dhokda) and *Diospyros melanoxylon* Roxb (Tendu) under a severe biotic pressure of animal grazing affecting the natural habit of the floral species especially *Anogeissus pendula* Edgew. (Dhonkda). Another continuous patch of *Wrightia tomentosa* Roem. (Dudhi) naturally colonizing in that area in ~20 Ha. Other common tree species included *Diospyros melanoxylon* Roxb., *Madhuca indica* (Koen.) Macbr., *Holarrhena antidysenterica* (L.) Wall., *Lannea coromandelica* (Houtt.) Merrill *and Butea monosperma* (Lam.) Taub interspersed with few individuals of *Flacourtia indica* (Burm.f.) Merrill, *Ziziphus xyloprus* Willd., *Randia dumetorum* (Retz.) Lam. *Carissa carandas* Wt. et. Arn and *Cassia fistula* L.. Total tree density was 716.39 trees/ha. The community consisted of *Diospyros melanoxylon* Roxb., *Madhuca indica* (Koen.) Macbr., *Anogeissus pendula* Edgew., and *Lannea coromandelica* (Houtt.) Merrill having important value index 66.92, 56.45, 23.27 and 14.35. A total of 21 species were recorded which included the rare species *Randia dumetorum* (Retz.) *Carissa carandas* Wt. et. Arn and *Ehretia laevis* Roxb.

Table 1: Species composition and distribution pattern of Site I (RATA DEVI)

S. No.	Name of Species	Den/ha	Rel. freq	Rel. den.	Rel. dom.	IVI	A/F
1	*Diospyros melanoxylon* Roxb.	220.67	23.23	34.23	17.45	66.92	0.03
2	*Madhuca indica* (Koen.) Macbr.	16.67	3.85	2.33	45.28	56.45	0.06
3	*Anogeissus pendula* Edgew.	66.67	11.54	9.3	2.43	23.27	0.03
4	*Acacia senegal* (L.) Willd.	38.33	6.92	9.65	5.91	12.49	0.48
5	*Terminalia tomentosa* (DC.)Wt.and Arn.	16.67	1.92	2.33	3.14	7.39	0.24
6	*Dichrostachys cinerea* (L.) Wight. (Kunali)	16.67	1.92	2.33	2.83	7.08	0.24
7	*Flacourita indica* (Burm. F.) Merr.	28.33	0.77	2.65	1.98	7.4	0.05
8	*Ziziphus xylopyrus* Willd..	50	3.85	3.98	1.05	11.88	0.18
9	*Holarrhena antidysenterica* (L.) Wall.	41.67	7.69	5.81	0.49	14	0.04
10	*Butea monosperma* (Lam.*) Taub.*	25	5.77	3.49	4.35	13.61	0.04
11	*Lannea coromandelica* (Houtt.) Merrill	16.67	3.85	2.33	4.18	14.35	0.06
12	*Kigelia pinnata* DC.	16.67	3.85	2.33	2.05	8.22	0.06
13	*Bridelia retusa* Linn. Spreng	54.33	1.77	4.14	3.32	13.23	0.09
14	*Lantana camara* L. var.	16.67	3.85	2.33	0.18	6.36	0.06
15	*Randia dumetorum* (Retz.)	8.33	1.92	1.16	0.09	3.18	0.12
16	*Pterocarpus marsupium* Roxb.	8.33	1.92	1.16	3.89	6.98	0.12
17	*Carissa carandas* Wt. et. Arn	8.33	1.92	1.16	0.29	3.38	0.12

18	*Nyctanthes arbor-tristis* L.	16.67	3.85	2.33	0.33	6.5	0.06
19	*Cassia fistula* L.	16.67	3.85	2.33	0.29	6.46	0.06
20	*Helicteres isora* L.	16.67	3.85	2.33	0.19	6.37	0.06
21	*Ehretia laevis* Roxb.	16.67	1.92	2.33	0.24	4.49	0.24
Total		716.69	100.01	100.03	99.96	300.01	2.44

Site II (BAGHER AREA, Jhalawar) (Table 2): The common species included *Anogeissus pendula* Edgew., *Lannea coromandelica* (Houtt.) Merrill, *Tamarindus indica* L. and *Diospyros melanoxylon* Roxb.. Few individuals of other species were *Cassia fistula* L. and *Boswellia serrata* Roxb Ex Colebr.. Total tree density was 565 trees/ha and community *Diospyros melanoxylon* Roxb., *Anogeissus pendula* Edgew., *Tamarindus indica* L. and *Butea monosperma* (Lam.) Taub. having important index 73.77, 63.19, 37.40, and 32.86. Total 11 species were recorded.

Table 2: Species composition and distribution pattern of Site II (BAGHER)

S. No.	Name of Species	Den/ha	Rel. freq	Rel. den.	Rel. dom.	IVI	A/F
1	*Butea monosperma* (Lam.) Taub.	65	12.795	16.07	4.87	33.73	0.065
2	*Diospyros melanoxylon* Roxb.	190	34.7	30.95	8.115	73.765	0.08
3	*Lannea coromandelica* (Houtt.) Merrill	20	3.175	5.355	16.305	24.835	0.02
4	*Anogeissus pendula* Edgew.	165	29.605	22.615	10.965	63.185	0.08
5	*Anogeissus latifolia* (Roxb. ex. DC.) Wall ex. Guill (Dhavra)	5	0.795	1.785	0.285	2.865	0.05
6	*Boswellia serrata* Roxb Ex Colebr.	45	7.145	7.145	18.565	32.855	0.03
7	*Cassia fistula* L.	5	0.795	1.785	0.23	2.805	0.05
8	*Tamarindus indica* L.	30	6	4.76	26.64	37.4	0.075
9	*Acacia leucophloea* (Roxb.) Willd.	25	5	4.76	1.475	11.235	0.0625
10	*Madhuca indica* (Koen.) Macbr.	10	2	2.38	13.9	18.28	0.100
11	*Flacourtia indica* (Burm.f.) Merrill	5	1	2.38	0.05	3.43	0.050
Total		565	103.01	99.985	101.4	304.39	0.6625

Site III (JHIRNIYA or Bijlia Bharak Area, Jhalawar) (Table 3): The common tree species occurred *Butea monosperma* (Lam.) Taub. (Palash), *Lannea coromandelica* (Houtt.) Merrill. Other species in few individuals were *Lannea coromandelica* (Houtt.) Merrill, *Diospyros melanoxylon* Roxb. and *Aegle marmelos* (L.) Correa., *Bombax ceiba* Linn. *Terminalia tomentosa* (DC) wight & Arn. and *Bridelia retusa* Linn. Spreng were also recorded. Total tree density was 515 trees/ha and community was *Butea monosperma* (Lam.) Taub. and *Lannea coromandelica* (Houtt.) Merrill having important value index 138.04 and 43.15. A total of 17 species were recorded and rare species were *Capparis sepiaria* L., *Mitragyna parvifolia* (Roxb.) Korth and *Parkinsonia aculeate* L. Shrub species included *Carissa opaca* Roem. (Karaunda), *Holarrhena antidysenterca* (L.)Wall (Indrajo) and *Lantana camara* L.Var (Barbena). were observed.

Table 3: Species composition and distribution pattern of Site III (JHIRNIYA)

S. No.	Name of Species	Den/ha	Rel. freq	Rel. den.	Rel. dom.	IVI	A/F
1	*Butea monosperma* (Lam.) Taub.	264.23	48.24	26.23	55.57	138.04	0.03
2	*Lannea coromandelica* (Houtt.) Merrill	57.54	6.95	13.6	17.6	43.15	0.02
3	*Diospyros melanoxylon* Roxb.	28.08	8.48	8.65	2.39	16.52	0.1
4	*Terminalia bellirica* (Gaertn.) Roxb.	15.38	2.99	4.65	4.05	11.69	0.07
5	*Ziziphus xylopyrus* Willd..	7.69	1.49	2.33	0.58	4.4	0.13
6	*Aegle marmelos* (L.) Correa.	15.38	2.99	4.65	2.13	13.76	0.07
7	*Holoptelea intergrifolia* (Roxb.) Planch.	15.38	2.99	4.65	3.61	13.25	0.07
8	*Cassia fistula* L.	7.69	1.49	2.33	2.18	4	0.13
9	*Prosopis juliflora* (Swartz) DC.,	15.38	2.99	4.65	4.63	10.27	0.07
10	*Carissa carandas* Wt. et. Arn	27.08	9.48	9.65	0.97	10.1	0.1
11	*Mitragyna parvifolia* (Roxb.) Korth	7.69	1.49	2.33	0.14	3.96	0.13
12	*Capparis sepiaria* L.	7.69	1.49	2.33	0.15	3.97	0.13
13	*Parkinsonia aculeata* L.	7.69	1.49	2.33	0.15	3.97	0.13
14	*Flacourita indica* (Burm. F.) Merr.	7.69	1.49	2.33	0.27	4.09	0.13
15	*Bombax ceiba* Linn.	15.38	2.99	4.65	4.88	10.52	0.07
16	*Terminalia tomentosa* (DC) wight & Arn.	7.69	1.49	2.33	0.32	4.14	0.13
17	*Bridelia retusa* Linn. Spreng	7.69	1.49	2.33	0.32	4.2	0.13
Total		515.35	100.02	100.02	99.94	300.03	1.64

Site IV (SHAHBAD, Baran) (Table 4): The common species occurred were *Anogeissus latifolia* (Roxb. ex. DC.) Wall ex. Guill (Dhavra), *Terminalia bellirica* (Gaertn.) Roxb. and *Acacia catechu* (L.f.) Willd., *Lannea coromandelica* (Houtt.) Merrill, *Buchanania lanzan* Spreng and *Cassia fistula* L. Total tree density was 521 tree/ha and community was *Anogeissus latifolia* (Roxb. ex. DC.) Wall ex. Guill (Dhavra), *Terminalia bellirica* (Gaertn.) Roxb. and *Acacia catechu* (L.f.) Willd. having important value index 100.86, 41.31 and 34.16. A total of 20 species were recorded and rare species were *Sterculia urens* Roxb., *Madhuca indica* (Koen.) Macbr. and *Lagerstroemia parvifora* Roxb. for this site.

Table 4: Species composition and distribution pattern of Site IV (SHAHBAD)

S. No.	Name of Species	Den/ha	Rel. freq	Rel. den.	Rel. dom.	IVI	A/F
1.	*Acacia catechu* (L.f.) Willd. (L.f.) Willd.	67	11.87	12.82	9.47	34.16	3
2.	*Anogeissus latifolia* (Roxb. ex. DC.) Wall ex. Guill (Dhavra) (Roxb. Ex DC.) Wall. Ex Guill. and Perr.	153	22.04	29.49	49.33	100.86	1
3.	*Limonia crenulata* Roxb.	13	1.69	2.56	0.18	4.43	13
4.	*Flacourtia indica* (Burm.f.) Merrill	20	5.09	3.85	0.81	9.75	9
5.	*Emblica officinalis* Gaertn.	7	1.69	1.28	0.4	3.37	14
6.	*Casearia tomentosa* Roxb.	7	1.69	1.28	0.2	3.17	15
7.	*Holarrhena antidysenterica* (L.) Wall.	20	3.39	3.85	0.3	7.54	11
8.	*Sterculia urens* Roxb.,	7	1.69	1.28	0.05	3.02	19
9.	*Cassia fistula* L.	20	5.09	3.85	1.23	10.17	7
10.	*Miliusa tomentosa* (Roxb.) Sincl.	7	1.69	1.28	0.09	3.06	17
11.	*Buchanania lanzan* Spreng	13	3.39	2.56	4.99	10.94	6
12.	*Ziziphus xylopyrus* Willd..	20	3.39	3.85	0.54	7.78	10
13.	*Diospyros melanoxylon* Roxb.	20	5.09	3.85	1.08	10.12	8
14.	*Lannea coromandelica* (Houtt.) Merrill	33	6.78	6.41	5.29	18.48	4
15.	*Madhuca indica* (Koen.) Macbr.	7	1.69	1.28	0.07	3.04	18
16.	*Terminalia bellirica* (Gaertn.) Roxb.	47	8.48	8.97	23.86	41.31	2
17.	*Nyctanthes arbor-tristis* L.	33	8.48	6.41	1.69	16.58	5
18.	*Lagerstroemia parviflora*	7	1.69	1.28	0.1	3.07	16
19.	*Elaeodendron glaucum* Roxb.pers	13	3.39	2.56	0.16	6.11	12
20.	*Helicteres isora* L.	7	1.69	1.28	0.04	3.01	20
TOTAL		521	100	99.99	99.88	299.97	210

Vegetation of other sites

Gagron Area (Jhalawar), Jhalawar: Common tree species occurred *Butea monosperma* (Lam.) Taub., *Anogeissus pendula* Edgew., *Acacia leucopholea* (Roxb.), *Holoptelea intergifolia* (Roxb.), *Mitragyna parvifolia* (Roxb.), *Phoenix sylvestris* (L.) Roxb., *Schleichera oleosa* (Lour) Oken., *Acacia catechu* (L.f.) and *Diospyros melanoxylon* Roxb.. *Schleichera oleosa* (Lour) Oken. found rare species for this site**.**

Table 5: Wild Edible Plants of the Study Area

S. No.	Botanical Name	Local Name	Family	Edible Plant Part	Availability	
					Baran	Jhalawar
1.	*Abelmoschus Moschatus* Medicus	Musk bhindi	Malvaceae	Seeds	C^+	C^-
2.	*Aegle marmelos* (L.) Correa	Bel	Rutaceae	Fruit	C^+	C^-
3.	*Acacia catechu* (L.f.) Willd.	Khair	Mimosaceae	Rasin	C^+	C^+
4.	*Acacia nilotica (*L.) Willd. Ex del.	Babool	Mimosaceae	Gum	C^+	C°
5.	*Acacia senegal* (L.) Willd.	Kumatio	Mimosaceae	Seed Gum	C^+	C^+
6.	*Aloe vera linn* (L.) Brum. f.	Gawarpath	Liliaceae	Pulp	C^+	C^+
7.	*Amaranthus caudatus* L.	Chauli	Amaranthaceae	Seeds, Leaves	C^+	C^+
8.	*Amaranthus viridis* L.	Jangli Chauli	Amaranthaceae	Seeds, Leaves	C^+	C^-
9.	*Ampelocissus latifolia* Roxb. Planch	Pani Bel	Vitaceae	Fruit	C°	C°
10.	*Anogeissus pendula* Edgew.	Dhokadra	Combretaceae	Gum	C^+	C°
11.	*Asparagus racemosus* Willd.	Satawari	Liliaceae	Tuber	C^+	C^-
12.	*Azadirachta indica* A. Juss.	Neemda	Meliaceae	Fruit	C^+	C^-
13.	*Bacopa monnieri* (Linn) Wettst.	Brahmi	Scorphulariaceae	Leaves	C^+	C^+
14.	*Bambusa bambos* Voss.	Bans	Poaceae	Tender	C^+	C°
15.	*Bauhinia variegata* L.	Kachnar	Caesalpiniaceae	Flower	C^+	C^-
16.	*Brachiaris ramose* (L.) Stapf	Sama	Poaceae	Grain	C^+	C°
17.	*Buchanania lanzan* Spreng	Char	Anacardiaceae	Fruit seed	C^+	C^+
18.	*Chenopodium album* L.	Bathua	Chenopodiaceae	Leaves	C^+	C^+
19.	*Cassia tora* Linn.	Punwad	Caesalpiniaceae	Leaves	C^+	C^+
20.	*Ceropegia attenuata* Hook.	Khandula	Asclepiadiaceae	Tuber	C^+	C^-
21.	*Chlorophytum tuberosum* (Roxb.) Baker	Safed musli	Liliaceae	Tuber	C^+	C°
22.	*Coccinia grandis* L.	Kundru	Cucurbitaceae	fruit	C^+	C^+
23.	*Cucumis callosus* Rottl.	Kachrio	Cucurbitaceae	fruit	C^+	C^+
24.	*Curcuma ameda* Roxb.	Jangli Haldi	Zingiberaceae	Rhizome	C^+	C^+
25.	*Cardiospermum helicacabum* L.	Chirputa	Sapindaceae	Leaves	C^+	C^0
26.	*Cyamopsis tetragonoloba* Linn.	Gwar	Fabaceae	Seeds and fruits	C^+	C^+
27.	*Dendrocalamus strictus* (Roxb.) Nees	Bans	Poaceae	Rhizome Tender shoots	C^+	C^+
28.	*Dioscorea bulbifera* L.	Vahrikand	Dioscoreaceae	Bulb	C^+	C^-
29.	*Dioscorea pentaphylla* L.	Lalwala	Dioscoreaceae	Tuber	C^+	C^-

30.	*Diospyros melanoxylon* Roxb.	Tendu	Ebenaceae	Fruit	C^+	C^+
31.	*Ficus benghalensis* Linn.	Badd	Moraceae	Fruit	C^+	C°
32.	*Ficus racemosa* Linn.	Gular	Moraceae	Fruit	C^+	C°
33.	*Ficus religiosa* Linn.	Pipal	Moraceae	Fruit	C^+	C°
34.	*Heteropogon contortus* (Linn.) P.Beauv	Sawa ghass	Poaceae	Grasses	C^+	C^-
35.	*Holoptelea intergrifolia* (Roxb.) Planch	Bander Ki Roti	Ulmaceae	Seed	C^+	C^+
36.	*Hibiscus cannabinus* L.	Patsan	Malvaceae	Fiber	C^+	C^+
37.	*Ipomoea aqatica* forsk.	Nail ka sag	Convolulaceae	Leaves or tender soot	C^+	C^0
38.	*Kigelia pinnata* L.	Balam Khira	Bignoneaceae	Fruit	C°	C^+
39.	*Madhuca longifolia* (Koen) Macbr.	Mahua	Sapotaceae	Flower and	C^+	C°
40.	*Mangifera indica* Linn.	Amba	Anacardiaceae	Fruit	C^+	C^+
41.	*Momordica dioica* Roxb. ex Willd.	Jangli Karela	Cucurbitaceae	Fruit	C^+	C^+
42.	*Moringa oleifera* Lamk.	Sainjna	Moringaceae	Fruit flower	C^+	C°
43.	*Nelumbo nucifera* Gaertn.	Kamal	Nymphaeaceae	seeds	C°	C°
44.	*Oxalis corniculata* L.	Khai buti	Oxalidaceae	Leaves	C^+	C^-
45.	*Papaver somniferum* L.	Apheem	Papaveraceae	Leaves Seeds	C^+	C^+
46.	*Pandanus odoratissimus* Lam.	Kewda	Pandanaceae	Bud	C°	C°
47.	*Panicum miliare auct.non* Lam.	(Little millet)	Poaceae	grains	C^+	C^+
48.	*Pennisetum americanum* (L.)	Bajra	Poaceae	grains	C^+	C^+
49.	*Phaseolus aconitifolius* jacq.	(Moong)	Fabaceae	Seeds	C^+	C^+
50.	*Pithecellobium dulce* (Roxb.) Benth	Jangel Jalebe	Mimosaceae	Fruit, Seeds	C^+	C^-
51.	*Polygonum barbatum* L.	Lal pattin, jhinu	Polyhonaceae	Root and leaves	C^+	C^-
52.	*Phoenix sylvestris* L. Roxb.	Khajoor	Arecaceae	Tender shoot and fruits	C^+	C^+
53.	*Portulaca oleracea* L.	Kulfa	Portulacaceae	Leaves	C^+	C^+
54.	*Sitaria glauca* L.	Kangni	Poaceae	Root	C^+	C°
55.	*Sesamum indicum* Linn.	Til	Fabaceae	Seeds	C^+	C^-
56.	*Solanum nigrum* L.	Mukko	Solanaceae	Tender shoot and leaves	C^+	C°
57.	*Sorghum bicolor* (L.) Moench	(Jowar)	Poaceae	grains	C^+	C^+
58.	*Sonchus oleraceus* L.	Dodok	Asteraceae	Whole plant	C^+	C^+
59.	*Tamarindus indica* L.	Imli	Caesalpiniaceae	Fruit leaves	C^+	C^+
60.	*Trachyspermum ammi* L. Sprangue.	Ajwain	Apiaceae	Leaves and seeds	C^+	C^+
61.	*Trigonella carniculata* Linn.	Dandi Methi	Fabaceae	Leaves	C^+	C^+
62.	*Vigna aconitifoila* (Jacq.) Marechal	Moth	Fabaceae	Seeds	C^+	C^+
63.	*Vigna radiata* (L.) Wiliczek	Green Moong	Fabaceae	Seeds	C^+	C^+
64.	*Ziziphus mauritiana* Lamk.	Jungli Bor	Rhamnaceae	Fruit	C^+	C^+
65.	*Ziziphus nummularia* (Burum) W. and A.	Jhar Ber	Rhamnaceae	Fruit	C^+	C^+
66.	*Ziziphus xylopyrus* Willd.	Gat Bor	Rhammnaceae	Fruit	C^+	C^+
Total				C^+	62	38
				C^-	Nil	15
				C°	4	12

C^+ - Common in use, C^- - Frequency in low, C° - Occasionally

Bhand Deora (Ramgarh), Baran: The common species observed *Butea monosperma* (Lam.) Taub., *Diospyros melanoxylon* Roxb., *Madhuca indica* (Koen). Macbr. included *Carissa* spp. and *Balanites aegyptiaca* Linn. Few individuals of *Guazuma ulmifolia* Lam., *Feronia limonia* (L.), *Balanites aegyptiaca* (L.) *Lagerstroemia parviflora* Roxb. were also recorded.

Table 5(a): Wild edible plants of the Study Area

Type	No. of Plant Species	Genera	Family
Dicotyledons	40	46	16
Monocotyledons	26	8	4
Total	66	54	20

Table 5(b): Habit wise distribution of wild edible plants of the Study Area

Habit wise wild edible plant of Study Area							
Study Area	**Plant Habit**						
	Trees	**Shrubs**	**Herbs**	**Grasses**	**Climbers**	**Geophyte**	**Total**
Baran & Jhalawar	23	5	26	4	2	6	66
	35%	7%	39%	6%	3%	9%	

Table 5(c): Comparative status of consumption of wild edible plants in Baran and Jhalawar

Comparative Status	Baran	Jhalawar
High consumption	62	38
Frequency is low	0	15
Occasionally	4	13
Total	66	66

Kotra Mataji (Shahbad Range), Baran: The common species of occurrence included *Anogeissus pendula* Edgew., *Holoptelea intergifolia* (Roxb.)., *Lannea coromandelica* (Houtt.), *Buchnania lanzan* Spreng., *Sterculia urens* Roxb. and *Diospyros melanoxylon* Roxb.. Very few individuals of *Madhuca indica* (Koen)., *Feronia limonia* (Linn.), and *Balanites aegyptiaca* (L.) *Lagerstroemia parviflora* Roxb. were also observed. Pure patch of *Butea monosperma* (Lam.)

Taub. including *Carissa* spp. and *Balanites aegyptiaca* (Linn.) were observed. *Madhuca indica* (Koen). Macbr. *Sterculia urens* Roxb. were found in rarity for this site.

Table 6: Wild Fodder Plant of the Study area

S. No.	Botanical Name	Local Name	Family	Plant Part
1	*Acacia leucophloea* (Roxb.) Willd.	Karir	Mimosaceae	Seeds
2	*Acacia nilotica* (L.) Willd. Ex del.	Babul	Mimosaceae	Seeds
3	*Apluda mutica* L.	Bhango	Poaceae	Hay
4	*Arachis hypogaea* L.	Groundnut	Fabaceae	Hay,Oil Cakes
5	*Avena sativa* L.	Oat	Poaceae	Straw
6	*Brachiaria ramose* (L.) Stapf.	Sama	Poaceae	Grains
7	*Brassica camperstris* L.	Sarson	Brassicaceae	Oil Cakes
8	*Bridelia retusa* L. Spreng.	Aggniya	Euphorbiaceae	Leaves
9	*Cannabis sativa* L.	Ganja	Cannabinaceae	Leaves
10	*Celastrus paniculatus* Willd.	Malkangani	Celastraceae	Leaves
11	*Chloris virgata* Sw.	Feather finger grass	Poaceae	Hay
12	*Chenopodium album* L.	Bathua	Chenopodiaceae	Whole plant
13	*Cicer ariehtinum* L.,	Chana	Fabaceae	Straw, hay of Whole plant
14	*Cucumis callosus* Rottl.	Kachri	Cucurbitaceae	Hay, Straw
15	*Crotalaria juncea* L.	Sanbija	Fabaceae	Hay, Straw of Leaves
16	*Cynodon dactylon* L. Pers.	Dhub	Poaceae	Hay and Straw
17	*Dichanthium annulatum* (F.) Sk.	Palvan	Poaceae	Oil Cakes
18	*Digitaria ciliaris* Retz.	Finger grass	Poaceae	Hay and Straw
19	*Echinochloa colonum* L.	Sawan	Poaceae	Hay and Straw
20	*Echniops echinatus* Roxb.	Oont Katalo	Asteraceae	Seeds
21	*Eleusine indica* (L.) Gaerth.	Chitki	Poaceae	Hay and Straw
22	*Eragrostis tenella* (L.) P. Beauv.	Bhurbhusi	Poaceae	Hay, Straw
23	*Flacourtia indica* (Burm.f.) Merrill	Kankairo	Flacourtiaceae	Leaves
24	*Foeniculum vulgar* Mills.	Saunf	Apiaceae	Hay, Straw
25	*Gossypiyum barbadense* L.	Kapas	Malvaceae	Seeds,Oil Cakes
26	*Heteropogon contortus* (L.) P. Beauv	Suva ghass	Poaceae	Hay, Straw
27	*Hordeum vulgare* L.	Barley	Poaceae	Hay, Straw
28	*Indigofera cordifolia* Heyne ex Roth	Bekar	Fabaceae	Seeds
29	*Indigofera oblongifolia* Forsk.	Khuaro	Fabaceae	Seeds
30	*Lathyrus sativus* L.	Jangli matar	Fabaceae	Hay and Straw
31	*Linum usitatissimum* L.	Ulsi	Linaceae	Hay, Straw, Oil Cakes
32	*Medicago sativa* L.	Luccerne	Fabaceae	Hay, Straw
33	*Moringa oleifera* Lamk.	Sanjan	Moringaceae	Leaves
34	*Nicotiana tabaccum* L.	Tambakhu	Solanaceae	Leaves
35	*Oryza sativa* L.	Paddy	Poaceae	Straw
36	*Panicum miliaceum* L.	(Common millet),	Poaceae	Hay, Straw
37	*Panicum miliare auct non* Lam.	(Little millet)	Poaceae	Hay, Straw
38	*Papaver somniferum* L.	Apheem	Papaveraceae	Leaves,Seeds
39	*Pennisetum americanum* (L.)	Bajra	Poeaceae	Hay, Straw
40	*Pennisetum purpureum.* K.shum	Deshi Bajra	Poeaceae	Hay, Straw
41	*Phalaris minor* Retz. Obs.	Guli danda	Poaceae	Hay and Straw
42	*Pisum sativum* var. *arvense* L.	Pea	Fabaceae	Straw
43	*Prosopis cineraria* L. Druce	Khejra	Mimosaceae	Leaves
44	*Rhus mysurensis* G. Don.	Darsan	Anacardiaceae	Leaves
45	*Saccharum officinarum* L.	Sugar-cane	Poaceae	Hay
46	*Sesamum indicum* L.	Til	Pedaliaceae	Oil Cakes
47	*Setaria glauca* L.	Bandra	Poaceae	Hay and Straw
48	*Triticum aestivum* L.	Gehu	Poaceae	Straw
49	*Vicia faba* L.	Bean	Fabaceae	Straw
50	*Vicia hirsute* L. S. F.	Manama	Fabaceae	Hay and Straw
51	*Vigna sinensis* L. Savi ex Hassk.	Cow-pea	Fabaceae	Hay
52	*Zey mays* L.	Makka	Poaceae	Hay, Straw
53	*Zizipus mauritiana* Lamk.	Bor	Rhamnaceae	Leaves
54	*Zizipus nummularia* (Burum)W. and A.	Jhar-bor	Rhamnaceae	Leaves

Table 6(a): Fodder plant species of Study Area

Type	No. of Plant Species	Genera	Family
Dicotyledons	34	30	12
Monocotyledons	20	20	4
Total	54	50	16

Nahar garh fort Kishanganj (Baran), Baran: Mixed deciduous vegetation of *Anogeissus pendula* Edgew. type appeared to be dominant. A natural patch of Teak with shrubs and under shrubs was also recorded in this area. *Acacia catechu* (L.f.) Willd., *Acacia nilotica*, (L.) Willd. Ex. del., *Acacia leucopholea* (Roxb.) Willd., *Balanites aeyptiaca*,(L.),

Butea monosperma (Lam.) Taub. and *Diospyros melanoxylon* Roxb., *Guazuma ulmifolia* Lam., *Balanites aeyptiaca* (L.) were frequent in the forest.

Table 7: Family wise richness and respective percentage of Medicinal Plant Species

S. No.	Family	No of Species	% Percentage
1	Poaceae	21	8.54
2	Fabaceae	18	7.32
3	Euphorblaceae	11	4.47
4	Asclepladaceae	10	4.07
5	Caesalpiniaceae	10	4.07
6	Cyperaceae	9	3.66
7	Liliaceae	9	3.66
8	Mimosaceae	8	3.25
9	Asteraceae	6	2.44
10	Malvaceae	6	2.44
11	Combretaceae	5	2.03
12	Convolvulaceae	5	2.03
13	Cucurbitaceae	5	2.03
14	Acanthaceae	4	1.63
15	Solanaceae	4	1.63
16	Verbenaceae	4	1.63
17	Amaranthaceae	3	1.22
18	Amaryllidaceae	3	1.22
19	Anacardiaceae	3	1.22
20	Apiaceae	3	1.22
21	Apocynaceae	3	1.22
22	Capparaceae	3	1.22
23	Dioscoreaceae	3	1.22
24	Lamiaceae	3	1.22
25	Menispermaceae	3	1.22
26	Moraceae	3	1.22
27	Oxalidaceae	3	1.22
28	Rutaceae	3	1.22
29	Aracaeae	2	0.81
30	Araceae	2	0.81
31	Burseraceae	2	0.81
32	Celastraceae	2	0.81
33	Ehretiaceae	2	0.81
34	Meliaceae	2	0.81
35	Musaceae	2	0.81
36	Myrtaceae	2	0.81
37	Nyctaginaceae	2	0.81
38	Oleaceae	2	0.81
39	Pedaliaceae	2	0.81
40	Rhamnaceae	2	0.81
41	Rubiaceae	2	0.81
42	Salvadoraceae	2	0.81
43	Sapindaceae	2	0.81
44	Sapotaceae	2	0.81
45	Scrophulariaceae	2	0.81
46	Sterculiaceae	2	0.81
47	Tiliaceae	2	0.81

S. No.	Family	No of Species	% Percentage
48	Zingiberaceae	2	0.81
49	Agavaceae	1	0.41
50	Aizoaceae	1	0.41
51	Alangiaceae	1	0.41
52	Annonaceae	1	0.41
53	Balanitaceae	1	0.41
54	Bignoniaceae	1	0.41
55	Bombacaceae	1	0.41
56	Boraginaceae	1	0.41
57	Cactaceae	1	0.41
58	Cannabinaceae	1	0.41
59	Chenopodiaceae	1	0.41
60	Cleomaceae	1	0.41
61	Costaceae	1	0.41
62	Ebenaceae	1	0.41
63	Flacourtiaceae	1	0.41
64	Gentiaceae	1	0.41
65	Hypoxidaceae	1	0.41
66	Lythraceae	1	0.41
67	Manispermaceae	1	0.41
68	Menyanthaceae	1	0.41
69	Moringaceae	1	0.41
70	Mymphaeaceae	1	0.41
71	Pandanaceae	1	0.41
72	Papaveraceae	1	0.41
73	Passifloraceae	1	0.41
74	Periplocaceae	1	0.41
75	Plantaginaceae	1	0.41
76	Plumbaginaceae	1	0.41
77	Polygonaceae	1	0.41
78	Pontederiaceae	1	0.41
79	Portulacaceae	1	0.41
80	Ulmaceae	1	0.41
81	Vitaceae	1	0.41
82	Vomicaceae	1	0.41
83	Zygophyllaceae	1	0.41

Table 7(a): Medicinal plant species of the Study Area

Type	No. of Plant Species	Genera	Family
Dicotyledons	202	175	73
Monocotyledons	45	38	6
Total	247	213	79

Table 7(b): Habit Wise Distribution of Medicinal Plant Species of the Study Area

Plant Habit							
Study area	**Tree**	**Shrub**	**Herb**	**Grasse**	**Climber**	**Geophyte**	**No. of medicinal plant**
Baran and Jhalawar	61	24	92	38	12	20	247
Percentage	25%	10%	37%	15%	5%	8%	

Jag devpura - Kishan Gunj, Baran: Common tree species were *Acacia leucophloea* (Roxb.) Willd., *Acacia catechu* (L.f.) Willd., *Anogeissus pendula* Edgew., *Azadirachta indica* A Juss., *Zizyphus mauritiana* (Burum) W. and A.. Few individual of *Madhuca indica* (Koen)., *Holoptelea intigrifolia* (Roxb.) Planch., *Ehretia laevis*. Abundance of *Opuntia* spp., *Lantana camara* L. were recorded.

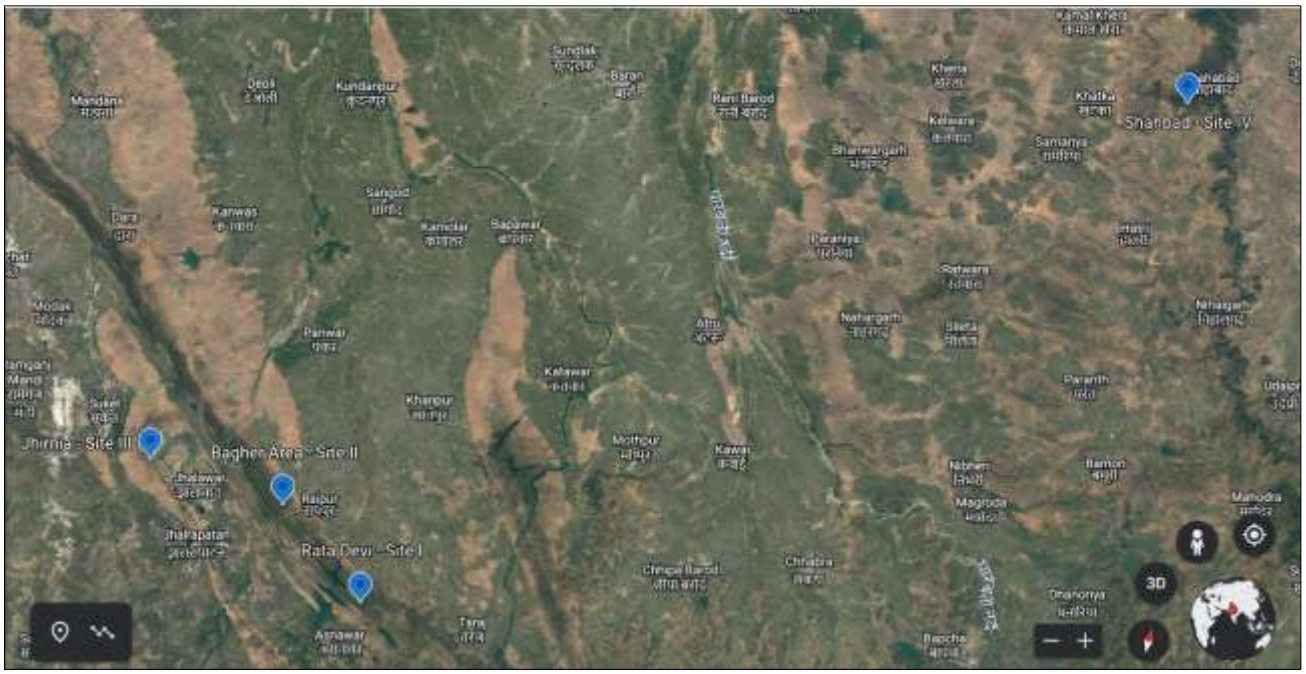

Fig 1: Location Map of the Study Sites (Blue Marks)

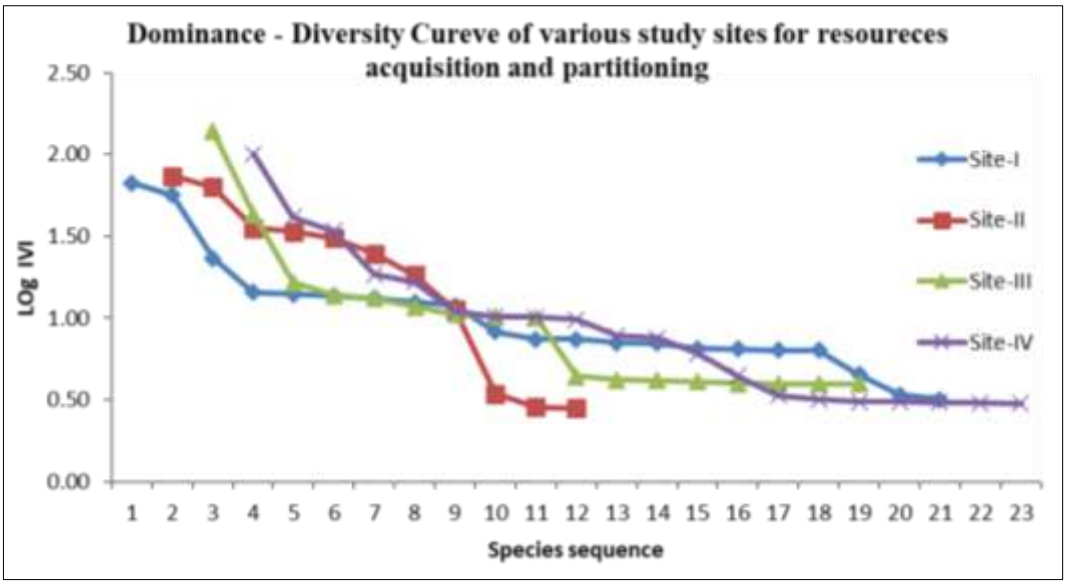

Fig 2: Dominance diversity (DD) Curve of Study sites

Jhora Tara- Kishan Gunj, Baran: Pure patches of *Tectona grandis* L.F. were found naturally colonizing in this area. Common tree species were *Acacia leucophloea*(Roxb.) Willd., *Acacia catechu* (L.f.) Willd., *Azadirachta indica* A Juss., *Anogeissus pendula* Edgew., and *Zizyphus mauritiana* (Burum) W., *Balanites aegyptiaca* Delile, Few individuals of *Annona squamosa* L., *Zizyphus xylopyrus* Willd., *Grewia optiva*, *Santalum album* L., *Mitragyna parvifolia* (Roxb.) Korth, *Carissa carandas* L. species were also seen. *Annona squamosa* L., was found rare species for this site area**.**

Ethnobotanical Aspects

Baran and Jhalawar districts of Hadoti region (Rajasthan) are rich in biodiversity. The geographical feature ismainly formed by the Aravali range having variability in the climatic, edaphic and topographic features along with widest variety of biomass. Several nomadic tribal which included *Banjara*, *Sansi*, *Rebari*, *Kalbeliya*, *Gaduliya-Lohar* wander from place to place, play important role in transmitting traditional knowledge from region to region. Settled tribes mainly *Bhill*, *Meena*, *Sahariya* reside in villages and remote area. Their settlements were far away from urban areas. Many of them still live in the traditional style. The focus of ethnobotanical study was, how plants had been used, managed and perceived by these communities.

A number of plants used for various purposes were broadly categorized under eleven 11 heads, covering almost all ethnobotanical aspects, mainly medicinal plants, wild edibles and fodder, cosmetics, in making musical instrument, house hold items and house building materials and their values in social and religious ceremonies, non timber forest products (dyes, tannin, gums, resins, essential oils, sprit, and other related products). In this investigation, Tables 5 – 7 presented the list of the plant species used only for edible, fodder and medicinal purposes.

Result and Discussions

Dominance of the tree species was determined by the Importance Value Index (IVI). Vegetation analysis of the four sites stated two types of distribution patterns, the lognormal pattern for sites I, III and IV followed with broken stic pattern for site II. It is worth mentioning that site II was most disturbed site. The lognormal distribution pattern of the sites I, III and IV indicated the uniformity in available resource shared among the species. Ecological study revealed that rapid deforestation caused by *jhum* practices, over harvesting and exploitative trade of useful plants for their medicinal and other commercial values had significantly reduced the availability of these plant resources in the investigated area. Disturbing composition was relatively more in different mosaic forest areas mainly Nahar garh fort, Kotra Mataji (Kishanganj), Bhund Devera (Ramgarh), Jag devpura (Banghaola) Jhora Tara (Sindu kara) and Gagron Area (Jhalawar).

Shanon- Wiener Diversity Index (H): As the species diversity is the measure of species richness and relative abundance of the species as per site. In the present study maximum species diversity 2.62 was calculated in the Rata Devi (Site I) and minimum 2.02 is observed in the Site III (Jhirniya). It may be concluded that there was low difference (2.62 to 2.02) among species diversity due to the similar nature (types) of forests, i.e., tropical dry deciduous forest under the investigated area. Figure 2 represents the DD Curve.

Ethnobotanical Aspects: Total 66 wild edible plant species (20 families) and 54 fodder plant species (16 families) were used by the local communities. Out of them Dicots constituted 61% (40) plant species of 46 genera from 16 families and Monocots constituted 39% (26) plant species of 8 genera from 4 families. The family Leguminoceae had been reported higher richness with 10 plant species followed by Poaceae with 8 richness plant species. Habit-wise distribution of edible showed maximum herbaceous plants which constituted 39% (26 species) followed by tree 35% (23 species), geophytes 9% (6 species), shrubs 7% (5 species), grasses 6% (4 species) and climbers 3% (2 species).

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