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Status of Medicinal Plants Diversity and Distribution at Rehabilitated Yamuna and Chambal Ravine land Ecosystems in India

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A B S T R A C T

Ravine ecosystems are highly dynamic and completely deformatted terrain landscape. In these regions, Indigenous plant species are playing significant role in environmental rehabilitation because of their exultant survival and high adaptation to local conditions. Despite this, very little information's available about existence of medicinal plants on the typical ravine flora. The present study attempted to explore the diversity and distribution of medicinal plant flora in the Yamuna ravines of Agra (U.P) and Chambal ravines of Kota district (Rajasthan). An account of 63 species belongs to 37 families were observed in the rehabilitated ravine areas at Agra. The documented plants were categorized according to their life form viz., trees (34.92%), shrubs (26.98%), herbs (23.8%), climbers (11.15%) and grasses (3.18%) were found in the representative blocks. The present study reveals that the distributions of species were mainly belong to the families of Euphorbiaceae, Apocynaceae, Solanaceae and Caesalpiniaceae. At Chambal ravines, 106 species observed and it represents 54 families of plant kingdom with dominant families of Euphorbiaceae, Fabaceae, Asteraceae, Solanaceae and Amaranthaceae. Documented plants were categorized according to their life form viz., herbs (42.5%), trees (23.6%), shrubs (21.6%), climbers (10.4%) and grasses (2%) were found in the representative blocks. It directly indicates rich plant biodiversity of Chambal ravines over Yamuna ravines. The documented indigenous plant species naturally have high drought tolerance capacity and ability to grow under harsh environment. The maximum revival of native flora in these rehabilitated ravines through rehabilitation, protection and other soil conservation measures. Urgent attention towards documentation, conservation, sustainable utilization and awareness creation are needed to protect indigenous medicinal flora by appropriate *in-situ* and *ex-situ* conservation measures.

Introduction

Water is a critical element for reclamation of degraded lands for sustainable biomass production, ultimately leading to a better quality of life and environmental conditions. Degraded non arable lands cover vast tract in the country and are major source for

supplying fuel, fodder and timber and other minor products to the population. The productivity of these lands is poor. Ravine lands are one of highly degraded dry land ecosystem associated with several ecological and environmental constraints for vegetation growth due to vicarious climate, poor soil fertility, low soil moisture, extreme variation in temperature and heavy biotic pressure. There are about 3.97 million hectors of ravine lands in India. In Uttar Pradesh alone, 1.23 million hectare (14.5%) of land is under ravines which are found along the bank of river Yamuna and Chambal along with its tributaries. The severity of water erosion is found at the peak along the banks of Yamuna and Chambal Rivers in the districts of Agra, Etawah, Kanpur and Fetehpur etc., where terrain has completely deformed into ravines. The hot, semi arid ravenous tracts of the indo-Gangetic region posses very harsh climatic conditions like low and erratic rainfall and high summer temperature. This vast tract of existing ravine lands in northwestern part of India is possessing potential threat to nearby productive lands because of over exploitation and poor management. The ravines are extending at the rate of 8 to 9 m per annum with average soil loss of more than17 tons per ha per year. The ravine lands are subjected to various forms of natural as well as anthropogenic forms of land degradation. Vegetation in this region suffers from a variety of unfavorable condition such as nutrient deficiency, moisture stress and biotic interference. Therefore, there is an urgent need to detain these problems and protect both the arable and non-arable land from further degradation. Situation specific cost-effective viable technologies and dissemination of suitable technologies for reclamation and productive utilization of ravine lands in India are highly essential for arresting ravine extension, reclamation of ravine lands and improving production from the rain fed production systems of ravenous regions. Through rehabilitation and protection measures are control of erosion, reduce run-off (check dams, spill ways), improve *in-situ* soil-moisture conservation (trenches), arrest land degradation by planting trees and grasses and conserve natural resources.

Already, India has been traditionally known as a treasure house of high value medicinal plants used in both the local folk health traditions and in the Indian Systems of Medicine. The continuous illicit exploitation of several medicinal plant species from the wild and substantial loss of their habitats have resulted in population decline of many high value medicinal plant species over the years from different parts of India. There are many other potential causes of rarity in medicinal plant species, such as habitat specificity, narrow range of distribution, land use disturbances, introduction of non-natives, habitat alteration, climatic changes, heavy livestock grazing, explosion of human population, fragmentation and degradation of population, population bottleneck, and genetic drift. Additionally, natural enemies (i.e., pathogens, herbivores, and seed predators) could substantially limit the abundance of rare medicinal plant species in any given area (Bevill *et al*., 1999) An estimated 4,000 to 10,000 species of medicinal plants face potential local, national, regional or global extinction, with subsequent serious consequences for livelihoods, economies and health care systems (Dhyani and Kala, 2005). The medicinal plant wealth of Indian forests is declining constantly over the years (Hall and Bawa, 1993). However, even as concerns about fast depletion of this resource are being voiced, the degradation continues at even faster pace. Comprehensive documentation of the diversity of medicinal plants is not available and their conservation status is not known. According to an estimate, the quantity of export of Ayurvedic products

produced in India has tripled between last two financial years. The demand of Indian medicinal plants has increased over the years in the international market.

The World Health Organization (WHO) has estimated the demand for medicinal plants is approximately US $14 billion per year (Sharma, 2004). The demand for medicinal plant-based raw materials is growing at the rate of 15 to 25% annually, and according to an estimate of WHO; the demand for medicinal plants is likely to increase more than US $5 trillion in 2050. In India, the medicinal plant-related trade is estimated to be approximately US $1 billion per year (Joshi *et al.*, 2004).

Ravine ecosystems are highly dynamic and completely deformatted terrain landscape. In these regions, Indigenous plant species are playing significant role in environmental rehabilitation because of their exultant survival and high adaptation to local conditions. To meet out the demand of medicinal plants at international market we should use degraded lands of the country, this practice will help to save the crop land from overburden and different researches explain that the cultivation of various medicinal plants helps to reclaim the degraded lands. Despite this importance, very little information exits about medicinal plants on ravine flora in particular. Publications on the traditional knowledge of use of indigenous resources by local people are meager from this region as well as there is a lack information about diversity and distribution medicinal plants in the present study area. Keeping this view, a study has conducted to document the indigenous medicinal plant diversity, use, and management of these plants in the rehabilitated Yamuna ravines (Agra district of Uttar Pradesh) and Chambal Ravines (Kota district of Rajasthan).

Materials and Methods

Yamuna Ravine at Agra District – Uttar Pradesh, India

An intensive survey was conducted at 85 ha of ravine land area which it is located inside our ICAR-IISWC, Research farm at Chhalesar in Agra district and it is core part of typical Yamuna ravine. The study site is located at 23^0 52' to 31^0 28' N latitudes and 77^0 06' to 84^0 37' E longitudes and 169 m above mean sea level with high terrain undulated topography. It has humid sub-tropical climate with high variation between summer and winter temperatures. Summers are long, from early April till October, with the monsoon season in between. Cold waves from the Himalayan region dip temperatures across the city in the winter from December to February. The average temperature is 32°C - 47°C in summer; 10°C-15°C in the winter. The average annual rainfall is 550 mm. Fog is common in winter while hot dry winds called loo blow in summer. Soils are generally old alluvial deposits of the middle Gangetic plain.

Chambal Ravine at Kota District – Rajasthan, India

The study area is located in Kota district of south-eastern Rajasthan (Latitude - 25°13′29″ to 25°14′18″ N; Longitude - 75°52′18″ to 75°52′44″ E). Climate of this region is hot semi-arid with the mean annual rainfall of 748 mm. The study was conducted during 2015 at research farm of ICAR-IISWC, Research Centre, Kota. The research farm comprises of two distinct landscapes, the agricultural table lands (34 ha) and ravenous lands (34 ha) adjoining Chambal river. Soils of the research farm are classified under Kota series. These soils are deep to very deep soils occurring on flat gently sloping land with less than 2% slope.

The CaCO3 layer generally occurs below 100 cm. Soils are dominantly fine textured (>35% clay) belonging to hyperthermic family of *Typic chromusterts*. Precipitation from June and September is nearly 80% of the mean annual rainfall (516 mm) and remaining 20% falls in winter season. Overall climate is moderate. Frost is common during winter season. Mean of minimum monthly temperature ranges from 4.7°C (Jan) to 24.2°C (Jul) and mean of maximum monthly temperature ranged from 21.2°C (Jan) to 33.10°C (Jul) in the year 2015. Kota district is situated in South of Rajasthan at latitude 30° 39.125' N and longitude 78° 31.156' E. and is located along the eastern bank of the Chambal river, covering an area of approximately 521324 hectare (12,436 km²) and that is 3.63 per cent of the Rajasthan State. Out of which, area of forests is 125379 hectare, non-agriculture land is 60021 hectare and cultivable barren land is 23011 hectare. The Chambal River is natural boundary of Kota district that separates Kota from neighboring Sawai Madhopur, Tonk and Bundi districts by forming the natural district boundary. The repeated field surveys were conducted in the randomly selected sample plots (10 m X 10 m) to document the floral diversity. Observations were made on the morphological features and habitats of each medicinal plant species in the field. A transect survey and personal observation was conducted to know and understand the ecological indication and distribution of medicinal plants diversity in protected and rehabilitated areas of Yamuna ravines of Agra region. All the information about the sampled plants species were categorized into herbs, shrubs and trees. Ethnomedicinal uses of the plants were collected with help of well experienced traditional healer at two different sites and information were cross checked by relevant literature available in the library of the centre as well as online resources. Tables 1 and 2 consist of enlisted medicinal plants and their uses in the following sequences: common name, botanical name, family, habit, economic part and medicinal uses.

Results and Discussion

This paper enlisted 63 medicinal plants belong to 37 families, which are used as a folk medicine for treatment various ailments or disease to humans beings and domestic animals by local and common people in this region. The identified medicinal plants were comprised of mainly trees, shrubs, climbers and herbs. The mainly trees accounts 34.92% followed by shrubs (26.98%), herbs (23.81%) and climbers (11.15%) in the whole study site (Figs. 1 and 2). The present study reveals that the majority of species were belonging to the families of Euphorbiaceae, Apocynaceae, Solanaceae and Cesalpinaceae. The identified /documented indigenous plant species have high drought tolerant capacity and ability to grow under harsh environment. Sustainable management of rehabilitated Yamuna ravines with proper protection definitely enhances the species richness and conservation biodiversity through vegetation cover induced microclimates modification. But rehabilitated ravine lands have considerable abundant diversity of medicinal plants compare unprotected ravine areas. The documented medicinal plants were categorized according to habit wise and their distribution viz., grasses (3.18%) herbs (23.8 %), climbers (11.15%), shrubs (26.98 %) and trees (34.92 %) were found in the sample plots (Fig. 2). The valley beds of ravines are occupied dense vegetative cover compared to slope and upper part of ravine lands. This may be due to more availability of soil moisture in the valley beds during monsoon and post monsoon seasons. Archana *et al*., (2007) documented and

reported that a rich diversity medicinal plant resources and their folk uses from Banaras Hindu University in varanasi, Uttar Pradesh. Other studies conducted in Chandauli district of Uttar Pradesh showed similar kind trend of emphasizing medicinal diversity and ethnomedicinal uses (Singh and Singh, 2009).

The plants part used for medicines is differed from plant to plant. The mode/ formulation of intake includes plants applied as a paste, powder, decoction, extracts and juices and other applied as oil, smoke and chew. From this study at Yamuna ravine areas, leaf is most frequently used plant part which accounts 28 % followed by root (20 %), Fruit (14%), Seed (11%), whole plant (9%), bark (8 %), flower (6%) and Gum (4%) (Fig. 3). From this study at Chambal ravine areas, leaf is most frequently used plant part which accounts 38 % followed by root (23 %), Fruit (16%), Seed (16%), whole plant (9%), bark (8 %), Latex (4%) and Gum (3%) (Fig. 3).

The ethno-medical uses and information were also collected from traditional healers and local dwellers (elder people) of sample region. Crushing, homogenizing with ingredients and chewing were the commonly used forms of herbal preparation. Drinking, smoke inhalation and strap and hold on were the most frequently used methods of application. During the field visit the survey of data collection was made in different places i.e. waste lands, barren lands play ground, road side and agricultural fields. The current over-exploitation and soil compaction due to climatic and biotic factors seems to limit the ability of some species to propagate. There is no considerable diversity of medicinal plants in unprotected area and other open areas during rainy season also due to heavy biotic pressure viz., grazing and felling and it is a considered as a serious problem in ravine lands. This clearly shows the diversity and distribution pattern medicinal plants in rehabilitated areas through effective protection efforts. Majority of the identified medicinal plants play ecological roles by protecting soils from erosion through reducing erosive forces of the rain drop and through reducing velocity of run-off water. Some of these plants have also cultural and economic values, means they are used to make stool (bench), bed, milk container, butter container and other culturally used home furniture. In addition large trees like *Ficus spp and* Neem have social and economic value, used as shed during community meeting, as fodder for animals (especially for goats and camels), for house and fence constructions. Most trees and shrubs of those medicinal plants are commonly used for fuel wood. Most of the medicinal plants had no market value. This could be explained by various reasons. It was observed that few medicinal plants such as *Aloe vera*, Ber, Neem and Bael, had market value. However their market price was not still attractive. They were supplied to the market in different forms, but the most common parts sold in the market were leaves, roots, seeds and fruits. The present study revealed that the rehabilitated ravine lands have rich diversity of medicinal plants as compared to outside unprotected ravines. Therefore, there is immediate need to conserve these important plant species for sustainable uses for the future. Efforts should be taken to start sustainable cultivation and harvesting programs in the ravine regions.

This study reveals that the majority of species were belonging to the families of Euphorbiaceae, Apocynaceae, Solanaceae and Cesalpinaceae.

Table.1 List of medicinal plants distributed in the rehabilitated Yamuna Ravines at Agra, Uttar Pradesh

Sl. No	Botanical Name	Local Name	Family	Habit	Part used & formulation	Medicinal use
1.	*Abutilan indicum*	Kanghil	Malvaceae	Herb	Leaf extract	Itching, wound healing
2.	*Acacia catechu*	Khair	Fabaceae	Tree	Bark & root decoction	Arthritis
3.	*Acacia nilotica*	Babool	Mimosaceae	Tree	Bark, gum	Burning sensation
4.	*Acalypa indica*	Chauriya	Euphorbiaceae	Herb	Leaf paste	Wound healing
5.	*Achryranthes aspera*	Chirchita	Amaranthaceae	Shrub	Whole plant	Tuberculosis
6.	*Adhatoda vassica*	Adathoda	Acanthaceae	Shrub	Leaf paste	Piles
7.	*Aegle marmelos*	Beal	Rutaceae	Tree	Fruit and leaves	Sunstroke, dysentery
8.	*Aerva lanata*	Geduakichal	Amarnthaceae	Herb	Root paste	Headache
9.	*Ailanthus excelsa*	Anjan	Simaroubaceae	Tree	Leaf & bark paste	Joint pain & leprosy
10.	*Albizia lebbeck*	Siris	Fabaceae	Tree	Seed paste	Snake bite
11.	*Aloe vera*	Gwar patha	Liliaceae	Herb	Dried leaf decoction	Easy and normal delivery
12.	*Andrograpis paniculata*	Kalmegh	Acanthaceae	Herb	Whole plant	Snake bite
13.	*Argemone mexicana*	Prickly poppy	Papaveraceae	Herb	Root paste	Skin disease
14.	*Asparagus racemosus*	Satawar	Liliaceae	Climber	Dried roots	Increase lactation (cattle)
15.	*Azadirachta indica*	Neem	Meliaceae	Tree	All parts paste	Skin disease & blood purifier
16.	*Balanites agyaptica*	Hingot	Balanitaceae	Tree	Fruit extract	Fever, deworming
17.	*Bauhinia varigata*	Kachnar	Caesalpiniaceae	Tree	Root dection	Reducing corpulence
18.	*Butea monosperma*	Palash	Papilionaceae	Tree	root & bark decoction	Dysentery control
19.	*Calotropis procera*	Madar	Asclepiadaceae	Shrub	Root paste, latex	Snake bite, toothache
20.	*Capparis decidua*	Karil	Cappariaceae	Shrub	Leaves, fruits	Dysentery
21.	*Carrisa carandus*	Karonda	Cappariaceae	Shrub	fruit	Dysentery and diarrhoria
22.	*Cassia fistula*	Amaltas	Caesalpiniaceae	Tree	Fruits and seeds	Dysentery(cattle)
23.	*Cassia tora*	Chakora	Fabaceae	Herb	Root paste	Deworming in children
24.	*Catharanthus roseus*	Sadabahar	Apocynaceae	Shrub	seed and leaf extract	Honey bee bite
25.	*Clitoria ternatea*	Aparajita	Papilionaceae	Climber	Root powder	Chest pain and insect bite
26.	*Commiphora mukul*	Guggal	Burseraceae	Herb	Gum decoction	Scorpion bite
27.	*Cordial myxa*	Lasoda	Boraginaceae	Tree	Bark powder	Cure piles
28.	*Cynodan dactylon*	Doob grass	Graminae	Grass	Whole plant	Menstrual disorders and fatness reduction
29.	*Datura metal*	Kali Dhatura	Solanaceae	Herb	Leaf paste	Cure pimples
30.	*Dendrocalamus*	Bans	Poaceae	Tree	Leaves, seeds, bark	Wound healing, stop

	strictus				juice	bleeding
31.	*Emblica officinalis*	Aonla	Euphorbiaceae	Tree	Fruits	vomiting
32.	*Euphorbia prostrata*	Dudhi	Euphorbiaceae	Climber	Root powder	Milk secretion
33.	*Grewia asiatica*	Phalsa	Tiliaceae	Shrub	Root paste	Back pain
34.	*Hemidesmus indicus*	Gurmar	Asclepediaceae	climber	Root paste	Blood purifier
35.	*Ipomea cornea*	Ipomea	Convolvulaceae	climber	Root	Increase Lactation
36.	*Jatropha curcas*	Ratanjot	Euphorbiaceae	Shrub	Seeds, oil and latex	Mouth ulcer
37.	*Lowsonia inermis*	Mehandi	Lytheraceae	Tree	Leaves, fruit paste	Body cooling, hair dyeing
38.	*Madhuca longifilia*	Mahua	Sapotaceae	Tree	Leaves, flower and seeds	Stomach pain
39.	*Melia azadirach*	Bakayan	Meliaceae	Tree	Leaf & flower paste	Pregnancy weakness
40.	*Mimosa pudica*	Laajivanthi	Mimosaceae	Herb	Leaf paste	Ear pain & headache
41.	*Moringa oleifera*	Sehjan	Moringaceae	Tree	Leaf, fruit, gum	Vomiting & constipation
42.	*Morus alba*	Shahtut	Moraceae	Tree	Root decoction	Dysentery
43.	*Nerium indicum*	Kaner	Apocynaceae	Shrub	Root paste	Skin disease
44.	*Ocimum grantissimum*	Van tulsi	Lamiaceae	Herb	Seed paste	Fever, dysentery
45.	*Ocimum sanctum*	Tulsi	Lamiaceae	Herb	Seed paste	Eye burning, dysentery
46.	*Phyllanthus niruri*	Bhui anola	Euphorbiaceae	Shrub	Whole plant extract	Jaundice
47.	*Pongamia pinnta*	Karanj	Leguminosae	Tree	Seeds oil and root bark paste	Mouth ulcer
48.	*Punica grantum*	Anar	Punicaceae	Shrub	Flower & fruit paste	Toothache, dysentery
49.	*Putranjiva roxburghii*	Putranjiva	Euphorbiaceae	Tree	Leaf extract	Fever, burning sensation
50.	*Ricinus communis*	Caster	Euphorbiaceae	Shrub	Root powder	Pregnancy weakness
51.	*Salmanelia malabarica*	Semal	Bombacaceae	Tree	Flower paste	For easy delivery
52.	*Sida cordifolia*	Kharenti	Malvaceae	Shrub	Whole herb	Rheumatism
53.	*Solanum nigrum*	Makoy	Solanaceae	Herb	Root decoction	Body pain externally
54.	*Syzygium cumini*	Jamun	Myrtaceae	Tree	Fruits and leaves	Diabetics
55.	*Tamarindus indica*	Imlli	Caesalpiiaceae	Tree	Leaf extract	Constipation blood purifier
56.	*Teprosia purpurea*	Sapunkha	Papilionaceae	Herb	Whole plant powder	Stomach problem
57.	*Terminalia arjun*	Arjun	Combretaceae	Tree	Leaf paste	Urinary infection
58.	*Tinospora cordifolia*	Giloy	Menispermaceae	Climber	Fruit paste	Blood purifier
59.	*Tridex procumbens*	Nahtoota	Asteraceae	Herb	Leaf extract	Rheumatism, ear pain
60.	*Vitex negundo*	Nirgundi	Verbanaceae	Shrub	Twig & Leaf paste	Toothache, cold & cough
61.	*Withania somnifera*	Aswagandh	Solanaceae	Shrub	Leaf powder	Reduce Fatness
62.	*Wrightia tictoria*	Kudruku	Apocyanaceae	Tree	Bark extract	Piles problem
63.	*Zizyphus jujube*	Ber	Rhamnaceae	Shrub	Fruit pulp	Health-tonic, constipation

Table.2 List of medicinal plants distributed in the rehabilitated Chambal Ravines at Kota district, Rajasthan, India

Sl. No	Botanical Name	Local Name	Family	Habit	Part used & formulation	Medicinal use
1.	*Abrus precatorius*	Chirmi	Fabaceae	Climber	Seed extract	Abortifacient and sedative
2.	*Abutilan indicum*	Kanghil	Malvaceae	Herb	Leaf extract	Itching, wound healing
3.	*Acacia catechu*	Khair	Fabaceae	Tree	Bark & Root	Arthritis
4.	*Acacia nilotica*	Babool	Mimosaceae	Tree	Bark, gum	Burning sensation
5.	*Acalypa indica*	Chauriya	Euphorbiaceae	Herb	Leaf paste	Wound healing
6.	*Achryranthes aspera*	Chirchita	Amaranthaceae	Shrub	Whole plant	Tuberculosis
7.	*Adhatoda zeylanica*	Ardusa	Acanthaceae	Shrub	Leaf extract	cough, cold, headache
8.	*Aegle marmelos*	Beal	Rutaceae	Tree	Fruit and leaves	Sunstroke, dysentery
9.	*Aerva lanata*	Kali-Bui	Amaranthaceae	Herb	Root extract	Pneumonia and typhoid
10.	*Ailanthus excelsa*	Anjan	Simaroubaceae	Tree	Leaf & bark paste	Joint pain & leprosy
11.	*Albizia lebbeck*	Siris	Fabaceae	Tree	Seed paste	Snake bite
12.	*Aloe vera*	Gwar patha	Liliaceae	Herb	Dried leaf	Easy and normal delivery
13.	*Amaranthus caudatus*	Chauli	Amaranthaceae	Herb	Green leafs	Constipation
14.	*Amaranthus blitoides*	Pigweed	Amaranthaceae	Herb	Green leafs	Vegetable for children
15.	*Ammannia baccifera*	Jal bhangro	Lythraceae	Herb	Leaf paste	Skin itching
16.	*Andrograpis paniculata*	Kalmegh	Acanthaceae	Herb	Whole plant	Snake bite
17.	*Argemone mexicana*	Prickly poppy	Papaveraceae	Herb	Root paste	Skin disease
18.	*Asparangus racemosus*	Satawari	Asparangaceae	Climber	Root powder	Peptic ulcers, Arthritis
19.	*Asphodelus tenuifolius*	Wild onion	Xanthorrhoeaceae	Herb	Leaf decoction	Kidney stone
20.	*Azadirachta indica*	Neem	Meliaceae	Tree	All parts paste	Skin disease & dewarming
21.	*Balanites agyaptica*	Hingot	Balanitaceae	Tree	Fruit extract	Fever, deworming
22.	*Bareria prionitis*	Bajrandanti	Acanthaceae	Shrub	Leaf decoction	Tooth ache and pyorrhea
23.	*Bauhinia varigata*	Kachnar	Caesalpiniaceae	Tree	Root	Reducing corpulence
24.	*Bergia suffruticosa*	Ankh-Phorniki	Elatinaceae	Herb	Plant paste	Cure broken bone
25.	*Boerhavia procumbens*	Santhi	Nyctaginaceae	Herb	Root paste	Cure scorpion sting
26.	*Butea monosperma*	Palash	Papilionaceae	Tree	Root & bark	Dysentery control
27.	*Calligonum polygonoides*	Phog	Polygonaceaee	Shrub	Plant extract	Typhoid, urinary problems
28.	*Calotropis procera*	Aakda	Asclepiadaceae	Shrub	Root paste, latex	Snake bite, toothache
29.	*Capparis decidua*	Karil	Cappariaceae	Shrub	Leaves & fruits	Dysentery
30.	*Carrisa carandus*	Karonda	Cappariaceae	Shrub	fruit	Dysentery and Diarrhea
31.	*Cassia fistula*	Amaltas	Caesalpiniaceae	Tree	Fruits and seeds	Dysentery (cattle)
32.	*Cassia tora*	Phunwad	Caesalpinaceae	Shrub	Leaf decoction	toothache Fever
33.	*Catharanthus roseus*	Sadabahar	Apocynaceae	Shrub	seed and leaf	Honey bee bite
34.	*Chenopodium album*	Chilva	Chenopodiaceae	Herb	Leafy vegetable	Leaf extract for worms
35.	*Citrullus colocynthis*	Gar-tumba	Cucurbitaceae	Climber	Roasted fruits	Digestive disorders (cattle)
36.	*Cleome gynandra*	Karalia	Cleomaceae	Herb	Green leafs	Skin diseases, earache

37.	*Cleome viscosa*	Singali	Cleomaceae	Herb	Seed powder	Cure bleeding piles
38.	*Clitoria ternatea*	Aparajita	Papilionaceae	Climber	Root powder	Chest pain and insect bite
39.	*Coculus hirsutus*	Bajar -bel	Menispermaceae	Climber	Leaf and root	Skin disease
40.	*Commiphora mukul*	Guggal	Burseraceae	Herb	Gum decoction	Scorpion bite
41.	*Corbichonia decumbens*	Patharchatti	Molluginaceae	Herb	Leaf juices	Treat gonorrhea
42.	*Cordial myxa*	Lasoda	Boraginaceae	Tree	Bark powder	Cure piles
43.	*Cynodan dactylon*	Doob grass	Graminae	Grass	Whole plant	Menstrual disorders
44.	*Datura innoxia*	Kali Dhatura	Solanaceae	Herb	Leaf paste	Cure pimples
45.	*Dendrocalamus strictus*	Bamboo	Poaceae	Tree	Leaves & bark	Stop bleeding
46.	*Dicoma tomentosa*	Choloharnach	Asteraceae	Herb	Root and branches	Cure pyorrhea
47.	*Emblica officinalis*	Aonla	Euphorbiaceae	Tree	Fruits	vomiting
48.	*Eucalyptus tereticornis*	Red gum	Myrtaceae	Tree	Leaf extract	Headache, body pain
49.	*Euphorbia hirsuta*	Dudhi	Euphorbiaceae	Herb	Root paste	Increase lactation
50.	*Euphorbia nerifolia*	Danda -thor	Euphorbiaceae	Shrub	Latex	Asthma, leprosy
51.	*Euphorbia prostrata*	Dudhi	Euphorbiaceae	Climber	Root powder	Milk secretion
52.	*Glinus lotoides*	Gandhi-buti	Molluginaceae	Herb	Plant juices	weakness and indigestion
53.	*Grewia asiatica*	Phalsa	Tiliaceae	Shrub	Root paste	Back pain
54.	*Hemidesmus indicus*	Gurmar	Asclepediaceae	Climber	Root paste	Blood purifier
55.	*Impatiens balasamina*	Timadia	Balsaminaceae	Herb	Leaf extract	Wounds and swelling
56.	*Ipomea cornea*	Ipomea	Convolvulaceae	Climber	Root	Increase Lactation
57.	*Jatropha curcas*	Ratanjot	Euphorbiaceae	Shrub	Seeds, oil and latex	Mouth ulcer
58.	*Lantana camera*	Lantana	Verbanaceae	Shrub	Leaf Decoction	Tetanus, Malaria
59.	*Leucas urticaefolia*	Darkan	Laminaceae	Herb	Leaf and flower	Cold and cough
60.	*Lowsonia inermis*	Mehandi	Lytheraceae	Tree	Leaves, fruit paste	Body cooling, hair dyeing
61.	*Madhuca longifilia*	Mahua	Sapotaceae	Tree	flower & fruit	Stomach pain
62.	*Martynia annua*	Bichtukando	Martynaceae	Shurb	Leaf paste	Treating rheumatism
63.	*Melia azadirach*	Bakayan	Meliaceae	Tree	Leaf & flower paste	Pregnancy weakness
64.	*Mimosa hamata*	Alai	Mimosaceae	Shrub	Seed powder	Cure male impotency
65.	*Mimosa pudica*	Laajivanthi	Mimosaceae	Herb	Leaf paste	Ear pain & headache
66.	*Mollugo cervianana*	Chirio ghas	Molluginaceae	Herb	leaf	Clean uterus
67.	*Momordia foetida*	khakoda	Cucurbitaceae	Climber	Leaf & fruit	Cure Malaria, Snakebite
68.	*Moringa oleifera*	Sehjan	Moringaceae	Tree	Leaf, fruit, gum	Vomiting & constipation
69.	*Medicago sativa*	Alfa-alfa	Fabaceae	Herb	Root decoction	Dysentery
70.	*Mucuna pruriens*	Kirmich	Fabaceae	Herb	Seed powder	Cure asthma
71.	*Nerium indicum*	Kaner	Apocynaceae	Shrub	Root paste	Skin disease
72.	*Ocimum americanum*	Bapchi	Laminaceae	Herb	Seed powder	Leucoderma and leprosy
73.	*Ocimum grantissimum*	Van tulsi	Lamiaceae	Herb	Seed paste	Fever, dysentery
74.	*Ocimum sanctum*	Tulsi	Lamiaceae	Herb	Seed paste	Malarial Fever
75.	*Oxalis corniculata*	Aaera	Oxalidaceae	Herb	Leaves	Piles, anemia
76.	*Pedalium murex*	Dakhni	Pedaliaceae	Herb	Plant extract	Health tonic
77.	*Pergularia daemia*	Milk weed	asclepiadaceae	Climber	leaves	Body pain
78.	*Phyllanthus niruri*	Bhui anola	Euphorbiaceae	Shrub	Whole plant	Jaundice

					extract	
79.	*Physalis angulata*	Cap Berry	solanaceae	Herb	Leaves	Hemorrhage
80.	*Physalis minima*	Chirpotan	solanaceae	Herb	fruits	Colic complaints, dropsy
81.	*Polygonum plebeium*	Lalbuti	Polygonaceae	Herb	Leaf extracts	Colic complaints, eczema
82.	*Pongamia pinnta*	Karanj	Leguminosae	Tree	Seeds & root paste	Mouth ulcer
83.	*Portulaca oleracea*	Lunkia	portulaceae	Herb	Leaf extracts	Scurvy, liver diseases
84.	*Punica grantum*	Anar	Punicaceae	Shrub	Flower & fruit	Toothache, dysentery
85.	*Ricicnus communis*	Castor	Euphorbiaceae	Shrub	Leaves	Eye diseases
86.	*Sida cordifolia*	Kharenti	Malvaceae	Shrub	Whole herb	Rheumatism
87.	*Sida ovata*	Desikharenti	Malvaceae	Herb	Seed powder	Cure Lumbago in winter
88.	*Solanum nigrum*	Makoy	Solanaceae	Herb	Root decoction	Body pain externally
89.	*Solnaum suranttense*	Pasarghatali	solanaceae	Herb	Leaf & fruits	Skin diseases, cures piles
90.	*Sonchus ankhali*	Ankhali	Asteraceae	Herb	Leaf extract	Cure live disease, cirrhosis
91.	*Sonchus asper*	Kalijibi	Asteraceae	Herb	Plant extract	Increasing Lactation
92.	*Sphaeranthus indicus*	Mundi	Asteraceae	Herb	Root powder	Cure male impotency
93.	*Syzygium cumini*	Jamun	Myrtaceae	Tree	Fruits and leaves	Diabetics
94.	*Tamarindus indica*	Imlli	Caesalpiiaceae	Tree	Leaf extract	Constipation blood purifier
95.	*Tecomella undulata*	Rohida	Bignonliaceae	Tree	Bark paste	Cure eczema and eruptions
96.	*Tephrosia purpurea*	Dhamaso	Fabaceae	Herb	Root powder	Snake bite, blood purifier
97.	*Terminalia arjun*	Arjun	Combretaceae	Tree	Leaf paste	Urinary infection
98.	*Tinospora cordifolia*	Giloy	Menispermacea e	Climber	Fruit paste	Blood purifier
99.	*Trianthema triquetra*	Lutanki	Aizoaceae	Herb	Plant paste	Cure rheumatism swellings
100.	*Tridex procumbens*	Nahtoota	Asteraceae	Herb	Leaf extract	Rheumatism, ear pain
101.	*Vitex negundo*	Sambhalu	Verbaceae	Shrub	Seed powder	Ladies menstrual problems
102.	*Waltheria americana*	Surli	Byttneriaceae	Tree	Root extract	Cure spermatorrhoea
103.	*Withania somnifera*	Aswagandh	Solanaceae	Shrub	Leaf powder	Reduce Fatness
104.	*Wrightia tictoria*	Kudruku	Apocyanaceae	Tree	Bark extract	Piles
105.	*Xanthium indicum*	Bichhu-butti	Asteraceae	Shrub	Fruit extract	Cure eczema and scabies
106.	*Zizyphus mauritiana*	Ber	Rhamnaceae	Tree	Fruit pulp	Constipation, dysentery

Fig.1 Map showing the two different ravine study sites

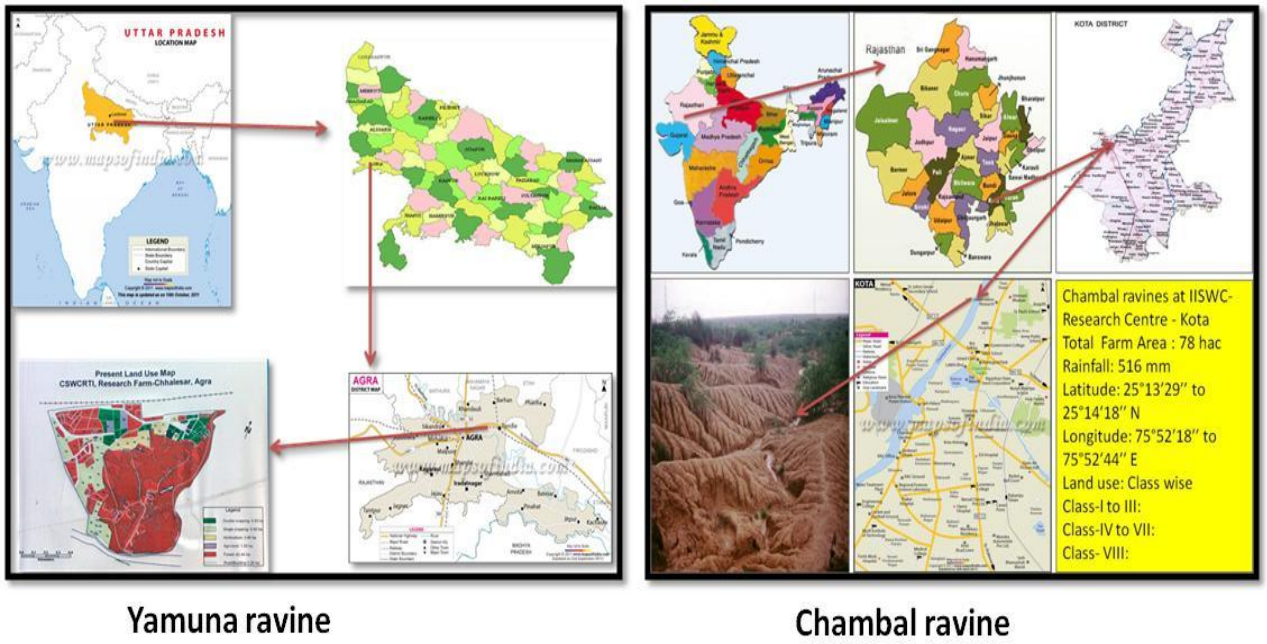


Fig.2 Habit wise distribution of medicinal plants

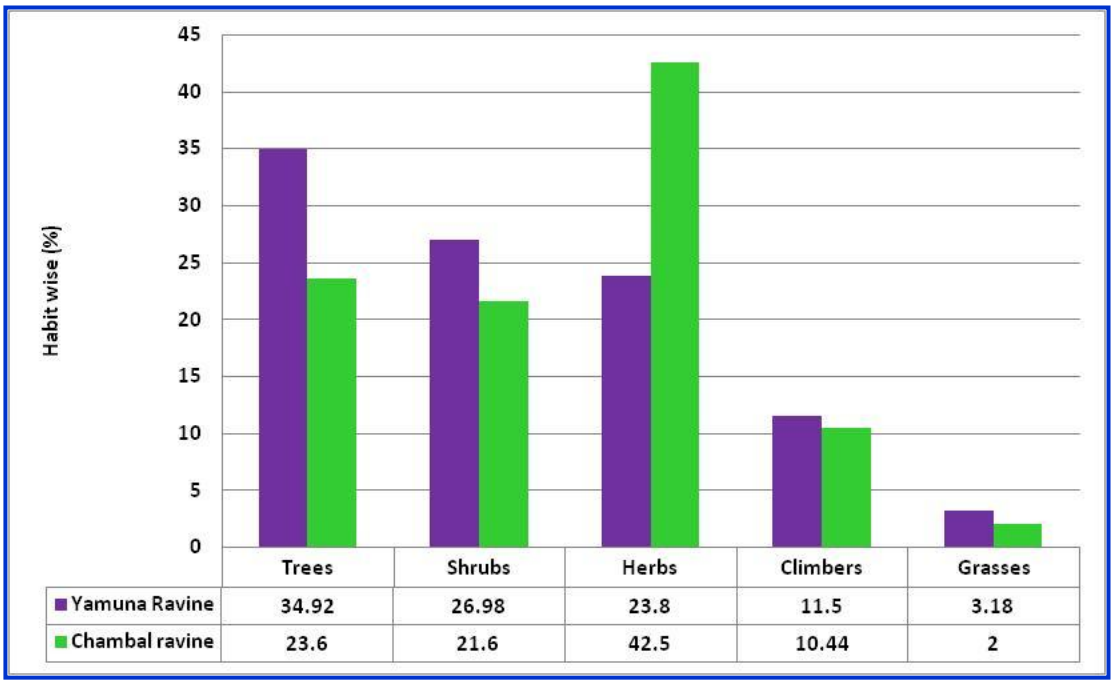
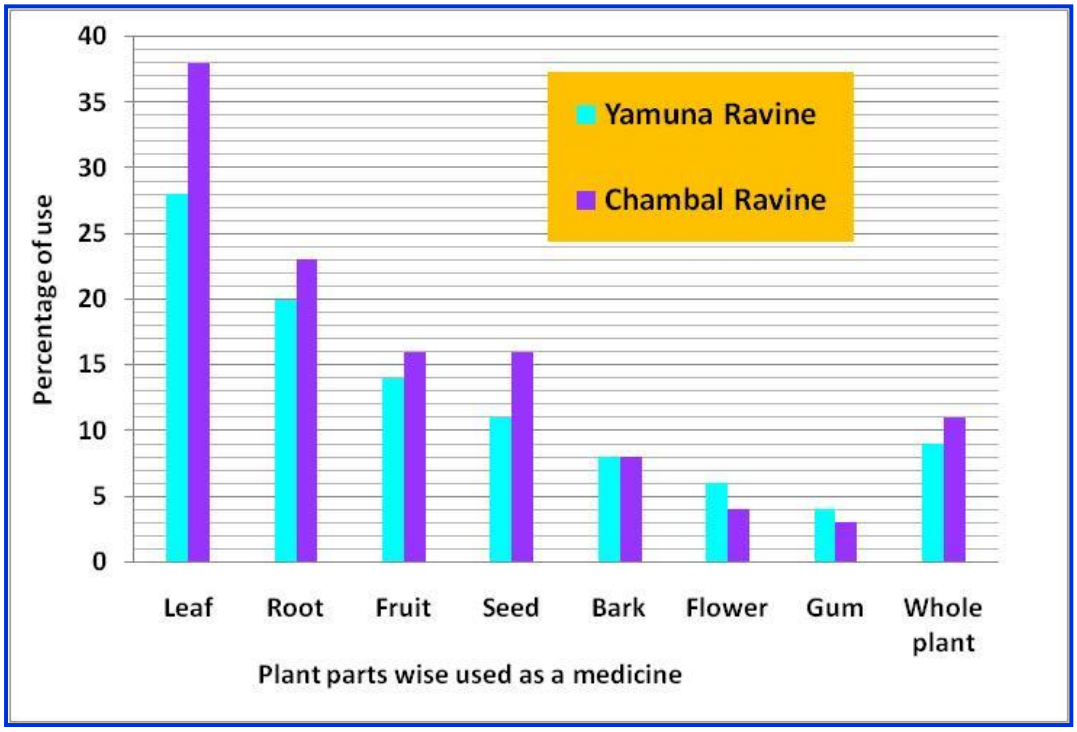


Fig.3 Proportion of plant parts used (%) as a medicine



The identified /documented indigenous plant species have high drought tolerant capacity and ability to grow under harsh environment. Sustainable management of rehabilitated Yamuna ravines with proper protection definitely enhances the species richness and conservation biodiversity through vegetation cover induced microclimates modification. The preparations of medicines are from leaves, root, bark, fruit, flowers and seeds. The mode/ formulation of intake includes plants applied as a paste, powder, decoction, extracts and juices and other applied as oil, smoke and chew.

Indigenous knowledge and their uses have to be analysed to develop appropriate management measures. Due respect must be given to the indigenous botanical knowledge of the local / traditional practitioners to ensure equality in benefit sharing and increased participation in conservation. Therefore, awareness creation campaigns are timely needed to improve local community's knowledge on the importance and management of medicinal plants. *In situ* conservation has come to be widely regarded as the only viable and cost effective measure to allow the species to follow the natural evolutionary course in interaction with their habitat and within themselves.

The existing information on the medicinal plant diversity in the country is sketchy and lies scattered with various research institutes across the country, Whereas the existing information needs to be compiled, a comprehensive programme to document the diversity and current status of medicinal plants in the country needs to be initiated. Hence this study has taken to identified indigenous medicinal plants diversity in the rehabilitated Yamuna and Chambal ravines for further bio-chemical and genetic variability studies are a means to arrive at the conservation and commercial value through value addition of different populations of the species.

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