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Revival of persistent native medicinal plants diversity through ravine restoration measures and their traditional uses in Chambal ravines of South-Eastern Rajasthan

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Abstract

Restoration of ravine ecosystems is highly different and difficult task for ecologist and environmentalist due its dynamic and complexity in terrain deformation forces. Natural vegetation of these lands was very poor and sparse in distribution and diversity. It is due to natural factors as well as made factors like high intensity biotic interferences (grazing pressure) in form of illicit felling and collection fuel and fodder. Despite of this, very little information's available about existence of medicinal plants on the typical ravine flora. The present study objective is to explore and elucidate the diversity and distribution of persistent native plants and their ethno medicinal uses in rehabilitated Chambal ravines (Rajasthan). In this study, 106 species observed and it represents 54 families of plant kingdom. The maximum revival of native plant species observed in rehabilitated ravines than open natural jungles. The documented indigenous plant species are having special stress tolerance capacity and ability to establish through root suckers to adopt this harsh and fragile environment. Through active and passive rehabilitation measures coupled with appropriate soil conservation techniques might foster the reappearance/revival of native medicinal species in rehabilitated ravine region. Now, special and proper attention towards documentation, conservation, sustainable utilization and awareness creation are highly needed to protect indigenous medicinal flora by appropriate *active and passive* restoration measures in fragile ecosystems.

Keywords: Ravines, rehabilitation, diversity, ethomedicinal, ethnoveterinary, conservation

Introduction

Ravines are the network of gullies running parallel and discharging into river. Most of the gullied and ravine lands are not inferior in their capabilities but are abandoned due to various other reasons. Being alluvial in nature and located nearby rivers the ravines are highly susceptible to erosion and quite often face consequences of severe floods ^[1]. Ravine lands are completely terrain deformatted lands associated with several biotic and abiotic constraints for vegetation establishment and growth. Still it is active and getting expanded due to various natural as well as man-made factors. This vast tract of existing ravine infested lands poses potential threat to nearby productive lands due to lack of stabilization and management strategies. The ravines are extending at the rate of 8 to 9 m per annum with average soil loss of more than 17 tons per ha per year ^[2]. Stream bank erosion is a major cause of land degradation, leading to deteriorated drainage systems, which ultimately govern natural calamities in terms of floods, and non point source pollution in ravine lands of India ^[1]. The severity of water erosion is found at the peak along the banks of Chambal Rivers in Rajasthan etc., these ravine ecosystems are highly dynamic and completely terrain deformatted landscape (Photo.1). The ravines flank of the Chambal river is about 10 km wide belt, which extends southwards from the Yamuna confluence to 480 km upto the town of Kota in Rajasthan.

Vegetation in this region suffers from a variety of unfavourable condition such as poor soil nutrients, high moisture stress and heavy biotic interference. The inclement weather conditions coupled with very high summer temperature further aggravates the problem and makes farming uneconomical to ravine infested farming lands. However, Indigenous plant species are playing significant role in environmental rehabilitation because of their exultant survival and high adaptation to local conditions in these regions. Since rain is a major source of water in the region, every drop of it must be conserved in the soil through in situ rainwater conservation. In such situations, rehabilitating ravine lands with perennials of less water and nutrient demanding tree and shrub species along with soil moisture conservation technologies hold a good promise to sustain the productivity, diversity and provide alternative source of income to

the farmers. Through, there is an urgent attention is need to arrest degradation of these lands and protect both the arable and non-arable lands from further degradation.

Further, the people of ravine infested nearby villages make use of this ravine lands as a collection ground for their daily demands of fuelwood, fodder grasses and non-timber forest products including medicinal plants for their own consumption as well as local marketing. But till date, there is none of research findings /related literature available about the diversity and ethno-botanical uses of medicinal plants in ravine lands. Now a days, the revival of interest in natural drugs, especially those derived from plants, started in the last decades mainly because of the widespread belief that '*green medicines*' or '*herbal renaissance*' are healthier and safer than the synthetic ones [5].

The ethnic and rural people of ravine lands have preserved a large bulk of traditional knowledge of medicinal uses of plants growing around them. This knowledge is handed down to generations through word of mouth and is extensively used for the treatment of common diseases and conditions. Ethno botany deals with the study of total natural and traditional interrelationship between man and plants and his domesticated animals. Ethnobiology which records and documents the age old knowledge and wisdom of the traditional people about the miraculous properties of diverse plant and animal species (biodiversity), is now emerging as holistic segment of Ecology [6]. Herbal medicines are assuming greater importance in the primary healthcare of individual as and communities in many developing countries. In India, 60-70% people lives in the rural areas and who cannot afford costly medicine every time for their petty sickness. They depend on vegetation surrounding them and make perfect uses of them for their medicinal needs. Demands for herbal health products viz. herbal tea, herbal cosmetics, essential oils and flavours are growing even these are proving costlier than the corresponding inexpensive synthetic ones [7, 8]. 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 could substantially limit the abundance of rare medicinal plant species in any given area [9]. 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 [10]. The medicinal plant wealth of Indian forests is declining constantly over the years. However, even as concerns about fast depletion of this resource are being voiced, the degradation continues at even faster pace. In developing countries like India due to high population rate there is extreme pressure on crop lands and simultaneously in recent years the demand of Indian medicinal plants species is creasing day- by -day therefore we will have to explore the methods of implanting medicinal plants in degraded land, most of the studies reveal that plantation of medicinal plants in degraded lands also help in reclaiming the degraded lands [11].

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 year¹². 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 [12].

But, comprehensive documentation of the diversity of medicinal plants in ravine lands is not available and their conservation status is not known. Similarly ethnoveterinary medicine is deal with traditional animal health care which encompasses the knowledge, skills, methods, practices and beliefs about animal health care. Nearby accessible and easily available medicinal plants provide a cheaper source for treatment of various ailments and diseases to livestock as compared to synthetic drugs. The study area was selected due to shortage of ethno botanical information on these districts as evident from literature. Hence, documentation of ethnoveterinary medicine from regions having a rich ethnographic and biodiversity setting would be of great significance. To meet out the demand of medicinal plants at international market, it could be initiated to use several kinds of degraded lands in the country, this practice will help to save the cultivable crop land from overburden and different researches explain that the cultivation of various medicinal plants helps to reclaim the degraded lands. Keeping of this above view, plan of exploration study has conducted identical villages to document the indigenous medicinal plant diversity and their traditional uses during various period of time in the rehabilitated Chambal Ravines (Rajasthan).



Photo 1: Depth and density of frilliness of Chambal ravines in Rajasthan India

Materials and Methods

Rehabilitation of ravine lands with various kinds of vegetation not only provides livelihood support but also helps natural resources conservation and carbon sequestration in long run. Further the increase in vegetative cover in degraded ravine lands enhances the flora and fauna, and restores natural ecosystem thereby mitigating the impacts of climate change in addition to conservation of land and water resources for sustained productivity. After 1950s, the GoI took a major initiative for addressing the ravine problem of India by establishing of Soil Conservation Research, Training and

Demonstration Centres at Agra, Kota and Vasad during 1954-1957 to address the problems of Yamuna, Chambal and Mahi ravines respectively. Subsequently these centres became constituents of Indian Council of Agricultural Research (ICAR) as Central Soil and Water Conservation Research and Training Institute (CSWCRTI) which is now renamed as Indian Institute of Soil and Water Conservation (IISWC). Over a period of sixty years, these centres have been engaged in various aspects of characterization of ravines, technology development for rehabilitation and productive utilization of ravine lands and dissemination of developed technologies through regular training and outreach activities. These centres have developed and successfully demonstrated the technological packages for reclaiming ravine lands for productive utilization on sustainable basis. Further, we were observed huge variation of vegetation density and species diversity in our rehabilitated ravine land villages in Chambal belts. These make intuition to conduct detailed exploration on vegetation dynamics for documentation and comparison between study sites. Further, the details of the study area were also described below.

An intensive survey was conducted in ICAR-IISWC-Research Centre Kota and few villages namely Lohli, Bagli and Rihana in of Bundi districts were selected for study. These villages comes under Bundi district of Chambal ravine belt in south-eastern Rajasthan (Latitude - 25°13'29" to 25°14'18" N; Longitude -75°52'18" to 75°52'44" E). The Chambal River is natural boundary of Kota district that separates Kota from neighbouring Sawai Madhopur, Tonk and Bundi districts by forming the natural district boundary. Climate of this region is hot semi-arid with the mean annual rainfall of 748 mm. 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 (750 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 2016.

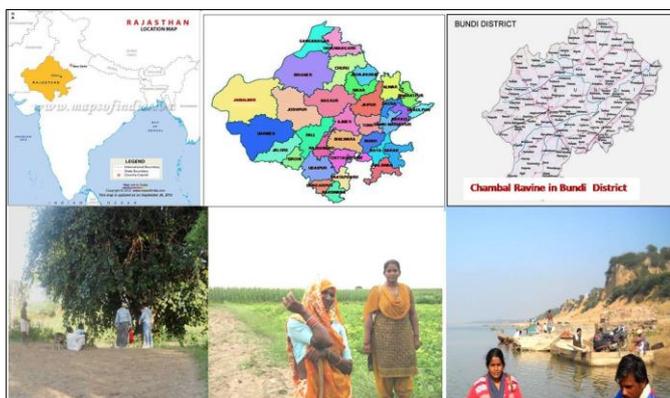


Fig 1: Study area map and collection information about traditional uses of medicinal plants in respective villages of Chambal ravines in Rajasthan

A field location map and field survey through transect and quadrat methods were conducted to know and explore the distribution of medicinal plants diversity in rehabilitated areas of the different study sites in Chambal ravines (Fig.1). During the field visit, data collection was made in different places

viz., protected ravine lands, barren lands 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 a limited 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 considered as a serious problem in ravine lands. Observations were made on the morphological features and habitats of each medicinal plant species in the field survey books. All the information about the sampled plants species were categorized into herbs, shrubs and trees. After basic vegetation survey, our team also collected and assembled the information on ethno-botanical uses medicinal plants from the study areas through questionnaire surveys, participatory observations and field visits were executed to elicit information on the traditional uses of various plants. The plant species were collected and identified upto species or family levels. The plants were identified according to Benthem and Hookers system of classification (or any other classification) using local floristic works (name of people who would have earlier identified some species). Other ethno medicinal uses of the plants were cross checked by relevant literature available in the library of the centre as well as online resources. The information regarding the usage of ethnoveterinary medicinal plants available in the local area for treating various ailments and disease of livestock, was also collected by directly interviewing herbal healers, aged farmers and experienced traditional healers who have traditional Knowledge about these ethno veterinary medicinal plants in the villages of surveyed district. In case, if doubtful plant material was observed, those were collected and brought to lab for identification by authenticated source. The standard procedure has followed to assembled the ethno-medicinal /traditional uses of each plant was explained in the following pattern: scientific name, common name, part used and mode intake and treating/ curing ailments or diseases of the livestock [13, 14].

Results and Discussion

This study enlisted and elucidated the native floral diversity of medicinal plants in Chambal ravine lands. The multi-utility of medicinal plants is an important part of the understory flora and plays an essential role in the ravine land rehabilitation. The identified medicinal plants were comprised of mainly trees, shrubs, climbers herbs and grasses. The table -1 indicated, 106 species belongs to 54 families were documented in Chambal ravines (Rajasthan). The plant family *viz.*, *Euphorbiaceae*, *Fabaceae*, *Asteraceae*, *Solanaceae* and *Amaranthaceae* were revealed as dominant families in Chambal ravines. Documented plants were categorized according to their life form *viz.*, trees (30.46%), shrubs (42.13%), herbs (24.5%), climbers (14.44%) and grasses (6.18%) were found in the overall estimates of the representative sites (Fig.2). The identified /documented indigenous plant species have special features of propagation, drought tolerant capacity and ability to grow under this harsh and fragile environment. Canopy/ vegetative cover induced microclimates modification and sustainable management of such lands with proper protection might enhance the species richness in this region. In addition to that, rehabilitated ravine lands have abundant diversity of medicinal plants compare unprotected ravine areas. This information has reported by few more authors under different situations that, where degraded forest are allowed to revive, the more probability of

recurrence of understory species may appeared due to rehabilitation^{14,15}. Similar kind of findings were reported by several authors studies that indicates a higher diversity and abundance of understory plant species in undisturbed forest compared to disturbed native forest on Himalayan forests^{15, 16, 17}. Apart from this, ravine beds are occupied dense vegetative cover compared to ravine slope and ravine hump (ravine top). This may be due to more availability of residual soil moisture in the valley beds during monsoon and post monsoon seasons. This is also concurrence with few other authors findings that forest vegetation regrowth alters conditions for the ground vegetation, such as soil fertility, light, temperature, and moisture all of which affect competition dynamics at ground level^{16, 17, 21, 22}.

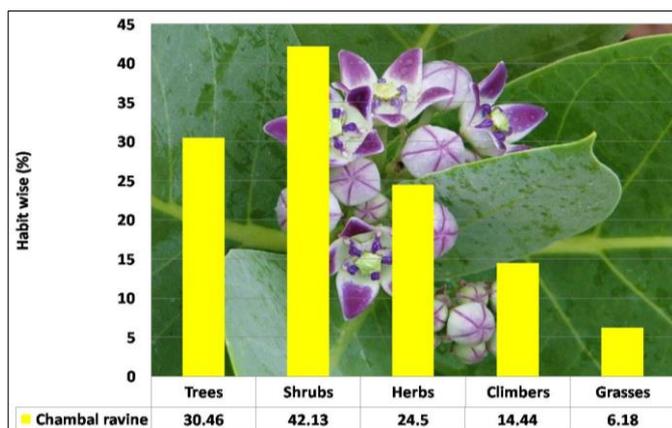


Fig 2: Habitwise (%) distribution of medicinal plants in ravine lands

But protected and rehabilitated ravine forest having significantly higher diversity of medicinal plants than unprotected ravine lands. Another rehabilitation research study reported that there was about 28 indigenous species were found naturally reoccurred through their rehabilitation efforts in sodic soils of semi-arid sub-tropical forest in India^[11]. In our study, higher medicinal plant density and diversity were related to higher tree diversity under forest regrowth. This clearly indicates the diversity and distribution pattern medicinal plants in rehabilitated areas through effective protection efforts and 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. Indigenous species have proved successful in environmental rehabilitation because of their adaptation to local condition and providing valuable ecosystem services.

Information on ethno-medical uses and information were also collected from traditional healers and local dwellers (elder people) of sample region. The plants part used for medicines is differed from plant to plant. Crushing, homogenizing with ingredients and chewing were the commonly used forms of herbal preparation. Decoction intake, smoke inhalation and external paste/strap application are the most frequently used mode of intakes. Another documented study of Banaras Hindu University reported that a rich diversity medicinal plant resources and their folk uses in Varanasi in Uttar Pradesh^[18]. Other studies conducted in Chandauli district of Uttar Pradesh showed similar kind trend of emphasizing medicinal diversity and ethomedicinal uses^[19]. Some of these plants have also cultural and economic values, means they are used to make small furniture articles (desk, bench), bed, milk container, butter container and other culturally used home furniture. In addition large trees like *Holoptelia integrifolia* and

Azadirachta indica have more social and economic value, such as to provide shade during community meeting, as fodder for animals (especially for goats and camels), for house and fence constructions.. It was observed that few medicinal plants such as *Aloe vera*, Ber, Keir, Kainth, Neem and Bael, had market value in local markets. 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 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. From this study, in Chambal ravine areas, leaf is most frequently used plant part which accounts 38% followed by root (23%), Fruit (16%), Seed (21%), whole plant (11%), bark (8%), Flower (4%), and Gum (3%) (Fig.3). many ethno botanical study reports says that, leaf part of the plants ranks first, among the other plant parts used for treatment of various diseases of the human and livestock in other studies at different part of India^[12, 20]. Indigenous knowledge and their uses have to be analyzed to develop appropriate management measures. Due respect must be given to the indigenous botanical knowledge of the local / traditional herbal healers to ensure equality in benefit sharing and increased participation in conservation.

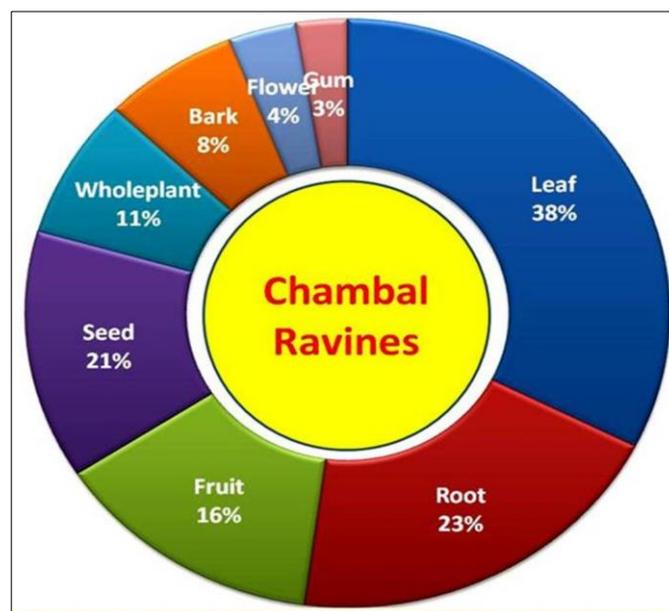


Fig 3: Proportion of plant parts used (%) as a medicine in ravine lands

The table- 3 indicated that most important indigenous ravine ethnoveterinary medicinal plants may play a key role in the management of animal health care. The livestock owner and traditional herbal healers were commonly used are Neem, Moringa, Calotropis, Datura, and Tulsi Leaves. Internal consumption of the preparations is mostly practiced by users except some skin diseases. Likewise, few other authors also documented ethnoveterinary uses of medicinal plants in other part of India^[13, 20]. Hence, there is an urgent attention needed for initiating the collective efforts from botanist, ethnobotanists and ethnopharmacologists to document, conserve and evaluate the efficiency of these valuable plant based drugs. *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.

Table 1: List of medicinal plants documented in the rehabilitated lands of Chambal ravines in Rajasthan

Sl. No	Botanical Name	Local Name	Family	Habit	Part used	Formulation, Mode of intake & Medicinal use
1.	<i>Abrus precatorius</i>	Chirmi	Fabaceae	Cl	Seed	Consumption of seed extract decoction used Abortifacient and used a sedative
2.	<i>Abutilan indicum</i>	Kanghil	Malvaceae	Hb	Leaf	Seed extract used as laxative & very effective for curing piles
3.	<i>Acacia catechu</i>	Khair	Fabaceae	T	Bark & Root	Root extract curing arthritis problem
4.	<i>Acacia nilotica</i>	Babool	Mimosaceae	T	Bark, gum	Bark extract applying over skin will cure burning sensation
5.	<i>Acalypha indica</i>	Chauriya	Euphorbiaceae	Hb	Leaf	Leaf paste mixing salt and turmeric powder used for curing skin Itching, psoriasis, wound healing
6.	<i>Achryranthes aspera</i>	Chirchita	Amaranthaceae	Sb	Whole plant	Whole plant extract useful in Hemorrhoids, indigestion, cough, asthma, anemia, jaundice and snake bite
7.	<i>Adhatoda vassica</i>	Ardusa	Acanthaceae	Sb	Leaf extract	It is used for a multitude of disorders including; leprosy, blood disorders, heart troubles, fever, vomiting, loss of memory, leucoderma, jaundice, tumors, mouth troubles, sore-eye, and gonorrhoea
8.	<i>Aegle marmelos</i>	Beal	Rutaceae	T	Fruit and leaves	Fruits are also used in the treatment of chronic diarrhea, dysentery, and peptic ulcers, as a laxative and to recuperate from respiratory affections in various folk medicines.
9.	<i>Aerva lanata</i>	Kali-Bui	Amaranthaceae	Hb	Root	Root extract decoction good remedy for bladder stones
10.	<i>Ailanthus excelsa</i>	Anjan	Simaroubaceae	T	Leaf & bark	Leaf and bark extract used joint pain & leprosy
11.	<i>Albizia lebbek</i>	Siris	Fabaceae	T	Seed	Seed powder can be used as a powerful antidote. Snake bite
12.	<i>Aloe vera</i>	Gwar patha	Liliaceae	Hb	Leaf gel	Leaf gel used as a remedy for skin conditions, including burns, sunburn, frostbite, psoriasis and cold sores,
13.	<i>Amaranthus caudatus</i>	Chauli	Amaranthaceae	Hb	Green leaves	Cooked leafy vegetable used cure constipation
14.	<i>Amaranthus blitoides</i>	Pigweed	Amaranthaceae	Hb	Green leaves	Cooked leafy vegetable for children
15.	<i>Ammannia baccifera</i>	Jal bhangro	Lythraceae	Hb	Leaf	Making leaf paste used for treating skin itching
16.	<i>Andrograpis paniculata</i>	Kalmegh	Acanthaceae	Hb	Whole plant	Plant extract is used for curing bronchitis, skin diseases, flatulence, colic, influenza, dysentery, dyspepsia and malaria
17.	<i>Argemone mexicana</i>	Prickly poppy	Papaveraceae	Hb	Leaf paste	Its leaves decoction is used to cure malarial fever, ulcers and skin problems
18.	<i>Asparagus racemosus</i>	Satawari	Asparagaceae	Cl	Root powder	Root powder used for upset stomach (dyspepsia), constipation, stomach spasms, and stomach ulcers
19.	<i>Asphodelus tenuifolius</i>	Wild onion	Xanthorrhoeaceae	Hb	Leaf extract	Plant extract used for rubbing on the bite of bees and wasps for relief.
20.	<i>Azadirachta indica</i>	Neem	Meliaceae	T	All parts paste	Anthelmintic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive, and sedative. Skin disease & dewarming
21.	<i>Balanites aegyptica</i>	Hingot	Balanitaceae	T	Fruit extract	The fruits have been used in the treatment of liver and spleen diseases
22.	<i>Bombax ceiba</i>	Semal	Bombacaceae	T	Flower Paste	Bark juice is given to reduce stomachache. Cooked flowers are edible and vegetable
23.	<i>Bareria prionitis</i>	Bajrandanti	Acanthaceae	Sb	Leaf decoction	Plant decoction is used in toothache and pyorrhoea. Leaf extract is used to prevent pus formation in the ears. Plant extract boiled with water to take bath to newborn baby to cure redness in body
24.	<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae	T	Root	Root extract is a good cure for healing Wounds and Injuries. Its leaves are crushed into a paste and used for treating Boils and Sores
25.	<i>Bergia suffruticosa</i>	Ankh-Phorniki	Elatinaceae	Hb	Plant paste	Plant paste applied on broken bones for early recovery.
26.	<i>Boerhavia procumbens</i>	Santhi	Nyctaginaceae	Hb	Root paste	Root decoction is used as an eye tonic. Root paste is applied on swellings and also on scorpain sting
27.	<i>Butea monosperma</i>	Palash	Papilionaceae	T	Root & bark	The leaves of the tree are used as ingredients of tonics and aphrodisiacs and are also helpful in arresting bleeding or secretion
28.	<i>Calligonum polygonoides</i>	Phog	Polygonaceae	Sb	Plant extract	Plant extract is used for typhoid. Plant decoction is given to animals used for urinary problems
29.	<i>Calotropis procera</i>	Aakda	Asclepiadaceae	Sb	Root paste, latex	The root bark with latex is smoked as remedy for cough
30.	<i>Capparis decidua</i>	Karil	Cappariaceae	Sb	Leaves & fruits	The plant leaves and unripe fruits are traditionally used to cure toothache, arthritis, asthma, cough, inflammation, intermittent fevers, malaria, rheumatism, and swelling
31.	<i>Carrisa carandus</i>	Karonda	Cappariaceae	Sb	fruit	Fruit used for constipation and diarrhea
32.	<i>Cassia fistula</i>	Amaltas	Caesalpiniaceae	T	Fruits and seeds	It used for treating constipation, fever, digestive troubles and skin diseases (catles)
33.	<i>Cassia tora</i>	Phunwad	Caesalpinaceae	Sb	Leaf decoction	It is very useful in treating skin diseases like ringworm and itching or body scratch and psoriasis.
34.	<i>Catharanthus roseus</i>	Sadabahar	Apocynaceae	Sb	seed and leaf	Seed powder has been used for relieving muscle pain, depression of the central nervous system. leaf extract also used for applying to wasp stings and to heal wounds.
35.	<i>Chenopodium album</i>	Chilva	Chenopodiaceae	Hb	Leaf and Leafy vegetable	It used in the treatment of rheumatism, bug bites, sunstroke, urinary problems, skin problems
36.	<i>Citrullus colocynthis</i>	Gar-tumba	Cucurbitaceae	Cl	Root	Root decoction is taken orally once in the morning for 25 - 30 days to cure jaundice
37.	<i>Cleome gynandra</i>	Karalia	Cleomaceae	Hb	Green leaves	The crushed leaves are also used as a vesicant and rubefacient to treat different kinds of pains such as headache, rheumatism.
38.	<i>Cleome viscosa</i>	Singali	Cleomaceae	Hb	Seed powder	The leaves and seeds of the plant are used as rubefacient and to treat

						infection, rheumatism, fever and headache
39.	<i>Clitoria ternatea</i>	Aparajita	Papilionaceae	Cl	Root powder	Decoction of leaf is applied topically to treat ringworm infection
40.	<i>Coculus hirsutus</i>	Bajar -bel	Menispermaceae	Cl	Leaf and root	Paste of the leaf and root with oil are reported to be used for treating burning sensation, skin diseases
41.	<i>Commiphora mukul</i>	Guggal	Burseraceae	Hb	Gum decoction	It is reported to be astringent, antiseptic and aphrodisiac. It is also employed for treatment of snake bite and scorpion sting
42.	<i>Corbichonia decumbens</i>	Pathar chatti	Molluginaceae	Hb	Leaf juices	Leaf juice are reported to be applied along with little tender coconut milk against dandruff and hairfall
43.	<i>Cordia myxa</i>	Lasoda	Boraginaceae	T	Leaf juice	Fresh leaves juice is used against earache.
44.	<i>Cynodon dactylon</i>	Doob grass	Graminae	Gs	Whole plant	Leaf extract is taken thrice a day to reduce the body heat, Menstrual disorders
45.	<i>Datura metal</i>	Dhatura	Solanaceae	Hb	Leaf paste	Dried leaf powder is smoked as cigarette twice a day for 2 - 3 weeks to get relief from asthma. Fruit juice with oil is applied to check hair falling
46.	<i>Dendrocalamus strictus</i>	Bamboo	Poaceae	T	Leaves	The leaves can restore body fluid and are a natural diuretic, promoting bladder health.
47.	<i>Dicoma tomentosa</i>	Choloharnach	Asteraceae	Hb	Root and branches	Root is used for toothache and cure pyorrhea
48.	<i>Emblica officinalis</i>	Aonla	Euphorbiaceae	T	Fruits	Fruit is used both as a medicine and as a tonic to build up lost vitality and vigor.
49.	<i>Eucalyptus tereticornis</i>	Red gum	Myrtaceae	T	Leaf extract	Leaf extract used for Headache, body pain
50.	<i>Euphorbia hirsuta</i>	Dudhi	Euphorbiaceae	Hb	Leaf and root extract	It is used to remove worm infestations in children, dysentery, jaundice, pimples, gonorrhea, digestive problems, and tumors.
51.	<i>Euphorbia nerifolia</i>	Danda -thor	Euphorbiaceae	Sb	Latex	Latex used in treatment of whooping cough, gonorrhoea, leprosy, asthma, dyspepsia, jaundice, enlargement of the spleen, tumours, stone in the bladder.
52.	<i>Euphorbia prostrata</i>	Dudhi	Euphorbiaceae	Cl	Plant extract	It is also used for mucus in the nose and throat, throat spasms, hay fever, and tumors.
53.	<i>Glinus lotoides</i>	Gandhi-buti	Molluginaceae	Hb	Plant juices	It used in treatment of tapeworm infestation
54.	<i>Grewia tenax</i>	Gangeran Phalsa	Tiliaceae	Sb	Root paste	Intestinal infections, cough, fever, diarrhoea, dysentery, jaundice, rheumatism
55.	<i>Hemidesmus indicus</i>	Anantmool	Asclepediaceae	C	Root extract	It is used to treat various disorders like indigestion, asthma, cough, fever, dysentery, poisoning and menorrhagia.
56.	<i>Impatiens balsamina</i>	Timadia	Balsaminaceae	Hb	Leaf extract	Leaf extract applied boils, Wounds and swelling
57.	<i>Ipomea cornea</i>	Ipomea	Convolvulaceae	Cl	Leaf	Leaf paste is applied twice a day on the spot for 2 days to cure pimples. Seed paste with coconut oil is applied to heal wounds.
58.	<i>Jatropha curcas</i>	Ratanjot	Euphorbiaceae	Sb	Seeds, oil and latex	Mouth ulcer
59.	<i>Lantana camera</i>	Lantana	Verbanaceae	Sb	Leaf Decoction	Lantana leaf is used in the treatment of skin, itches, wounds. In leprosy and scabies decoctions were applied externally.
60.	<i>Leucas urticaefolia</i>	Darkan	Laminaceae	Hb	Leaf and flower	Leaf extract is applied for twice day for 2 days to treat painful swellings. 5 - 10 flowers are eaten raw for cough and cold
61.	<i>Lowsonia inermis</i>	Mehandi	Lytheraceae	T	Leaves, fruit paste	it is used to cure sunburn and other rashes in the body, body cooling, hair dyeing
62.	<i>Madhuca longifolia</i>	Mahua	Sapotaceae	T	Bark extract	It is used in rheumatism, ulcers, bleedings and tonsillitis.
63.	<i>Martynia annua</i>	Bichtukando	Martynaceae	Sb	Leaf paste	used in Indian traditional medicines for epilepsy, inflammation and tuberculosis
64.	<i>Melia azadirach</i>	Bakayan	Meliaceae	T	Leaf & flower paste	Leaf extract used for pregnancy weakness anthelmintic effect and used for worm infestation
65.	<i>Mimosa hamata</i>	Alai	Mimosaceae	Sb	Leaf extract	The leaf extract for treatment of bronchitis and diarrhea in children
66.	<i>Mimosa pudica</i>	Laajivanthi	Mimosaceae	Hb	Leaf paste	Decoction of root is taken orally once a day for one week to get relief from urinary complaints.
67.	<i>Mollugo cervianana</i>	Chirio ghas	Molluginaceae	Hb	leaf	Grind the leaf by adding milk and apply over the body for body odour and cure fever.
68.	<i>Momordia foetida</i>	Khakoda	Cucurbitaceae	Cl	Leaf & fruit	Drinking of aqueous leaf extracts of the plant to treat malaria
69.	<i>Moringa oleifera</i>	Sehjan	Moringaceae	T	Leaf, fruit, gum	<i>Moringa leaf powder is given to malnourished children, pregnant women and breast-feeding mothers as a food supplement</i>
70.	<i>Medicago sativa</i>	Alfa-alfa	Fabaceae	Hb	Root decoction	Used for high cholesterol, asthma, osteoarthritis, rheumatoid arthritis, diabetes, upset stomach, and a bleeding disorder
71.	<i>Mucuna pruriens</i>	Kirmich	Fabaceae	Hb	Seed powder	Seed powder useful for snakebite, intestinal disorders Cure asthma
72.	<i>Nerium indicum</i>	Kaner	Apocynaceae	Sb	Root paste	Leaves and flowers are also used to treat malaria and as traditional medicine it induces the termination of embryo. The root powder is an external remedy for hemorrhoids and ulcers around genitals
73.	<i>Ocimum americanum</i>	Bapchi	Laminaceae	Hb	Seed powder	Decoctions are used for coughs, pounded leaves are placed on the forehead to relieve catarrh or on the chest for respiratory problems, the whole plant is used in baths to treat rheumatism, renal colic and calcifications
74.	<i>Ocimum grantissimum</i>	Van tulsi	Lamiaceae	Hb	Seed paste	used as a general tonic and anti-diarrhea agent and for the treatment of conjunctivitis
75.	<i>Ocimum sanctum</i>	Tulsi	Lamiaceae	Hb	Seed paste	Raw tulsi leaves are very helpful in providing relief from cold and cough
76.	<i>Oxalis corniculata</i>	Aaera	Oxalidaceae	Hb	Leaves	It is used in the treatment of influenza, fever, urinary tract infections, enteritis, diarrhoea, traumatic injuries, sprains and poisonous snake

						bites
77.	<i>Pedaliium murex</i>	Dakhni	Pedaliaceae	Hb	Plant extract	Used traditionally for the treatment of genitourinary disorders, spermatorrhoea, nocturnal emissions, menstrual irregularities, puerperal disorders, ulcers, fever, wounds, other ailments and general debility
78.	<i>Pergularia daemia</i>	Milk weed	Asclepiadaceae	Cl	leaves	The whole plant is used as ananthelmintic, antiseptic, antivenin, emmenagogue, emetic expectorant and expectorant.
79.	<i>Phyllanthus niruri</i>	Bhui anola	Euphorbiaceae	Sb	Whole plant extract	It is used for the treatment of fever, inflammation of spleen and liver, fractures, jaundice and skin diseases.
80.	<i>Physalis angulata</i>	Cap Berry	Solanaceae	Hb	Leaves	It is used to treat malaria, toothache, liver ailments including hepatitis, rheumatism, and is considered a diuretic and relaxant.
81.	<i>Physalis minima</i>	Chirpotan	Solanaceae	Hb	fruits	It is used to treat malaria, toothache, liver ailments including hepatitis, rheumatism, and is considered a diuretic and relaxant.
82.	<i>Polygonum plebeium</i>	Lalbuti	Polygonaceae	Hb	Leaf extracts	Root paste is applied twice a day for inflammations
83.	<i>Pongamia pinnta</i>	Karanj	Leguminosae	T	Seeds & root paste	It is seed paste applied as crude drug for the treatment of tumors, piles, skin diseases, and ulcers ; The root is effective for treating gonorrhoea, cleaning gums, teeth, and ulcers, and is used in vaginal and skin diseases; Roots are used for cleaning gums, teeth, and ulcers. Bark is used internally for bleeding piles.
84.	<i>Portulaca oleracea</i>	Lunkia	Portulacaceae	Hb	Leaf extracts	Its leaves are used for insect or snake bites on the skin, boils, sores, pain from bee stings, bacillary dysentery, diarrhea, hemorrhoids, postpartum bleeding, and intestinal bleeding.
85.	<i>Punica grantum</i>	Anar	Punicaceae	Sb	Flower & fruit	Used to treat sore throats, coughs, urinary infections, digestive disorders, skin disorders, arthritis, and to expel tapeworms.
86.	<i>Ricinus communis</i>	Castor	Euphorbiaceae	Sb	Leaves	Useful in the treatment of Constipation, Worms, Arthritis, muscle aches and back ache, Joint pains, Insomnia and Skin.
87.	<i>Salvadora persica</i>	Meswak	Salvadoraceae	Tb	Leaf & Stem	The stem bark is good for gastropathy. The leaves are diuretic anthelmintic, astringent, expectorant ingredient of toothpaste meswak.
88.	<i>Sida cordifolia</i>	Kharenti	Malvaceae	Sb	Whole herb	It is a useful herb to treat broad variety of ailments such as Vata roga, Pitta roga, bronchial asthma, fever, dry cough, nervous debility, infertility, emaciation etc.
89.	<i>Sida ovata</i>	Desikharenti	Malvaceae	Hb	Flower and Seed powder	The flowers and seeds are astringent, cooling and anthelmintic. It is reported to be used as a gargle. It is also useful in urethrorrhoea, diarrhoea and dysentery.
90.	<i>Solanum nigrum</i>	Makoy	Solanaceae	Hb	Root decoction	The juice from its roots is used against asthma and whooping cough; This is useful for the treatment of ulcer. Useful for asthma, cough and oral ulcer, it also cures an earache.
91.	<i>Solnaum surantense</i>	Pasarghatali	Solanaceae	Hb	Leaf & fruits	Very useful in the treatment of cough, cold, asthma and such other respiratory tract conditions. Whole plant used in bronchitis, cough, constipation and in dropsy, decoction used in gonorrhoea and promotes conception.
92.	<i>Sonchus ankhali</i>	Ankhali	Asteraceae	Hb	Leaf extract	Cure live disease, cirrhosis, skin diseases, cures piles. The leaves of the plant is applied the area affected with skin diseases like scabies, ringworm, vitiligo etc; Poultice of the leaf is prepared and applied externally to treat localized swelling.
93.	<i>Sonchus asper</i>	Kalijibi	Asteraceae	Hb	Plant extract	The latex in the sap is used in the treatment of warts. It is also said to have anticancer activity. treatment of headaches, general pain, diarrhea, menstrual problems, fever, hepatitis, salmonella infection, wars, eye problems, liver infections, infections, inflammation and rheumatism.
94.	<i>Sphaeranthus indicus</i>	Mundi	Asteraceae	Hb	Root powder	Used to treat vitiated conditions of epilepsy, mental illness, hemicrania, jaundice, hepatopathy, diabetes, leprosy, fever, pectoralgia, cough, gastropathy, hernia, hemorrhoids, helminthiasis, dyspepsia and skin diseases.
95.	<i>Syzygium cumini</i>	Jamun	Myrtaceae	T	Fruits, seed Bark and leaves	It is effective in the treatment of diabetes mellitus, inflammation, ulcers and diarrhea; the seeds are used to treat diabetes mellitus; the fruits have been useddiabetes, dysentery, inflammation and ringworm; blood purifier; Bark is good for sore throat, bronchitis, asthma, thirst, biliousness, dysentery, blood impurities and to cure ulcers.
96.	<i>Tamarindus indica</i>	Imlli	Caesalpiaceae	T	Leaf extract	It can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhea, helminth infections, and fever; in the treatment or prevention of obesity and other chronic diseases
97.	<i>Tecomella undulata</i>	Rohida	Bignoniaceae	T	Bark paste	The bark obtained from the stem is used as a remedy for syphilis. It is also used in curing urinary disorders, enlargement of spleen, gonorrhoea, leucoderma and liver diseases.
98.	<i>Tephrosia purpurea</i>	Dhamaso	Fabaceae	Hb	Root powder	It is used in the treatment of leprosy, ulcers, asthma, and tumors, as well as diseases of the liver, spleen, heart, and blood.
99.	<i>Terminalia arjun</i>	Arjun	Combretaceae	T	Leaf paste	Urinary infection, Treatment of wounds, hemorrhages and ulcers, applied topically as a powder; its mostly touted to be a cardioprotective agent; well known cardiac tonic; Arjuna's bark is a very important ingredient in the treatment of Leucoderma.

100	<i>Tinospora cordifolia</i>	Giloy	Menispermaceae	Cl	Fruit paste	It is also very useful in Dengue because it helps to increase the count of platelets. It used for diabetes, high cholesterol, allergic rhinitis (hay fever), upset stomach, gout, lymphoma and other cancers, rheumatoid arthritis (RA), hepatitis, peptic ulcer disease (PUD), fever, gonorrhoea, syphilis, and to boost the immune system
101	<i>Trianthema triquetra</i>	Lutanki	Aizoaceae	Hb	Plant paste	Plant paste is applied on swelling caused by rheumatism. It is used in the treatment of edema in the liver and spleen, uteralgia,
102	<i>Tridax procumbens</i>	Nahtoota	Asteraceae	Hb	Leaf extract	It is an anticoagulant, antifungal, and insect repellent. The juice extracted from the leaves is directly applied on wounds. Its leaf extracts were used for infectious skin diseases in folk medicines. Prevent hair fall and promotes growth of hair. Hemorrhage from cuts, bruises and wounds, Antidiabetic activity
103	<i>Vitex negundo</i>	Sambhalu	Verbaceae	Sb	Seed powder	It is a muscle relaxant and pain relieving herb. It is used externally in the form of paste or oil and orally in the form of powder, leaf juice or water decoction. It treats diseases caused due to vitiation of Vata and Kapha, Headache, Skin affections, Wounds, Swelling, Asthma, Bronchitis
104	<i>Waltheria americana</i>	Surli	Byttneriaceae	T	Root extract	Root extract used to cure spermatorrhoea, Rheumatism, ear pain. Its flowers and leaves possess antiseptic, insecticidal and parasiticidal properties
105	<i>Withania somnifera</i>	Aswagandh	Solanaceae	Sb	Leaf powder	Leaf used as an excellent rejuvenator, a general health tonic, it stimulates the immune system, combats inflammation, increases memory, and helps maintain general health and wellness. It is known to increase the production of bone marrow, semen, and acts anti-aging.
106	<i>Wrightia tinctoria</i>	Kudruku	Apocyanaceae	T	Bark extract	It is used for checking blood in the stool. Bark juice is also used for checking diarrhoea. It is also used in the treatment of piles and skin diseases like ringworm, leprosy etc. Powder of the bark is also used for treatment of kidney stones. Its stem bark extract is used in animals for the treatment of Anthrax.

*T-Tree, Sb-Shrub, Hb-Herb, Gs-Grass, Cl-Climber

Table 2: Important indigenous ravine land medicinal plants used as an ethnoveterinary medicine (EVM) in ravine lands.

Sl. No	Name of the Species	Local Name	Part used & Mode of uptake	Ethno-veterinary medicinal uses
1.	<i>Acacia nilotica</i>	Desibabool	Flower paste decoction	Flower decoction given orally to livestock to cure jaundice
2.	<i>Adhatoda vassica</i>	Ardusa	Leaf and bark	Leaf and bark paste to given orally twice a day to cure cold cough and fever
3.	<i>Aegle marmelos</i>	Beal	Leaf & fruit paste with castor oil	Leaf and fruit paste with castor oil applied on body to cure heat and sun burn problem
4.	<i>Aloe vera</i>	Guarpatha	Leaf pulp	Leaf pulp given orally to removal ecto-parasites animal stomach
5.	<i>Argemone mexicana</i>	Prickly poppy	Leaf paste	Leaf paste with castor oil applied on broken bones
6.	<i>Asparagus racemosus</i>	Satawari	Root powder and leaf juice	Root powder mixed turmeric to cure wounds and foot infection
7.	<i>Bareria prionitis</i>	Bajrandanti	Leaf juice and flower paste	Leaf and flower paste mixed with neem oil to cure fever and redness in body
8.	<i>Azadirachta indica</i>	Neem	Bark paste	Grind small quantity neem bark with turmeric powder and water. The paste so obtained is applied over wounds till complete recovery
9.	<i>Capparis decidua</i>	Keir	Leaf fodder	Leaf fodder given cattle to cure diarrhoea
10.	<i>Calotropis procera</i>	Aakda	Latex	plant latex externally on affected part body to cure poisonous insect bites
11.	<i>Cassia fistula</i>	Amaldas	Leaf and pod paste	Leaf and green pod paste given orally with water to cure indigestion
12.	<i>Cynodon dactylon</i>	Doop	Whole plant	Feed as a simple grass fodder effective digestion incase less than year old cattle
13.	<i>Datura metal</i>	Datura	seed paste	Seed paste mixed with neem oil is effective for Wound healing
14.	<i>Dendrocalamus strictus</i>	Solid Bamboo	Leaf as a fodder	Small quantity leaf fodder is given to pregnant animal once in day to cure diarrhoea
15.	<i>Dalbergia sissoo</i>	Shisham	Leaf juice	Small quantity shisham leaves is given daily to reduce chronic constipation effectively.
16.	<i>Feronia elephantum</i>	Kainth	Leaf +Flower paste	Leaf and flower paste given to pregnant cattle for easy delivery and cure ulcers
17.	<i>Grewia tenax</i>	Gangeran	Flower paste	Flower paste is given cattle suffering from stomach-ache and indigestion
18.	<i>Moringa oleifera</i>	Moringa	Leaf, flower, pod	Leaf fodder given to livestock for increasing lactation
19.	<i>Ocimum grantissimum</i>	VanTulsi	Leaf decoction	Leaf decoction useful to cure common cold and cough
20.	<i>Ocimum sanctum</i>	Tulsi	Leaf decoction	Leaf juice given to weak cattle to removal stomach parasites
21.	<i>Richinus communis</i>	Castor	Seed paste	Seed paste given orally to cure constipation
22.	<i>Syzygium cumini</i>	Jamun	Bark paste + Neem oil	Park paste applied with neem oil on leg to remove joint pain and leg swelling
23.	<i>Salvadora persica</i>	Palash	Flower paste decoction	Flower paste decoction is orally twice a day to cure paralysis
24.	<i>Tamarindus indica</i>	Imli	Fruit pulp with onion + edible oil	Fruit pulp paste grinded with onin to make paste. The mixture is fried with edible oil and applied on the tongue sores.
25.	<i>Tribulus terrestris</i>	Gokshura	Leaf juice	Leaf juice given orally twice a day to cure colic cough
26.	<i>Vitex negundo</i>	Nirgundi	Dried leaf	Leaf juice is mixed with equal amount of bark juice of Jamun is administered thrice a day for one week to treat diarrhoea and dysentery
27.	<i>Ziziphus jujuba</i>	Ber	Leaf paste + Neem oil	External application of Leaf paste mixed neem oil to cure skin burn

Conclusion

Finally, this study reveals that the majority of native species were belonging to the families of *Euphorbiaceae*, *Fabaceae*, *Asteraceae*, *Solanaceae* and *Amaranthaceae*. Hence, the maximum number of species belong to these families is considered as a pioneer species and indicator of primary succession in ravine region. Sustainable management of rehabilitated Chambal and Yamuna ravines with proper protection definitely enhances the species richness and conservation biodiversity through vegetation cover induced microclimates modification. The present study revealed that the rehabilitated ravine lands have rich diversity of medicinal plants as compared to outside unprotected ravines. Therefore, there is an immediate action like active and passive restoration activities should be initiated to conserve the fragile ecosystem from further degradation. Efforts should be taken to start sustainable cultivation and harvesting programs in the ravine regions and thereby promote local involvement and participation of ravine reforestation and medicinal plant conservation in the region. Hence, this study will further helpful for initiation and retrieval of several medicinal based bio-chemical studies for extracting commercial value from indigenous medicinal plants in the respective ravines.

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