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Diversity and Conservation Strategies of Pharmaceutically important Medicinal plants of Bundelkhand region, India

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ABSTRACT

Bundelkhand is located Central part of India with an unique type of climatic condition having stony sandy and rocky soil deficient in water. Gradual climatic change due to acute pressure on land for various developmental activities are regularly increasing the degradation of biodiversity which is affecting the potential of medicinal plants and invite needs for the conservation of biodiversity of medicinal plants in the region. During the course of various studies authors have identified the medicinal plants of high value, used in top medical prescriptions and traditional medical practices viz. *Acacia catechu* (Khadira), *Asparagus racemosus* (Shatawari), *Boswellia serrata* (Shalaki), *Desmodium gangeticum* (Shalaparni), *Gymnema sylvestre*.(Retz.) R. Br. ex Sm.(Gudmaar), *Hemidesmus indicus* R.Br.(Anantmoola), *Oroxylum indicum* (L.) Kurz, *Pluchia lanceolata* (Rasana), *Tribulus terrestris* (Gokshuru), *Uraria picta* (Prishniparni), *Withania somnifera* (Ashwagandha), *Writia tinctoria* etc. Efforts are needed in acclimatizing the medicinal plants in the garden land, nurseries, development of strategy of protection of natural habitat of the medicinal plants of region, developing agro-technical protocols for cultivation of medicinal plants suitable for farmers to enrich their economy as well as biodiversity under Government control is need of the day ensuring effective conservation of these valuable medicinal resources of the country. Cultivation of *Cymbopogon flexuosus* (Pootika), *Saccharum munja* (Munja), and *Chrysopogon zizanioides* (Ushir) is also the need of time for enriching the biodiversity through conserving the medicinal plants.

Keywords: Bundelkhand, Agro-geoclimatic conditions, Conservation, Pharmaceuticals, Secondary metabolites.

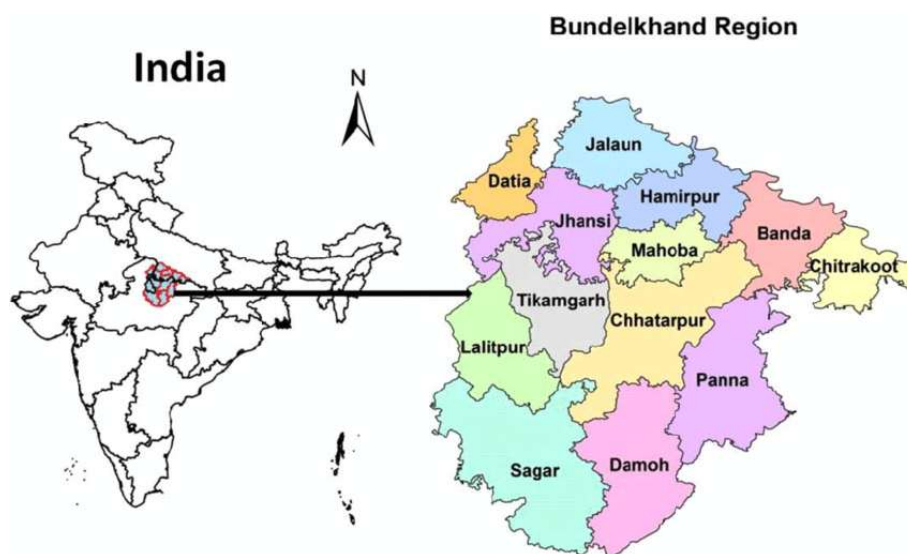
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INTRODUCTION

Bundelkhand region of India is recognized by its unique cultural heritage and topographical identity. The region is named after Bundela domain that replaced the Chandela's from the region in fourteenth century (*Mitra, 1977*). Bundelkhand a part of Central India situated between the gangetic plain and Vindhyan region from north to south. It comprises of seven districts of Uttar Pradesh (Banda, Chitrakoot, Hamirpur, Jhansi, Jalaon, Lalitpur and Mahoba) and six districts of Madhya Pradesh (Chhatarpur, Datia, Damoh, Panna, Sagar and Tikamgarh). The region is located on low altitude with slopes from south to north and topographically it is divided into northern monotonous flat Bundelkhand plain rises up to Bundelkhand plateau, broken down into low flat topped hills in the south. Major part of the region contain impermeable rocky layer making it prone to draught as well as flood. The upland with gentle slopping and hilly terrain contain the sparse vegetation due to scanty rainfall (*Ramesh et al., 2019*).



Source: https://www.researchgate.net/figure/Location-of-Bundelkhand-region_fig1_316907483

China and India are the leading countries both in occurrence of diversity of medicinal plants as well as their utilization (*Rafieian- Kopaei, 2013*). India is recognized as one of the rarest biodiversity enriched country utilizing plants both in modern and traditional system of medicine which is only possible due to the prevalence of diverse agro-geoclimatic conditions in the Indian subcontinent. Bundelkhand region located in Central India is characterized by unique type of climatic condition having dry and hot climatic zone, resembling partly with desert and partly with tropical type, dominated by less rain fall as well as ground water. Soil condition is stony sandy and rocky with water deficient soil. Gradual climatic change due to acute pressure on land for various developmental activities like extraction of sand and stones for building and road constructions are regularly increasing and degrading the biodiversity which is affecting the potential of medicinal

plants of the region. At present due to increased urbanization and industrialization the status of loss of biodiversity in the region become alarming and it reached to the extent that invite the need of proper conservation strategies for the existing biodiversity in the region having valuable medicinal plants. Though the region is classified as hot and dry but this region entails several medicinally important species of herb, shrub and tree that mostly used by the local inhabitants of the region (Mishra *et al.*, 2010; Ahirwar, 2013 & Uniyal *et al.*, 2011). The region also contains rich diversity of ethno-medicinally important weed plants utilized by the local people and herbal practitioners of the region (Maurya & Nigam, 2018). These pharmaceutically important plants contain several pharmacologically important secondary metabolites that bear medicinal implications and hence they are utilized as medicinal resource (Evans, 2009 & Chopra *et al.*, 1992). Since the land is having uniqueness for being suitable for the occurrence and cultivation of selected group of medicinal plants like the plants belonging to spiny Mimosaceae, Solanaceae, Rutaceae, latex bearing Apocynaceae, Asclepiadaceae and succulent plants like *Aloe barbadensis* Mill., and Nitrogen fixing legumes of family Fabaceae. Efforts are being made in acclimatizing the medicinal plants of the region in the garden land and developing agro technical protocols for cultivation of medicinal plants suitable for farmers to enrich their economy as well as biodiversity under Government control. During the course of various studies authors have identified the plants of *Acacia catechu* (L.f.) Willd. (Khadira), *Aegle marmelos* Correa ex Roxb. (Bilwa), *Aloe barbadensis* Mill. (Ghritakumari), *Asparagus racemosus* Willd. (Shatawari), *Boswellia serrata* Roxb. (Shalaki), *Desmodium gangeticum* DC. (Shalaparni), *Fagonia cretica* L. (Dhavasa), *Gymnema sylvestre* (Retz.) R. Br. ex Sm. (Gudmaar), *Hemidesmus indicus* R. Br. (Anantmoola), *Oroxylum indicum* (L.) Kurz, *Pluchea lanceolata* C.B. Clarke (Rasana), *Solanum virginianum* L. (Kantakari), *Tribulus terrestris* L. (Gokshuru), *Uraria picta* Desv. (Prishniparni), *Withania somnifera* Dunal. (Ashwagandha), *Wrightia tinctoria* R. Br. (Swet, Kutaj) etc. The cultivation of grasses like *Cymbopogon flexuosus* (Nees ex Steud.) W. Watson. (Pootika), *Saccharum bengalense* Retz. (Munja), *Tephrosia candida* and *Vetiveria zizanioides* (L.) Nash. (Ushir), *Woodfordia fruticosa* Kurz. (Dhataki) in the region is also the need of time for enriching the biodiversity through conserving the medicinal plants. *Pluchea lanceolata* (DC.) Oliv. and Hiern., a perennial herb is one of the important ayurvedic medicinal plant of the region widely used in arthritis, rheumatism, muscular pain and specially leaves have laxative, analgetic and antipyretic property (Arya & Patni, 2013 & Pandey, 2018).

MATERIALS AND METHOD

Exhaustive and extensive survey has been made in different part of Bundelkhand and areas of occurrence of selected medicinal plants have been identified for conservation. During course of study areas with more dominance were marked and identified for in situ conservation. Meanwhile germplasm for cultivation in other places was collected and studies on germination and plant growth and development were recorded for extension of the plant cultivation to other land. Side by side protocols for extending the cultivation practices with an involvement of farmers and other land holders were prepared. Some thematic facts and findings for public participation in cultivation programmes of medicinal plants were also noted. Meanwhile germplasm from of some important medicinal plants were procured and acclimatized in the Medicinal Plants garden of the Ewing Christian College. Soil analysis and developing agro technique for medicinal plants has been initiated and conservation of medicinal plants is being worked out on the pattern as suggested by different authors (*Piper, 1950; Jackson, 1973; Panse & Sukhatme, 1978; Shankar & Rawat, 2013 & Shankar et.al., 2015, 2016*).

Acclimatization of plants growing in wet tropical zone are also being carried out through which *Abroma augusta* L., *Acorus calamus* L., *Alpinia galangal* Willd., *Curcuma aromatica* Salisb., *Curcuma caesia* Roxb. , *Curcuma zedoeria* Rosc. , *Oroxylum indicum* Vent, *Saraca asoca* (Roxb.) De Wilde, *Tecomela undulate* (Sm.) Seem, etc. which has given fruitful results.

RESULTS AND DISCUSSION

During course of study it was found that the area is dry tropical and rain fall and ground water is least in different areas however, certain spots were marked as marshy places where water level is within 3 to 8 feet. Under such land plants of *Acorus calamus* L., *Alpinia galangal* Willd., *Costus speciosus* (Koenig) Sm., *Curcuma aromatica* Salisb., *Curcuma. caesia* Roxb .are found suitable for cultivation. During exploration of medicinal plants certain areas for conservation of the selected medicinal plants within the region has also been identified. Most of the important medicinal of this dry region are at the brink of threat of the gradual loss due to felling of the trees by local peoples, increased grazing area for the cattle, construction of road highway and roads and rapid urbanization and erratic monsoon prevailing in the region since long.

General vegetation of Bundelkhand is having distribution of medicinal plants like *Abutilon indicum*(L.) Sweet, *Boerhaavia diffusa* L., *Centella asiatica* (L.) Urban, *Convolvulus arvensis* L., *Gymnema sylvestre* (Retz.) R. Br. ex Sm., *Heliotropium indicum* L., *Hemidesmus indicus* R.Br., *Oroxylum indicum*(L.) Kurz, *Phyllanthus amarus* Schum &Thonn., *Pluchia lanceolata* C.B.

Clarke , *Sida rhombifolia* L., *Solanum virginianum*, *Tribulus terrestris* L., *Withania somnifera* Dunal etc. as ground medicinal flora and tree species of *Acacia catechu*(L.f.)Willd, *Aegle marmelos* Correa exRoxb., *Alstonia scholaris* R.Br., *Butea monosperma* (Lam.)Kuntze, *Pongamia pinnata* Pierre, *Ceiba pentrandra* (L.)Gaertn., *Wrightia tinctoria* R. Br. etc. which needs protection through mass cultivation as their occurrence is not so dominated that they can serve the purpose of pharmaceuticals. Accordingly, these plants were identified for mass cultivation for economic growth of the farmers as well as for conservation in the areas where they are distributed.

In general plants of *Aloe barbadensis* Mill.(Ghritakumari), *Asparagus racemosus* Willd.(Shatawari), *Boswellia serrata*Roxb.(Shalaki), *Desmodium gangeticum*DC.(Shalaparni), *Fagonia cretica* L.(Dhavasa),*Hemidesmus indicus* R.Br.(Ananta moola),*Oroxylum indicum* (L.) Kurz.*Pluchia lanceolata*C.B.Clarke(Rasana), *Solanum virginianum* L. (Kantakari), *Tribulus terrestris*L.(Gokshuru), *Uraria picta*Desv.(Prishniparni), *Withania somnifera*Dunal (Ashwagandha), *Writia tinctoria*R.Br. (Swet Kutaj) etc.Grasses cultivation of *Cymbopogonflexuosus*(Pootika),*Saccharum bengalense* Retz., and *Vetiveria zizanioides*(L.)(Ushir) may also be undertaken for improvement of the socio economic status through medicinal plants cultivation in the areas.

Table1. Enumerations of pharmaceutically important plants of Bundelkhand region their active pharmaceuticals and medicinal use.

Botanical name	Family	Common name	Active phytochemicals	Medicinal use
<i>Abroma augusta</i> (L.) L.f.	Malvaceae/Sterculiaceae	Devil's cotton , Ulatkambal	Abromine, sterol abromasterol, betaine,amyrin	Antidiabetic, used in treatment of amenorrhea, antifertility, uterine tonic and used in dysmenorrhoea, antioxidant
<i>Abutilon indicum</i> (Link) Sweet	Malvaceae	Kanghi, Atibala	Sitosterol, alkaloids, cardiac glycosides	Leaves demulcent, bark astringent , diuretic , used in treatment of bronchitis, anti- diabetic, seeds aphrodisiac and laxative
<i>Acacia catechu</i> (L.f) Willd.	Fabaceae	Khadira	Cathechin, catechtannic acid, epcatechin, catechol	Bark astringent, masticator
<i>Acorus calmus</i> L.	Araceae/Acoraceae	Vacha	Asarone, acorone	Emetic, dyspeptic and colic, nerve tonic and also used in bronchitis.
<i>Aegle marmelos</i> (L.) Correa ex Roxb.	Rutaceae	Bilwa, Bael, Golden apple	Marmalysin (fruit), marmesin, furocoumarin, rutin , Aegeline (leaf)	Pulp aromatic, cooling and laxative, astringent, antiulceric, antidiarrhoeal, antidysentric
<i>Aloe barbadensis</i> Mill.	Liliaceae/Asphodelaceae	Ghritkumari	Aloin, Isobarbaloin, aloe- emodin, Chrysophanic acid	Purgative, anthelmentic,used in piles and rectal fissures, constipation and mental disorders
<i>Alpinia galangal</i> (L) Willd.	Zingiberaceae	Barakulanjan/ blue ginger	Galangal, cineol, eugenol	Rhizome used in rheumatism and fever, carminative and aphrodisiac
<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	Saptaparna/devil tree	Echitenine, echitamine,Ditamine and strictamine	Bark febrifuge and used in malaria, dysentery and diarrhoea
<i>Asparagus racemosus</i> Willd.	Liliaceae / Asparagaceae	Shatawari	Shatavarin, asparagamine, shatavarosides	Rejuvenative, inducer of WBC production,

				antitumouric, diuretic, demulscent and aphrodisiac
<i>Boerhaavia diffusa</i> L. nom.cons.	Nyctaginaceae	Punarnava	Punarnavine, phytoecdysone, Boeravinones	Anti-inflammatory, expectorant, diuretic, used in oedema, anemia, jaundice, hepatoprotective
<i>Boswellia serrata</i> Triana & Planch.	Burseraceae	Shalaki/salai guggul	Boswellic acid	Gum diaphoretic, anti-inflammatory diuretic, astringent and used in rheumatism
<i>Butea monosperma</i> (Lam.)Taub.	Fabaceae Zingiberaceae	Palash/Dhak/flame of the forest	Alkaloids, steroid, flavonoids, glycosides	Astringent, diuretic, anthelmintic used in diarrhoea and dysentery.
<i>Centella Asiatic</i> (L.)Urban. <i>Hydrocotyle asiatica</i> L.	Apiaceae	Brahmi/ manduki brahmi	Asiaticosides, brahmosides, centellosides	Tonic of nerve and blood, improve memory and used in syphilitic, antirheumatic
<i>Convolvulus arvensis</i> L.	Convolvulaceae	Field bindweed	Convolvulin, scammonic acid	Root purgative, used as nervous and brain tonic improving memory, used in hypertension, anxiety and stress
<i>Curcuma aromatic</i> Salisb.	Zingiberaceae	Jungli haldi	Curcumins, Curcuminoids (diferuloyl methane), dihydrocurcumin	Rhizome tonic, carminative, stomachic, diuretic, antihepatotoxic, used in sprains and bruises
<i>Curcuma caesia</i> Roxb.	Zingiberaceae	Kali haldi	Alkaloids, flavanoids, tannins, saponins	Aromatic, stimulants, carminative used in sprains and bruises
<i>Curcuma zedoaria</i> Rosc.	Zingiberaceae	Sati/ Kachura	Alkaloids, flavanoids, tannins, saponins	Rhizome stomachic, cooling, diuretic, carminative applied to bruises and pain.
<i>Desmodium</i>	Fabaceae	Shalaparni/Anshumati	N-dimethyltryptamine,	Root astringent, used in

<i>gangeticum</i> (L.) DC.			hypaphorine, Hordenine, Deesmodin, Caudicine	diarrohea,carminative diuretic, used in cough asthma and vomiting
<i>Fagonia cretica</i> L.	Zygophyllaceae	Dhavasa	Triterpenoids, saponins, flavanoids , glycosides	Anti-inflamaory, androgenic, antitumorogenic, Astringent, febrifuge, prophylactic against small pox, anticancerous
<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Sm.	Asclepiadaceae	Gudamar	Gymnemic acid, guramin, gymnemasaponin, triterpenes saponins, hydroxy longispinogenin	Antidiabetic, enhances sugar absorption
<i>Heliotropicum indicum</i> L.	Boraginaceae	Hatisura	Alkaloids, saponins, steroids, terpenoids, glycosides, phenols. -	Leaves applied to ulcers and wound, antitumoric
<i>Hemidesmus indicus</i> R. Br.	Asclepiadaceae	Anantmoola/ Indian sarsaprilla	Hemidesmine, amyrrin, hemidesminone	Demulcent, diaphoretic, diuretic, tonic in loss of appetite, used in leucorrohea, syphilis, blood purifier
<i>Oroxylum indicum</i> (L.) Benth. ex Kurz	Bignoniaceae	Indian trumpet flower/Shyonaka	Oroxinidin, oroxylin, emodin, sitosrerol	R4ootbark astringent, used in diarrrohea and dysentery, diaphoretic used in rheumatism
<i>Phyllanthus amarus</i> Schum.&Thonn.	Euphorbiaceae/Phyllanthaceae	Bhui amla	Phyllanthine, hypophyllanthine, flavonoids, astralgin, quercetrin	Used in syphilis, leucorrohea and rheumatism
<i>Pluchea lanceolata</i> C.B. Clarke.	Asteraceae	Rasana	Pluchicine, quercetin, hesperidin, isorhamentin,	Leaves laxative used as substitute of Senna, anti- inflammatory analgesic
<i>Pongamia pinnatas</i>	Fabaceae	Karanj	Alkaloids, glycosides, saponins, phenols, tepenoids	Seed oil used in cutaneous affections, herpes and scabies, liver ulcers and

				piles
<i>Sida rhombifolia</i> L.	Malvaceae	Swet barela	Vascin, ephedrine	Roots used in rheumatism, stem demulcent used in pulmonary tuberculosis
<i>Solanum virginianum</i> L.	Solanaceae	Kantkari, Katili bhatkataya	Alkaloids, glycosides, saponins	Cough, asthma
<i>Tecomella undulata</i> (Sm.)Seem.	Bignoniaceae	Desert teak, Marwar teak	Rodermachol, lapachol, sitosrterol, ursolonic acid	Syphilis treatment, urinary disorder, leucoderma, liver disorder
<i>Tribulus terrestris</i> L.	Zygophyllaceae	Gokshsru, Bindii	Flavonoids, flavanol glycosides, steroids, saponins	Fruit cooling , diuretic, aphrodisiac, used in painful micturition, calculus affection, improve blood glucose and cholesterol level.
<i>Uraria picta</i> Desv.	Fabaceae	Prishniparni, Pithava, Dabra	Steroids, flavanoids, terpenoids, glycosides, saponins	Fruit applied to sore mouth of children's
<i>Withania somnifera</i> Dunal.	Solanaceae	Ashwagandha	Withanolides, withaferin	root aphrodisiac, ,antibacterial, aborifacient, used in rheumatism and debility from old age
<i>Woodfordia fruticosa</i> Kurtz.	Lythraceae	Dhataki	Phytosterols, glycosides, alkaloids tepenoids, flavanoids	Liver disorder, astringent used in menorrhagia
<i>Wrightia tinctoria</i> R.Br.	Apocynaceae	Sweet kutaj/Indrajau	Flavanoids, lupeol, stigmasterol , campesterol	Bark tonic , seed aphrodisiac

Conservation strategies in Bundelkhand

Wild medicinal plants are the valuable sources of new pharmaceuticals, herbal products and drugs in both developed and developing countries as sufficient portion of top prescriptions of medicines are directly or indirectly derived from plants (*Hamilton , 2004 & Balunas and Kinghorn, 2005*). The conservative estimates showed that the current loss of plant species is many time higher than the rate of natural extinction and the extent of loss is so as the earth is losing minimum of one highly potential drug in every 2 years (*Pimm et al, 1995*). As per the estimation of International Union for Conservation of Nature (IUCN) and World Wildlife Fund (WWF) that 15-30% of the total plants used for the purpose of medicine are at the brink of extinction whereas about 20% have been nearly exhausted due to overharvesting, overexploitation, habitat destruction, indiscriminate collections, uncontrolled deforestation and industrialization (*Bentley, 2010*). Since the demands of the wild medicinal plants are gradually increasing beyond the threshold limit of the reproductive ability of plant leading to its overexploitation and resulting irreversible reduction in its reproductive ability and resulting loss of the species from the habitat (*Semwal et al, 2007*).

Extensive investigation regarding sustainable utilization and conservation of medicinal plants have been carried out by different authors including recommendations based on the establishment of species status monitoring and inventorying system for existing medicinal plants followed by need for concerted effort for coordinated conservation through in-situ, ex-situ and in-vitro conservation strategies (*Hamilton, 2004*).

For the proper and effective implementation of conservation strategies of medicinal plants it is imperative to have appropriate knowledge of the botanical characteristic, habit, habitat, phonological period and geographical distribution of the medicinal plant species to be conserved. It helps in planning the type of conservation activities to be adopted for specific medicinal plant.

In- situ conservation strategies

The natural reserves and wild habitat and wild nurseries are the typical examples of this type of conservation and retaining the medical efficacy and uniqueness of medicinal plants. The medicinal property of a plant is due to presence of specific secondary metabolites, synthesized by the expression of specific genes under the influence of specific biotic and a-biotic stimuli and stresses prevail in the natural habitat. So any alteration in natural habitat of medicinal plant may alter the metabolic pathway of synthesis of medicinally desired secondary metabolites consequently declining the medicinal values of the plant species. Thus the conservation of medicinal plants in their natural habitat for maintaining their medicinal efficacy is the best strategy for their

conservation and cultivation. Conservation of medicinal plants in their natural habitat also ensures the conservation of its natural relatives (*Chen et al 2016*).

Following in -situ conservation strategy can be recommended for the conservation of medicinal plants in Bundelkhand region.

- Establishment of natural reserves in the region by prohibiting the degradation and destruction of the natural habitat of specific medicinal plants in the region.
- Establishment of species oriented wild nursery for cultivation and domestication of medicinal plants of the region.
- Declaration conservation sites/ areas for specific medicinal plants.
- Collection of drugs from half portion of the identified area and leave rest half for further germination and growth of the specific medicinal plants followed by drug collection from rest part in next and subsequent years. This will results in no loss of drugs from natural habitat. Meanwhile nursery must be establish for raising seedlings for further cultivation activities.
- Demarcation of conservation sites with proper sign board and nursery at entrance will help the people to know how for the areas earmarked and getting the visitors the planting material for cultivation of medicinal plants.

Ex –situ conservation strategy through cultivation of Medicinal Plants

Though ex-situ conservation strategy is not effective for the conservation of medicinal plants having unique medicinal property as it may results in alteration of the uniqueness of the secondary metabolites due changed habitat. But this strategy is effective to ensure the conservation of over exploited and endangered medicinal plants with slow growth rate and high susceptibility to disease. Medicinal plants cultivation is a long and short term involvement which requires land, germ- plasm and methodology for cultivation as well as marketing.

Various scientific institutions universities, science colleges, research institutions may play a vital knowledgeable role for developing germplasm bank of economically viable medicinal plants. Identification of genuine drug yielding plants to be conserved through cultivation is an essential part which can be served by the research institutions only. Medicinal plants of the region can be effectively conserved by implementing of good agricultural practices. Farmers role goes very critical for why they go for medicinal plants and how? The role of farmers is to undertake medicinal plants cultivation with assurance by the consumers like pharmaceuticals who need more crude drugs with legal memorandum of understanding.

In general the farmers should prefer mixed cropping of herbal drug plants with crop plants to avoid any loss from this type of cultivation. This practice of mixed cropping of herbals with crop plants ensures the health protection of crop plants as described in Vrikshayurveda literatures. Litters of medicinal plants serve the purpose of organic pest controller and fertility enhancer of crops in the field by allopathic associations of medicinal and crop plants. Purpose of organic farming is also becoming a part of the crops through mixed cropping.

Sustainable use of Medicinal plants

Sustainable use of medicinal plants and good harvesting practices should be considered as effective conservation approach which can be ensured by protecting the propagative part or propagules of plans and root from destruction during the use of medicinal plants.

In-vitro culture practices

Now a day's effective tissue culture technique are available for conservation and propagation of medicinal plants. Cell and tissue culture techniques, molecular farming and biotransformation techniques based on totipotency of plant cell can be exploited for valuable drugs from the plants without imposing any adverse effect on biodiversity of medicinal plants.

CONCLUSION

Bundelkhand region contains rich diversity of valuable medicinal plants but due to natural and anthropogenic pressure on the natural habitat some of these medicinal resources are at the risk of extinction from the region or they are gradually losing their medicinal efficacy. Therefore effective conservation plan is imperative to protect and conserve these valuable drug yielding natural resources along with their natural metabolites. The large scale cultivation approach of domestication of the valuable medicinal plants in this region can be recommended as fruitful approach of conservation of the threatened and less explored pharmaceutically important plants of this region.

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