Research article

Medicinal plants diversity modelling using remote sensing & GIS technology of Chilkigarh, West Bengal, India

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Abstract: The present study integrates Remote Sensing, GIS and ground survey to study the floristic composition of medicinal as well as herbal plants within and around Chilkigarh village; the major fascination of Chilkigarh, West Bengal, India. The Global Positioning System (GPS) and Geographic Information System (GIS) layers of land use and land cover (LULC), and plants species location interpolated were created using thematic functions in Arc GIS software. The relationship between the landuse and medicinal plant species were implemented to explore the plants modeling both spatial and non-spatial data under the GIS platform. The forest is covered with 184 medicinal plant species under 155 genera, distributed among 56 plant families under the division Mono-cotyledons and Di-cotyledons. Our checklist represents some dominating families like- Fabaceae (16), Poaceae (13) Asteraceae (13), Euphorbiaceae (13), Malvaceae (11), Apocynaceae (10), Araceae (9), Acanthaceae (8), Solanaceae (7). Rubiaceae (6), Verbenaceae (6) among the 184 species, presented checklist includes herbs (98), shrubs (33), trees (34), climbers (18) and epiphyte (1). Finally, the medicinal plant's information as a geographic database determination assists the conservation prioritization, methodical documentation, continuous monitoring and safeguard the forest from anthropogenic activities of the plant species.

Keywords: Bio-processing - GIS - Global positioning system - Medicinal plants - Chilkigarh.

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INTRODUCTION

The government of West Bengal has been declared that Chilkigarh consecrated orchard within Jhargram as a biodiversity affluent heritage site (Goswami 2018) after considering and elongated to eminence of stress to feel necessitate of legislation concerning the protection of consecrated groves within the state. The Jhargram district under the Jamboni police station is commonly name as Chilkigarh the heritage site of West Bengal government. Now, over 47500 plant species familiar from India surrounded by them the angiosperms have over 18,000 species which correspond to additional than 1.4% of the world's recognized flowering plants (Goswami 2018). The West Bengal is a species rich diverse region, contains diversity of species naturally or through man-made plantation, augmented through different sapling system. It consists of mixed vegetation of deciduous, semi-deciduous and evergreen trees. This vegetation is on totally private land bounded by crop fields, households, Sal forests and river. But in recent times, this biodiversity-rich area is gradually losing its diversity due to some anthropogenic activities like habitat loss, introduction of invasive species, grazing and deficiency of appropriate management.

The application of Geographic Information System (GIS) technology in ethnobotanical work is a forthcoming research field. Geo-visualization study in last 15 years has concentrating substantial efforts to ornamental potential and interactive maps (MacEachren *et al.* 2008, Biswas *et al.* 2017). The GIS and Global

Positioning System (GPS) system to important tools in conservation of medicinal plants through geospatial modelling were reported in many studies (Mustalish *et al.* 1996, Schumaker 1996, Sperduto & Congalton 1996, Roy & Tomar 2000, Saadi *et al.* 2016). The GIS and GPS is by far the most articulate tools used nowadays for studying the forest, vegetation and plants cover of a particular area.

This study exhibited that the investigation of medicinal plants in the upper slopes region has a maximum elevation range of 60–85 m. The major objective of this study is to prepare a geospatial study of the medicinal plants of the geo-botanical map to incorporating various geo-ethnobotanical information by GPS and GIS platforms for management and conservation of the plants. The interrelationship between land use and land cover and elevation, slopes wise to identify the particular location of medicinal plants species to destitution under the GIS platform; the hotspots zone where in-situ management and conservation would be possible to reduce the anthropogenic stresses on medicinal plants.

MATERIALS AND METHODS

Data and method

An extensive study was carried out throughout the forest of Kanakdurga temple from 2012–2017 in different seasons. Collected plants were identified properly from recent floras as well as different herbarium specimens accessible in Vidyasagar University and Botanical Survey of India, Shibpur, Howrah.

The most recent technology of GPS and Remote Sensing & GIS are enormously appreciated in the expansion of databanks. The Land sat 8 OLI satellite cloud-free data of 2018 were downloaded from GLOVIS site. The essential aspects of this work were through based on interpretation for Land use and Land cover (LULC) mapping using satellite image. The GPS technology using to exacting geo-position of the particular plants to the identification and incorporating the diverse of geo-ethnobotanical information under the GIS platform. The RS & GIS software Erdas Imagine were used for satellite image analysis and data processing, the Arc GIS have been used for geodatabase creation to set up and propose to final map of LULC and exacting medicinal plants location of the present area.

Study area

Figure 1. Location of study area.

The West Bengal state consists of 23 districts among them Jhargram district is the most species diversity rich area. Chilkigarh village is the parts of Jhargram which focus the zone of bio-diversity and situated more or less 57 km north-west of Kharagpur railway station under Jamboni police station. Our study is restricted to the Chilkigarh village and the major attraction of Chilkigarh is the Kanakdurga temple (Fig. 1). Detailed field surveys were made in this forest belt from 2012 to 2017. The area is located between latitudes 22° 27' 20" N to 22° 56' 50" N and longitude 86° 52' 20" E to 86° 53' 10" E; while the average elevation is 60–85 m of the mean sea level (Table 1, Fig. 2). The landscape ecology of Chilkigarh was mapped in terms of fragmentation, patchiness, interspersions, and porosity using GIS and GPS spatial analysis of the vegetation type map generated by remote sensing information. This study major landuse pattern is dense Sal forest, dominated area settlement and fallow land and the main river are Dulung (Fig. 3).

Table 1. Medicinal plant species location.

Name of the species identified (Vidyasagar University and Botanical Survey of India)	Latitude	Longitude	Elevation (m)
<i>Ampelocissus latifolia</i> (Roxb.) Planch.	2483044	487744	70
<i>Dioscorea bulbifera</i> L.	2482944	487869	67
<i>Diospyros malabarica</i> (Desr.) Kostel.	2482835	487880	69
<i>Diospyros sylvatica</i> Roxb.	2482853	487980	74
<i>Geodorum densiflorum</i> (Lam.) Schltr.	2483069	487783	67
<i>Globba racemosa</i> Sm.	2483037	487811	75
<i>Helicteres isora</i> L.	2483128	487913	79
<i>Ichnocarpus frutescens</i> (L.) W. T. Aiton	2483082	487879	72
<i>Mallotus philippensis</i> (Lam.) Muell.Arg.	2482808	487855	78
<i>Putranjiva roxburghii</i> Wall.	2482951	487911	76
<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	2483023	487758	78
<i>Scindapsus officinalis</i> (Roxb.) Schott	2482765	487948	81
<i>Tacca leontopetaloides</i> (L.) Kuntze	2482830	487863	75
<i>Tropidia curculigoides</i> Lindl.	2482723	487911	85
<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	2482975	487790	78

Figure 2. Plant species map of study area (Chilkigarh, West Bengal, India).

Figure 3. Land use and land cover map of Chilkigarh, West Bengal, India.

RESULTS AND DISCUSSION

Upto now, India has recorded 18000 flowering plant species. Among them the forest of Kanakdurga temple contains 1%, which amounts a total of 184 species (Table 2, 3) (36 and 148 from monocot and dicot respectively) 155 genera and 56 families were recorded. Most of the 56 plant families the dominating families like- Fabaceae (16), Poaceae (13) Asteraceae (13), Euphorbiaceae (13), Malvaceae (11), Apocynaceae (10), Araceae (9), Acanthaceae (8), Solanaceae (7). Rubiaceae (6), Verbenaceae (6). They have different plant habits like herbs, shrubs, trees, climbers and epiphyte represent 98, 33, 34, 18 and 1 species respectively. This forest generate 16 species with edible fruits, 15 species used as timber, 13 species having firewood value, and 140 species are ethno-medicinally most important species. Here *Ampelocissus latifolia* (Roxb.) Planch., *Dioscorea bulbifera* L., *Diospyros malabarica* (Desr.) Kostel., *Diospyros sylvatica* Roxb., *Ecbolium viride* (Forssk.) Alston., *Eulophia ochreatea* Lindl., *Globba racemosa* Sm., *Helicteres isora* L., *Ichnocarpus frutescens* (L.) W. T. Aiton, *Mallotus philippensis* (Lam.) Muell.Arg., *Putranjiva roxburghii* Wall., *Rauvolfia serpentina* (L.) Benth. ex Kurz, *Scindapsus officinalis* (Roxb.) Schott, *Tacca leontopetaloides* (L.) Kuntze, *Tropidia curculigoides* Lindl. and *Zingiber zerumbet* (L.) Roscoe ex Sm. are gradually disappearances from the surrounding forest areas. This study revealed that shrubs is absent in monocotyledons except herbs are largely dominated than trees in dicot. Our checklist recorded families with a maximum number of species include Fabaceae and 2 invasive species including *Lantana camara* L., *Parthenium hysterophorus* L. Quantitative and qualitative floristic survey, constant monitoring and protection the whole diversity should be require to save the different plant species.

Table 2. List of plant species under the division Monocotyledones.

Family	Species	Habit	Habitat
Araceae	<i>Alocasia macrorrhizos</i> (L.) G.Don	Herb	Terrestrial
	<i>Amorphophallus bulbifer</i> (Roxb.) Blume	Herb	Marshy
	<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	Herb	Marshy
	<i>Caladium bicolor</i> (Aiton) Vent.	Herb	Marshy & Shady
	<i>Colocasia esculenta</i> (L.) Schott	Herb	Marshy
	<i>Dieffenbachia seguine</i> (Jacq.) Schott	Herb	Marshy
	<i>Pothos scandens</i> L.	Climber	Terrestrial
	<i>Scindapsus officinalis</i> (Roxb.) Schott	Climber	Terrestrial
	<i>Typhonium trilobatum</i> (L.) Schott	Herb	Terrestrial
Arecaceae	<i>Borassus flabellifer</i> L.	Tree	Terrestrial
	<i>Phoenix sylvestris</i> (L.) Roxb.	Tree	Terrestrial

Commelinaceae	<i>Commelina benghalensis</i> L.	Herb	Moist
	<i>Commelina diffusa</i> Burm.f.	Herb	Moist
Costaceae	<i>Cheilocostus speciosus</i> (J.Konig) C.Specht.	Herb	Terrestrial
Cyperaceae	<i>Cyperus kyllinga</i> Endl.	Herb	Marshy
	<i>Cyperus rotundus</i> L.	Herb	Marshy
Hypoxidaceae	<i>Curculigo orchiodes</i> Gaertn.	Herb	Marshy
Orchidaceae	<i>Eulophia ochreatea</i> Lindl.	Herb	Terrestrial
	<i>Nervilia plicata</i> (Andrews) Schltr.	Herb	Terrestrial
	<i>Tropidia curculigoides</i> Lindl.	Herb	Terrestrial
	<i>Vanda tessellata</i> (Roxb.) Hook. ex G.Don	Epiphytic	Terrestrial
Poaceae	<i>Aristida funiculate</i> Trin. & Rupr	Herb	Marshy
	<i>Bambusa tulda</i> Roxb.	Tree	Terrestrial
	<i>Chloris barbata</i> Sw.	Herb	Marshy
	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Herb	Marshy
	<i>Cynodon dactylon</i> (L.) Pers.	Herb	Marshy
	<i>Digitaria sanguinalis</i> (L.) Scop.	Herb	Marshy
	<i>Echinochloa colona</i> (L.) Link	Herb	Marshy
	<i>Echinochloa frumentacea</i> Link	Herb	Marshy
	<i>Eleusine indica</i> (L.) Gaertn.	Herb	Marshy
	<i>Paspalidium flavidum</i> (Retz.) A. Camus	Herb	Marshy
	<i>Sporobolus diander</i> (Retz.) P.Beauv.	Herb	Marshy
	<i>Saccharum spontaneum</i> L.	Herb	Marshy
	<i>Setaria glauca</i> (L.) Beauv.	Herb	Marshy
Zingiberaceae	<i>Globba racemosa</i> Sm.	Herb	Marshy
	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	Herb	Marshy

Table 3. List of plant species under the division Dicotyledones.

Family	Species	Habit	Habitat
Acanthaceae	<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Herb	Terrestrial
	<i>Barleria prionitis</i> L.	Shrub	Terrestrial
	<i>Dipteracanthus prostrates</i> (Poir.) Nees.	Herb	Terrestrial
	<i>Ecbolium viride</i> (Forssk.) Alston.	Shrub	Terrestrial
	<i>Justicia gendarussa</i> Burm.f.	Shrub	Terrestrial
	<i>Justicia adhatoda</i> L.	Shrub	Terrestrial
	<i>Rungia pectinata</i> (L.) Nees	Herb	Terrestrial
	<i>Ruellia tuberosa</i> L.	Herb	Terrestrial
Amaranthaceae	<i>Achyranthes aspera</i> L.	Herb	Terrestrial
	<i>Aerva lanata</i> (L.) Juss. ex Schult.	Herb	Terrestrial
	<i>Amaranthus spinosus</i> L.	Herb	Terrestrial
	<i>Celosia spicata</i> L.	Herb	Terrestrial
	<i>Gomphrena globosa</i> L.	Herb	Terrestrial
	<i>Gomphrena serrata</i> L.	Herb	Terrestrial
Anacardiaceae	<i>Anacardium occidentale</i> L.	Tree	Terrestrial
	<i>Mangifera indica</i> L.	Tree	Terrestrial
Apocynaceae	<i>Catharanthus roseus</i> (L.) G.Don	Shrub	Terrestrial
	<i>Calotropis gigantea</i> (L.) W.T.Aiton	Shrub	Terrestrial
	<i>Gymnema sylvestre</i> R.Br.	Climber	Terrestrial
	<i>Hemidesmus indicus</i> (L.) R.Br.	Climber	Terrestrial
	<i>Holarrhena pubescens</i> Wall. ex G.Don	Tree	Terrestrial
	<i>Ichnocarpus frutescens</i> (L.) W.T. Aiton	Climber	Terrestrial
	<i>Pergularia daemia</i> (Forsk.) Chiov.	Climber	Terrestrial
	<i>Rauvolfia tetraphylla</i> L.	Shrub	Terrestrial
	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	Herb	Terrestrial
	<i>Tylophora indica</i> (Burm.f.) Merrill	Climber	Terrestrial
Asteraceae	<i>Acmella oleracea</i> (L.) R.K. Jansen	Herb	Terrestrial
	<i>Ageratum conyzoides</i> L.	Herb	Terrestrial
	<i>Blumea lacera</i> L.	Herb	Terrestrial
	<i>Chromolaena odorata</i> (L.) King & H.E. Robins.	Herb	Terrestrial
	<i>Eclipta prostrata</i> (L.) L.	Herb	Marshy
	<i>Elephantopus scaber</i> L.	Herb	Terrestrial

	<i>Mikania micrantha</i> Kunth	Climber	Terrestrial
	<i>Parthenium hysterophorus</i> L.	Herb	Terrestrial
	<i>Synedrella nodiflora</i> (L.) Gaertn.	Herb	Terrestrial
	<i>Acmella paniculata</i> (Wall. ex DC.) R.K. Jansen	Herb	Terrestrial
	<i>Tridax procumbens</i> L.	Herb	Terrestrial
	<i>Vernonia cinerea</i> Less	Herb	Terrestrial
	<i>Xanthium strumarium</i> L.	Herb	Terrestrial
Boraginaceae	<i>Heliotropium indicum</i> L.	Herb	Terrestrial
Caryophyllaceae	<i>Polycarpaea corymbosa</i> (L.) Lam.	Herb	Terrestrial
Cannabaceae	<i>Trema orientalis</i> (L.) Blume	Tree	Terrestrial
Cleomaceae	<i>Cleome viscosa</i> L.	Herb	Terrestrial
Capparaceae	<i>Crateva nurvala</i> Buch.-Ham.	Tree	Terrestrial
Combretaceae	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	Tree	Terrestrial
Costaceae	<i>Cheilocostus speciosus</i> (J. König) C. Specht.	Herb	Terrestrial
Convolvulaceae	<i>Evolvulus alsinoides</i> L.	Herb	Terrestrial
	<i>Evolvulus nummularius</i> (L.) L.	Herb	Terrestrial
	<i>Merremia tridentata</i> (Linn.) Hallier f.	Herb	Terrestrial
Crassulaceae	<i>Bryophyllum pinnatum</i> (Lam.) Oken.	Herb	Terrestrial
Cucurbitaceae	<i>Coccinia grandis</i> (L.) J. Voigt	Climber	Terrestrial
Dioscoreaceae	<i>Dioscorea alata</i> L.	Climber	Terrestrial
	<i>Dioscorea bulbifera</i> L.	Climber	Terrestrial
	<i>Dioscorea esculenta</i> var. <i>spinosa</i> (Roxb.) Prain & Burkill.	Climber	Terrestrial
	<i>Tacca leontopetaloides</i> (L.) Kuntze	Herb	Terrestrial
Ebenaceae	<i>Diospyros malabarica</i> (Desr.) Kostel.	Tree	Terrestrial
	<i>Diospyros sylvatica</i> Roxb.	Tree	Terrestrial
Euphorbiaceae	<i>Acalypha indica</i> L.	Herb	Terrestrial
	<i>Breynia vitis-idaea</i> Burm.f.	Shrub	Terrestrial
	<i>Croton bonplandianum</i> Baill	Herb	Terrestrial
	<i>Euphorbia heterophylla</i> L.	Herb	Terrestrial
	<i>Euphorbia hirta</i> L.	Herb	Terrestrial
	<i>Jatropha curcas</i> L.	Shrub	Terrestrial
	<i>Jatropha gossypifolia</i> L.	Shrub	Terrestrial
	<i>Mallotus philippensis</i> (Lam.) Muell.Arg.	Tree	Terrestrial
	<i>Pedilanthus tithyzinioides</i> L.	Herb	Terrestrial
	<i>Phyllanthus fraternus</i> Webster	Herb	Terrestrial
	<i>Phyllanthus virgatus</i> G. Forst.	Herb	Terrestrial
	<i>Ricinus communis</i> L.	Shrub	Terrestrial
	<i>Tragia involucrata</i> L.	Shrub	Terrestrial
Fabaceae	<i>Abrus precatorius</i> L.	Climber	Terrestrial
	<i>Albizia lebbek</i> (L.) Benth.	Tree	Terrestrial
	<i>Alysicarpus vaginalis</i> (L.) DC.	Herb	Terrestrial
	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Tree	Terrestrial
	<i>Casia aldabrensis</i> Hemsl.	Herb	Terrestrial
	<i>Cassia occidentalis</i> L.	Shrub	Terrestrial
	<i>Cassia tora</i> L.	Shrub	Terrestrial
	<i>Crotalaria pallid</i> Aiton	Herb	Terrestrial
	<i>Derris scandens</i> (Roxb.) Benth.	Tree	Terrestrial
	<i>Desmodium gangeticum</i> (L.) DC.	Shrub	Terrestrial
	<i>Indigofera miniata</i> Ortega	Herb	Terrestrial
	<i>Millettia pinnata</i> (L.) Panigrahi	Shrub	Terrestrial
	<i>Mimosa pudica</i> L.	Herb	Terrestrial
	<i>Mucuna pruriens</i> (L.) DC.	Climber	Terrestrial
	<i>Tephrosia purpurea</i> (L.) Pers.	Herb	Terrestrial
	<i>Tamarindus indica</i> L.	Tree	Terrestrial
Lamiaceae	<i>Anisomeles indica</i> L.	Shrub	Terrestrial
	<i>Leonotis nepetifolia</i> (L.) R.Br.	Herb	Terrestrial
	<i>Ocimum tenuiflorum</i> L.	Herb	Terrestrial
	<i>Ocimum gratissimum</i> L.	Herb	Terrestrial
Malvaceae	<i>Abelmoschus moschatus</i> Medik.	Shrub	Terrestrial

	<i>Abutilon indicum</i> (Link) Sweet	Herb	Terrestrial
	<i>Grewia hirsuta</i> L.	Tree	Terrestrial
	<i>Grewia serrulata</i> DC.	Tree	Terrestrial
	<i>Sida acuta</i> Burm.f.	Shrub	Terrestrial
	<i>Sida cordifolia</i> L.	Shrub	Terrestrial
	<i>Sida humilis</i> Cav.	Herb	Terrestrial
	<i>Sida rhombifolia</i> L.	Shrub	Terrestrial
	<i>Urena lobata</i> L.	Herb	Terrestrial
	<i>Urena sinuate</i> L.	Herb	Terrestrial
	<i>Helicteres isora</i> L.	Tree	Terrestrial
Meliaceae	<i>Azadirachta indica</i> A.Juss.	Tree	Terrestrial
Molluginaceae	<i>Glinus oppositifolius</i> (L.) Aug.DC.	Herb	Marshy
Moraceae	<i>Ficus benghalensis</i> L.	Tree	Terrestrial
	<i>Ficus racemosa</i> L.	Tree	Terrestrial
	<i>Ficus religiosa</i> L.	Tree	Terrestrial
Myrtaceae	<i>Psidium guajava</i> L.	Tree	Terrestrial
	<i>Syzygium jambos</i> (L.) Alston	Tree	Terrestrial
Nyctaginaceae	<i>Boerhavia diffusa</i> L.	Herb	Terrestrial
Onagraceae	<i>Ludwigia octovalvis</i> (Jacq.) Raven.	Herb	Marshy
Oxalidaceae	<i>Oxalis corniculata</i> L.	Herb	Terrestrial
Papaveraceae	<i>Argemone Mexicana</i> L.	Herb	Terrestrial
Passifloraceae	<i>Passiflora edulis</i> Sims	Climber	Moist
Plantaginaceae	<i>Scoparia dulcis</i> L.	Herb	Terrestrial
Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delabre	Herb	Marshy
Primulaceae	<i>Ardisia solanacea</i> (Poir.) Roxb.	Tree	Terrestrial
Putranjivaceae	<i>Putranjiva roxburghii</i> Wall.	Tree	Terrestrial
Rhamnaceae	<i>Zizyphus nummularia</i> (Burm.f.) Wight & Arn.	Shrub	Terrestrial
	<i>Zizyphus oenoplia</i> (L.) Mill.	Shrub	Terrestrial
Rubiaceae	<i>Ixora arborea</i> Roxb. ex Sm.	Shrub	Terrestrial
	<i>Mitracarpus maxwelliae</i> Britton & P. Wilson	Herb	Terrestrial
	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Tree	Terrestrial
	<i>Oldenlandia corymbosa</i> L.	Herb	Terrestrial
	<i>Spermacoce hispida</i> L.	Herb	Terrestrial
	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Tree	Terrestrial
Rutaceae	<i>Aegle marmelos</i> (L.) Corr. Serr.	Tree	Terrestrial
Sapindaceae	<i>Cardiospermum halicacabum</i> L.	Climber	Terrestrial
Sapotaceae	<i>Mimusops elengi</i> L.	Tree	Terrestrial
Scrophulariaceae	<i>Lindenbergia indica</i> Vatke	Herb	Terrestrial
Simaroubaceae	<i>Ailanthus excels</i> Roxb.	Tree	Terrestrial
Solanaceae	<i>Datura inoxia</i> Mill.	Shrub	Terrestrial
	<i>Datura metel</i> L.	Shrub	Terrestrial
	<i>Daturas tramonium</i> L.	Shrub	Terrestrial
	<i>Physalis minima</i> L.	Herb	Terrestrial
	<i>Solanum indicum</i> L.	Shrub	Terrestrial
	<i>Solanum nigrum</i> L.	Herb	Terrestrial
	<i>Solanum sisymbirifolium</i> Lam.	Shrub	Terrestrial
Sterculiaceae	<i>Pterospermum acerifolium</i> (L.) Willd.	Tree	Terrestrial
Tiliaceae	<i>Corchorus aestuans</i> L.	Herb	Terrestrial
Verbenaceae	<i>Clerodendrum infortunatum</i> L.	Shrub	Terrestrial
	<i>Lantana camara</i> L.	Shrub	Terrestrial
	<i>Lippia alba</i> (Mill.) N.E.Br. ex Britton & P. Wilso	Herb	Terrestrial
	<i>Premna herbacea</i> Roxb.	Herb	Terrestrial
	<i>Tectona grandis</i> L.f.	Tree	Terrestrial
	<i>Vitex negundo</i> L.	Shrub	Terrestrial
Urticaceae	<i>Pouzol ziazeylanica</i> (L.) Benn. & R.Br.	Herb	Moist
Vitaceae	<i>Cayratia trifolia</i> (L.) Domin	Climber	Terrestrial
	<i>Ampelocissus latifolia</i> (Roxb.) Planch.	Climber	Terrestrial
	<i>Leea asiatica</i> (L.) Ridsdale	Shrub	Terrestrial

Diversity and species of Chilkigarh Kanakdurga temple forest

Figure 4. A, *Ampelocissus latifolia* (Roxb.) Planch; B, *Dioscorea bulbifera* L.; C, *Diospyros malabarica* (Desr.) Kostel.; D, *Diospyros sylvatica* Roxb.; E, *Ecbolium viride* (Forssk.) Alston.; F, *Geodorum densiflorum* (Lam.) Schltr.; G, *Globba racemosa* Sm.; H, *Helicteres isora* L.; I, *Ichnocarpus frutescens* (L.) W. T. Aiton; J, *Mallotus philippensis* (Lam.) Muell. Arg.; K, *Putranjiva roxburghii* Wall.; L, *Rauvolfia serpentina* (L.) Benth. ex Kurz; M, *Scindapsus officinalis* (Roxb.) Schott; N, *Tacca leontopetaloides* (L.) Kuntze; O, *Tropidia curculigoides* Lindl.; P, *Zingiber zerumbet* (L.) Roscoe ex Sm.

Ampelocissus latifolia (Roxb.) Planch

Different plant parts (tuber, stem, leaves) are used to cure broad series of health problems (Patil & Patil 2005, Swarnkar & Katewa 2008, Choudhury *et al.* 2013). Intact plant utilize as tonic for aged persons (Swarnkar & Katewa 2008). The plant extract used to treat bone fractured and to alleviate flatulence (Ramawat 2008) (Fig. 4A). The particular medicinal plant species coordinate position is 22° 27' 13.07" N, 86° 52' 51.15" E and elevation is 70m from the GPS survey (Fig. 2).

Dioscorea bulbifera L.

Tubers of *D. bulbifera* (Fig. 4B) are used to treating goitre as well as thyroid glands (Liu *et al.* 2010, Williams 2013). A mixture of steamed leaf employed in east Africa for treating a type of conjunctivitis called

pink eye (Williams 2013). The particular medicinal plant species coordinate position is 22° 27' 09.82" N, 86° 52' 55.55" E and elevation is 67 m from the GPS survey (Fig. 2).

Diospyros malabarica (Desr.) Kostel.

This medicinal plant employed for snakebite, discontinuous fever, wound and ulcer curing (Chopra *et al.* 1994). *Diospyros malabarica* (Fig. 4C) bark is bitter, astringent and febrifuge. The particular medicinal plant species coordinate position is 22° 27' 09.82" N, 86° 52' 55.55" E and elevation is 67 m from the GPS survey (Fig. 2).

Diospyros sylvatica Roxb.

The bark of this plant and *Phyllanthus emblica* L. made in to paste and given in bloody dysentery as well as powdered leaves with powdered roots of *Gardenia turgida* Roxb. and *Tephrosia purpurea* (L.) Pers. is used to cure gonorrhoea (Quattrocchi 2012). Gum of this plant employed in jaundice, liver disorder and typhoid (Vardhana 2008). A dried flower is useful in urinary, skin and blood diseases (Mudaiya *et al.* 2016). A paste made from bark is applied to cure tumors (Chintala *et al.* 2012). Leaves are used as anti-emetic also in scabies, night blindness (Jadhao 2013) (Fig. 4D). The particular medicinal plant species coordinate position is 22° 27' 06.87" N, 86° 52' 59.45" E and elevation is 74 m from the GPS survey (Fig. 2).

Ecbolium viride (Forssk.) Alston.

In herbal medicine, the aqueous extraction of dry roots is employed to cure menorrhagia (Datta & Maiti 1968). The tribes (Tripura and Paliyar) roots use to treat jaundice (Nair *et al.* 2007). Roots of *Ecbolium. viride* (Forssk.) Alston possess anti-inflammatory (Lalitha & Sethuraman 2010) (Fig. 4E). The particular medicinal plant species coordinate position is 22° 27' 07.82" N, 86° 52' 55.53" E and elevation is 68m from the GPS survey (Fig. 2).

Geodorum densiflorum (Lam.) Schltr.

Geodorum densiflorum (Fig. 4F) tubers used in the treatment of sexual disability and male sterility (Kirtikar *et al.* 1918, Hossain 2011). Tubers decoction used as an antidote in snake bite and to heal leukemia (Mali & Bhadane 2008). The particular medicinal plant species coordinate position is 22° 27' 13.89" N, 86° 52' 52.55" E and elevation is 67 m from the GPS survey (Fig. 2).

Globba racemosa Sm.

Globba racemosa (Fig. 4G) fruit used in heart pain, stomach pain (Rao *et al.* 2011). The particular medicinal plant species coordinate position is 22° 27' 12.84" N, 86° 52' 53.52" E and elevation is 75 m from the GPS survey (Fig. 2).

Helicteres isora L.

Anti-dysenteric and vermifuge are taken from the extraction of fruit pod and also used in flatulence, stomach ache, gout and as astringent (Chopra *et al.* 1956). Root and bark extract employed to treating type 2 diabetes (Kumar & Murugesan 2007) (Fig. 4H). The particular medicinal plant species coordinate position is 22° 27' 15.81" N, 86° 52' 57.08" E and elevation is 79 m from the GPS survey (Fig. 2).

Ichnocarpus frutescens (L.) W. T. Aiton

This plant used as a laxative, diuretic and curing asthma, bronchitis, cholera, cough, dog-bites, diabetes, snake-bites, syphilis and tumor (Duke's 2008). Crude extract of the leaves also reduce fever, inflammation and plasma glucose in diabetes (Patocka 2003) (Fig. 4I). The particular medicinal plant species coordinate position is 22°27'14.34" N, 86° 52'55.58" E and elevation is 72 m from the GPS survey (Fig. 2).

Mallotus philippensis (Lam.) Muell.Arg.

Usually this plant is used for antibacterial and immune-regulatory activity (Kumar *et al.* 2006). *Mallotus philippinensis* (Fig. 4J) has been frequently used to treat helminthosis in ruminants (Jabbar *et al.* 2006). The particular medicinal plant species coordinate position is 22° 27' 05.39" N, 86° 53' 55.06" E and elevation is 78 m from the GPS survey (Fig. 2).

Putranjiva roxburghii Wall.

The leaves of *Putranjiva roxburghii* are used to treating phlegm, skin ailment, aridity as well as curing rheumatism (Sheth *et al.* 2005, Bajpai *et al.* 2016). *Putranjiva roxburghii* (Fig. 4K) cure mouth and stomach ulcers, small pox and as well as burning sensation, ophthalmopathy, elephantiasis, impairment, azoospermia, and infertility (Varshney *et al.* 1973). The particular medicinal plant species coordinate position is 22° 27' 10.03" N, 86° 52' 57.02" E and elevation is 76 m from the GPS survey (Fig. 2).

Rauvolfia serpentina (L.) Benth. ex Kurz

Rauvolfia serpentina (Fig. 4L) roots generally employed for high blood pressure, insomnia, anxiety and excitement. A decoction of powdered rhizome as well as leaves employed for snake bite (Rajith & Ramachandran 2010). Roots of medicinal plants are used in mental, nervous and psychosis disorders in Karnataka, India used in primary healthcare (Shiddamallayya *et al.* 2010). The particular medicinal plant species coordinate position is 22° 27' 12.39" N, 86° 52' 51.68" E and elevation is 78 m from the GPS survey (Fig. 2).

Scindapsus officinalis (Roxb.) Schott

Leaves used as a bone fracture, rheumatism and body pain (Quattrocchi 2012). In male reproductive dysfunction, it employed to increase the power of erection and number of coitus (Mishra *et al.* 2003), Employed to treat goiter (Khare 2015), Powdered mixed with warm water to stop bleeding after child birth, used in ghee's, powders to cure abdominal tumors (Bhattacharya 2006), used to treat diabetes mellitus (Pullaiah & Naidu 2003) (Fig. 4M). The particular medicinal plant species coordinate position is 22° 27' 03.98" N, 86° 52' 58.34" E and elevation is 81 m from the GPS survey (Fig. 2).

Tacca leontopetaloides (L.) Kuntze

The raw tubers used to cure stomach ailments. Mixed with red clay and water, employed to stop internal hemorrhaging within the stomach and colon, used in wounds to stop bleeding (Kaviratna 2009) (Fig. 4N). The particular medicinal plant species coordinate position is 22° 27' 06.12" N, 86° 52' 55.33" E and elevation is 75 m from the GPS survey (Fig. 2).

Tropidia curculigoides Lindl.

A decoction prepared from roots to cure diarrhoea (Khasim & Rao 1999). Boiled extract of entire plant parts to treating malaria (Chopra *et al.* 1969) (Fig. 4O). The particular medicinal plant species coordinate position is 22° 27' 02.63" N, 86° 52' 57.02" E and elevation is 85 m from the GPS survey (Fig. 2).

Zingiber zerumbet (L.) Roscoe ex Sm.

Zingiber zerumbet (Fig. 4P) is used to healing fever, constipation and also treating stomach ache, toothache, fever, sprain and indigestion (Huang *et al.* 2005). It is a novel factor for mitigating experimental ulcerative colitis (Sakinah *et al.* 2007). The particular medicinal plant species coordinate position is 22° 27' 10.84" N, 86° 52' 52.52" E and elevation is 78 m from the GPS survey (Fig. 2).

CONCLUSIONS

The GPS and GIS technology is responsible for a variety of functions to assist the ethnomedicinal environment assessment process to medicinal plants. The GPS and GIS technology were used to outline specified medicinal plants in nature to a speedy approach. Present survive frightening is to require preserving and defence the ecosystem and significant medicinal plants species for sustainable harvesting mitigation and management. Therefore, we found the number of medicinal plant species at altitudes of 60–85 m of the present area for in-situ measurement of GPS instrument. Since, the forest is covered with 184 medicinal plant species under 155 genera, distributed among 56 plant families distribution to Mono-cotyledons and Di-cotyledons are to store. Along with the selected medicinal plant species checklist includes herbs (98), shrubs (33), trees (34), climbers (18) and epiphyte (1). The medicinal conservation and important species are a prime concern, the Chilkigarh reserve forest was identified as biodiversity heritage site should be made protected habitat for in-situ conservation and preservation. Finally, we attempted use of GPS and GIS as spatial information database to assess the conservation, development along with sustainable management of medicinal plants.

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