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

Sk Md Abu Imam Saadi1,2, Ismail Mondal3*, Subrata Sarkar4 and Amal Kumar Mondal2

1Department of Biological Sciences, Aliah University, Kolkatta-700156, West Bengal, India
2Department of Botany and Forestry, Vidyasagar University, Midnapore-721102, West Bengal, India
3School of Oceanographic Studies, Jadavpur University, Kolkata-700032, West Bengal, India
4Department of Remote Sensing and GIS, Vidyasagar University, Midnapore-721102, West Bengal, India

*Corresponding Author: ismailmondal58@gmail.com
[Accepted: 12 August 2020]

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.

[Cite as: Saadi SMAI, Mondal I, Sarkar S & Mondal AK (2020) Medicinal plants diversity modelling using remote sensing & GIS technology of Chilkigarh, West Bengal, India. Tropical Plant Research 7(2): 440–451]

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 than11.4% 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 (Mustash 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
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, interspersion, 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) |
|---|---|---|---|
| Ampelocissus latifolia (Roxb.) Planch. | 24°30′44″ | 87°47′44″ | 70 |
| Dioscorea bulbifera L. | 24°82′44″ | 87°86′9″ | 67 |
| Diospyros malabarica (Desr.) Kostel. | 24°82′35″ | 87°88′0″ | 69 |
| Diospyros sylvestra Roxb. | 24°82′53″ | 87°98′0″ | 74 |
| Geodorum densiflorum (Lam.) Schltr. | 24°82′69″ | 87°77′83″ | 67 |
| Globba racemosa Sm. | 24°82′37″ | 87°81′1″ | 75 |
| Helicteres isora L. | 24°83′12″ | 87°91′3″ | 79 |
| Ichnocarpus frutescens (L.) W. T. Aiton | 24°82′08″ | 87°87′9″ | 72 |
| Mallotus philippensis (Lam.) Muell.Arg. | 24°82′08″ | 87°85′5″ | 78 |
| Putranjiva roxburghii Wall. | 24°82′95″ | 87°91′1″ | 76 |
| Rauwolfia serpentina (L.) Benth. ex Kurz | 24°83′23″ | 87°75′8″ | 78 |
| Scindapsus officinalis (Roxb.) Schott | 24°82′75″ | 87°94′8″ | 81 |
| Tacca leontopetaloides (L.) Kuntze | 24°82′30″ | 87°86′3″ | 75 |
| Tropidica curculigoides Lindl. | 24°82′73″ | 87°91′1″ | 85 |
| Zingiber zerumbet (L.) Roscoe ex Sm. | 24°82′97″ | 87°79′0″ | 78 |
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 sylvestris Roxb., Ecbolium viride (Forssk.) Alston., Euphoria ochreata 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      | Alocasia macrorrhizos (L.) G.Don | Herb     | Terrestrial   |
|              | Amorphophallus bulbifer (Roxb.) Blume | Herb     | Marshy        |
|              | Amorphophallus paeonifolius (Dennst.) Nicolson | Herb     | Marshy        |
|              | Caladium bicolor (Aiton) Vent. | Herb     | Marshy & Shady|
|              | Colocasia esculenta (L.) Schott | Herb     | Marshy        |
|              | Dieffenbachia seguine (Jacq.) Schott | Herb     | Marshy        |
|              | Pothos scandens L.            | Climber   | Terrestrial   |
|              | Scindapsus officinalis (Roxb.) Schott | Climber   | Terrestrial   |
|              | Typhonium trifolatum (L.) Schott | Herb     | Terrestrial   |
| Areccaceae   | Borassus flabellifer L.        | Tree      | Terrestrial   |
|              | Phoenix sylvestris (L.) Roxb. | Tree      | Terrestrial   |
Table 3. List of plant species under the division Dicotyledones.

| Family            | Species                                              | Habit | Habitat       |
|-------------------|------------------------------------------------------|-------|---------------|
| Commelinaceae     | Commelina benghalensis L.                            | Herb  | Moist         |
|                   | Commelina diffusa Burm.f.                            | Herb  | Moist         |
| Costaceae         | Cheilocostus speciosus (J.Konig) C.Speccht.          | Herb  | Terrestrial   |
| Cyperaceae        | Cyperus kyllinga Endl.                               | Herb  | Marshy        |
|                   | Cyperus rotundus L.                                  | Herb  | Marshy        |
| Hypoxidaceae      | Curculigo orchoides Gaertn.                          | Herb  | Marshy        |
| Orchidaceae       | Eulophia ochreata Lindl.                             | Herb  | Terrestrial   |
|                   | Nervilia plicata (Andrews) Schltr.                   | Herb  | Terrestrial   |
|                   | Tropidia curculigoides Lindl.                        | Herb  | Terrestrial   |
|                   | Vanda tessellata (Roxb.) Hook. ex G.Don              | Epiphytic | Terrestrial |
| Poaceae           | Aristida juniculate Trin. & Rupr                     | Herb  | Marshy        |
|                   | Bambusa tulda Roxb.                                  | Tree  | Terrestrial   |
|                   | Chloris barbata Sw.                                  | Herb  | Marshy        |
|                   | Chrysocephalus aciculatus (Retz.) Trin.              | Herb  | Marshy        |
|                   | Cynodon dactylon (L.) Pers.                          | Herb  | Marshy        |
|                   | Digitaria sanguinalis (L.) Scop.                     | Herb  | Marshy        |
|                   | Echinochloa colona (L.) Link                         | Herb  | Marshy        |
|                   | Echinochloa frumentacea Link                         | Herb  | Marshy        |
|                   | Eleusine indica (L.) Gaertn.                          | Herb  | Marshy        |
|                   | Paspalidium flavidum (Retz.) A. Camus                | Herb  | Marshy        |
|                   | Sporobolus diander (Retz.) P.Bauv.                   | Herb  | Marshy        |
|                   | Saccharum spontaneum L.                              | Herb  | Marshy        |
|                   | Setaria glauca (L.) Beauv.                            | Herb  | Marshy        |
| Zingiberaceae     | Globba racemosa Sm.                                  | Herb  | Marshy        |
|                   | Zingiber zerumbet (L.) Roscoe ex Sm.                 | Herb  | Marshy        |
| Scientific Name                  | Common Name                  | Type       | Life Form    |
|---------------------------------|------------------------------|------------|--------------|
| Mikania micrantha Kunth         | Climber                      | Herb       | Terrestrial  |
| Parthenium hysterophorus L.     | Herb                         | Herb       | Terrestrial  |
| Synechocystis nodiflora (L.) Gaertn. | Herb                     | Herb       | Terrestrial  |
| Acmella paniculata (Wall. ex DC.) R.K. Jansen | Herb            | Herb       | Terrestrial  |
| Tridax procumbens L.            | Herb                         | Herb       | Terrestrial  |
| Vernonio cinerea Less           | Herb                         | Herb       | Terrestrial  |
| Xanthium strumarium L.          | Herb                         | Herb       | Terrestrial  |
| Boraginaceae Heliotropium indicum L. | Herb                     | Herb       | Terrestrial  |
| Caryophyllaceae Polycarpaea corymbosa (L.) Lam. | Herb           | Herb       | Terrestrial  |
| Cannabaceae Trema orientalis (L.) Blume | Tree                | Tree       | Terrestrial  |
| Cleomaceae Cleome viscosa L.     | Herb                         | Herb       | Terrestrial  |
| Capparaceae Crateva nurvala Buch.-Ham. | Tree                  | Tree       | Terrestrial  |
| Combretaceae Terminalia arjuna (Roxb.) Wight & Arn. | Tree     | Tree       | Terrestrial  |
| Costaceae Cheilocostus speciosus (J. Konig) C. Specht. | Herb | Herb | Terrestrial  |
| Convolvulaceae Evolulus alsinoides L. | Herb                  | Herb       | Terrestrial  |
| Convolvulaceae Evolulus nummularius (L.) L. | Herb           | Herb       | Terrestrial  |
| Costaceae Merremia tridentata (Linn.) Hallier f. | Herb | Herb | Terrestrial  |
| Crassulaceae Bryophyllum pinnatum (Lam.) Oken. | Herb | Herb | Terrestrial  |
| Cucurbitaceae Coccinia grandis (L.) J. Voigt | Climber | Climber | Terrestrial  |
| Dioscoreaceae Dioscorea alata L. | Climber                      | Climber    | Terrestrial  |
| Dioscoreaceae Dioscorea bulbifera L. | Climber              | Climber    | Terrestrial  |
| Costaceae Tacca leontopetaloides (L.) Kuntze | Herb | Herb | Terrestrial  |
| Ebenaceae Diospyros malabarica (Desr.) Kostel. | Tree | Tree | Terrestrial  |
| Ebenaceae Diospyros sylviatica Roxb. | Tree               | Tree       | Terrestrial  |
| Euphorbiaceae Acalypha indica L. | Herb                         | Herb       | Terrestrial  |
| Euphorbiaceae Brevia vitis-idea f. | Shrub                       | Shrub      | Terrestrial  |
| Euphorbiaceae Croton bonplandianum Baill | Herb       | Herb       | Terrestrial  |
| Euphorbiaceae Euphorbia heterophylla L. | Herb | Herb | Terrestrial  |
| Euphorbiaceae Euphorbia hirta L. | Herb                         | Herb       | Terrestrial  |
| Euphorbiaceae Jatropha curcas L. | Shrub                        | Shrub      | Terrestrial  |
| Euphorbiaceae Jatropha gossypifolia L. | Shrub | Shrub | Terrestrial  |
| Malvaceae Mallotus philippensis (Lam.) Muell.Arg. | Tree | Tree | Terrestrial  |
| Fabaceae Pedilanthus tithyzinoides L. | Herb       | Herb       | Terrestrial  |
| Fabaceae Phyllanthus fraternus Webster | Herb   | Herb       | Terrestrial  |
| Fabaceae Phyllanthus virgatus G. Forst. | Herb | Herb | Terrestrial  |
| Fabaceae Ricinus communis L.     | Shrub                        | Shrub      | Terrestrial  |
| Fabaceae Tragia involucrata L.   | Shrub                        | Shrub      | Terrestrial  |
| Fabaceae Abrus precatorius L.    | Climber                      | Climber    | Terrestrial  |
| Fabaceae Albizia lebbeck (L.) Benth. | Tree               | Tree       | Terrestrial  |
| Fabaceae Alysicarpus vaginalis (L.) DC. | Herb | Herb | Terrestrial  |
| Fabaceae Caesalpinia pulcherrima (L.) Sw. | Tree | Tree | Terrestrial  |
| Fabaceae Cassia aldabrensis Hemsl. | Herb                       | Herb       | Terrestrial  |
| Fabaceae Cassia occidentalis L.  | Shrub                        | Shrub      | Terrestrial  |
| Fabaceae Cassia tora L.          | Shrub                        | Shrub      | Terrestrial  |
| Fabaceae Crotalaria pallid Aiton | Herb                         | Herb       | Terrestrial  |
| Fabaceae Derris scandens (Roxb.) Benth. | Tree               | Tree       | Terrestrial  |
| Fabaceae Desmodium gangeticum (L.) DC. | Shrub             | Shrub      | Terrestrial  |
| Fabaceae Indigofera miniata Ortega | Herb       | Herb       | Terrestrial  |
| Fabaceae Millettia pinnata (L.) Panigrahi | Shrub  | Shrub | Terrestrial  |
| Fabaceae Mimosa pudicu L.        | Herb                         | Herb       | Terrestrial  |
| Fabaceae Mucuna pruriens (L.) DC. | Climber                     | Climber    | Terrestrial  |
| Fabaceae Tephrosia purpurea (L.) Pers. | Herb   | Herb       | Terrestrial  |
| Fabaceae Tamarindus indica L.    | Tree                         | Tree       | Terrestrial  |
| Lamiaceae Anisomeles indica L.   | Shrub                        | Shrub      | Terrestrial  |
| Lamiaceae Leonotis nepetfolia (L.) R.Br. | Herb | Herb | Terrestrial  |
| Lamiaceae Ocimum tenuiflorum L.  | Herb                         | Herb       | Terrestrial  |
| Lamiaceae Ocimum gratissimum L.  | Herb                         | Herb       | Terrestrial  |
| Malvaceae Abelmoschus moschatus Medik. | Shrub | Shrub | Terrestrial  |
| Family               | Genus                                      | Type       | Habitat     |
|---------------------|-------------------------------------------|------------|-------------|
| Abutilon indicum   | (Link) Sweet                              | Herb       | Terrestrial |
| Grewia hirsuta     | L.                                         | Tree       | Terrestrial |
| Grewia serrulata   | DC.                                        | Tree       | Terrestrial |
| Sida acuta         | Burn.f.                                    | Shrub      | Terrestrial |
| Sida cordifolia    | L.                                         | Shrub      | Terrestrial |
| Sida humilis       | Cav.                                       | Herb       | Terrestrial |
| Sida rhombifolia   | L.                                         | Shrub      | Terrestrial |
| Urena lobata       | L.                                         | Herb       | Terrestrial |
| Urena sinuata      | L.                                         | Herb       | Terrestrial |
| Helicteres isora   | L.                                         | Tree       | Terrestrial |
| Meliaceae          | Azadirachta indica A.Juss.                | Tree       | Terrestrial |
| Molluginaceae      | Glinus oppositifolius (L.) Aug.DC.        | Herb       | Terrestrial |
| Moraceae           | Ficus benghalensis L.                      | Tree       | Terrestrial |
|                    | Ficus racemosa L.                          | Tree       | Terrestrial |
|                    | Ficus religiosa L.                         | Tree       | Terrestrial |
| Myrtaceae          | Psidium guajava L.                         | Tree       | Terrestrial |
|                    | Syzygium jambos (L.) Alston               | Tree       | Terrestrial |
| Nyctaginaceae      | Boerhavia diffusa L.                      | Herb       | Terrestrial |
| Onagraceae         | Ludwigia octovalvis (Jacq.) Raven.        | Herb       | Terrestrial |
| Oxalidaceae        | Oxalis corniculata L.                      | Herb       | Terrestrial |
| Papaveraceae       | Argemone Mexicana L.                       | Herb       | Terrestrial |
| Passifloraceae     | Passiflora edulis Sims                    | Climber    | Moist       |
| Plantaginaceae     | Scoparia dulcis L.                         | Herb       | Terrestrial |
| Polygonaceae       | Persicaria hydropiper (L.) Delabre        | Herb       | Terrestrial |
| Primulaceae        | Ardisia solanacea (Poir.) Roxb.           | Tree       | Terrestrial |
| Putranjivaceae     | Putranjiva roxburghii Wall.               | Tree       | Terrestrial |
| Rhamnaceae         | Zizyphus nummularia (Bur.m.f.) Wight & Arn. | Shrub      | Terrestrial |
|                    | Zizyphus oenoplia (L.) Mill.              | Shrub      | Terrestrial |
| Rubiaceae          | Isora arborea Roxb. ex Sm.                | Shrub      | Terrestrial |
|                    | Mitracarpus maxwelliae Britton &P.Wilson  | Herb       | Terrestrial |
|                    | Neolamarckia cadamba (Roxb.) Bosser       | Tree       | Terrestrial |
|                    | Oldenlandia corymbosa L.                  | Herb       | Terrestrial |
|                    | Spermacoce hispida L.                     | Herb       | Terrestrial |
|                    | Mitragyna parvifolia (Roxb.) Korth.       | Tree       | Terrestrial |
| Rutaceae           | Aegle marmelos (L.) Corr. Serr.           | Tree       | Terrestrial |
| Sapindaceae        | Cariospermum halicacabum L.               | Climber    | Terrestrial |
| Sapotaceae         | Mimusops elengi L.                        | Tree       | Terrestrial |
| Scrophulariaceae   | Lindenhergia indica Vatke                 | Herb       | Terrestrial |
| Simaroubaceae      | Ailanthus excels Roxb.                    | Tree       | Terrestrial |
| Solanaceae         | Datura inoxia Mill.                       | Shrub      | Terrestrial |
|                    | Datura metel L.                           | Shrub      | Terrestrial |
|                    | Daturas tramonium L.                      | Shrub      | Terrestrial |
|                    | Physalis minima L.                        | Herb       | Terrestrial |
|                    | Solanum indicum L.                        | Shrub      | Terrestrial |
|                    | Solanum nigrum L.                         | Herb       | Terrestrial |
|                    | Solanum sisymbrofolium Lam.               | Shrub      | Terrestrial |
| Sterculiaceae      | Pterospermum acerfolium (L.) Willd.       | Tree       | Terrestrial |
| Tiliaceae          | Corchorus aetuans L.                      | Herb       | Terrestrial |
| Verbenaceae        | Clerodendrum infortunatum L.              | Shrub      | Terrestrial |
|                    | Lantana camara L.                         | Shrub      | Terrestrial |
|                    | Lippia alba (Mill.) N.E.Br. ex Britton & P. Wilso | Herb       | Terrestrial |
|                    | Premna herbacea Roxb.                     | Herb       | Terrestrial |
|                    | Tectona grandis L.f.                      | Tree       | Terrestrial |
|                    | Vitex negundo L.                          | Shrub      | Terrestrial |
| Urticaceae         | Pouzol ziaeylanica (L.) Benn. & R.Br.     | Herb       | Moist       |
| Vitaceae           | Cayratia trifolia (L.) Domin              | Climber    | Terrestrial |
|                    | Ampelocissus latifolia (Roxb.) Planch.    | Climber    | Terrestrial |
|                    | Lelea asiatica (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.) Kunze; O, *Tropidia curculigoïdes* 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’ 13.89” N, 86° 52’ 52.55” 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’ 15.81” N, 86° 52’ 57.08” E and elevation is 79 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 (Pullaih & 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 defend 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 Chikigarh 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.

ACKNOWLEDGEMENTS

The authors want to thank the authorities of Vidyasagar University and Botanical Survey of India, Shibpur, Howrah for their help and support during collection and identification of plants. We also want to show our gratitude to NASA for providing the Landsat 8 OLI satellite data to analyse the spatial distribution model of medicinal plants of hotspots zone identification using GIS and GPS technology in ethnobotanical work is an upcoming research field.

REFERENCES

Bajpai O, Pandey J & Chaudhary LB (2016) Ethnomedicinal uses of tree species by Tharu tribes in the Himalayan Terai region of India. Research Journal of Medicinal Plant 10(1): 19–41.

Bhattacharya S (2006) Anticancer botanicals. Daya Publishing House, New Delhi, India. [ISBN: 978817035383: 180]

www.tropicalplantresearch.com
Biswas B, Walker S & Varun M (2017) Web GIS based recognition and Mapping of Medicinal Plants: A Case Study Ofagra (U.P.), India. Plant Archives 171: 8–20.

Chintala S, Kandhula A, Janapathi YK, Khan FM & Vani D (2012) Pharmacognostic Studies on Diospyros melanoxylon. International Journal of Pharmaceutical Sciences and Research 3(9): 3438–3443.

Chopra RN, Chopra IC & Handa KL (1994) Chopra's Indigenous drugs of India, 2nd edition. Academic Publishers, Calcutta, India, 505 p.

Chopra RN, Chopra IC & Verma BS (1969) Supplement of Glossary of Indian Medicinal Plants. CSIR, New Delhi, India, 119 p.

Chopra RN, Nayar SL & Chopra IC (1956) Glossary of Indian Medicinal Plants, 1st edition. CSIR, New Delhi, India, 131 p.

Choudhury S, Chowdhury HR & Mandal S (2013) Pharmacognostic Studies of Ampelocissus latifolia (Roxb.) Planch.-An important ethnomedicinal plant. International Journal of Current Research 5(3): 643–648.

Datta PC & Maiti RK (2016) Medicinal wealth of dindori forest division of Madhya Pradesh India needs protection and systemic Collection. International Journal of Current Research 8: 1189–1192.

Duke's (2008) Phytochemical and Ethnobotanical Databases, USA. Available from: http://www.ars-grin.gov/cgi-bin/dukeethnobot.pl?ethnobot.taxon=Ichnocarpus%20frutescens (accessed: 25 Feb. 2020).

Goswami B (2018) Chilkigarh sacred grove to be declared as biodiversity site. Available from: https://www.thestatesman.com/cities/chilkigarh-sacred-grove-declared-biodiversity-site-1502615370.html (accessed: 10 Mar. 2020).

Hossain MM (2011) Therapeutic orchids: Traditional uses and recent advances - An overview. Fitoterapia 82: 102–140.

Huang GC, Chien TY, Chen LG & Wang CC (2005) Anti-tumour effect of zerumbone from Zingiber zerumbetin P-388D1 cells in vitro and in vivo. Planta Medica 71: 219–224.

Jabbar A, Raza MA, Iqbal Z & Khan MN (2006) An estimate of the ethno-botanicals used as antihelmintics in the southern Punjab (Pakistan). Journal of Ethnopharmacology 108: 152–154.

Jadhao AB (2013) An Ethno-Botanical and Phytochemical Screening Some Medicinal Plants from Shegaon Tahsil. (Maharashtra) India. International Journal of Pharmaceutical Science Invention 2(8):19–21.

Kaviratna AC (2009) Tacco leontopetaloides (Dioscoreaceae), Corinthian Press; Calcutta, India.

Khare CP (2015) Ayurvedic pharmacopoeial plant drugs: expanded therapeutics. Boca Raton: CRC Press, 498 p.

Khasim SM & Rao PRM (1999) Medicinal importance of orchids. The Botanica 49: 86–91.

Kirtikar KR, Basu BD & Verbenaceae NO (1918) In: Basu SN (ed) Indian Medicinal Plants. Bahadurganj, Allahabad, India.

Kumar G & Murugesan AG (2007) Influence of Helicteres isora bark extracts on plasma and tissue glycoprotein components in streptozotocin diabetic rats. Journal of Clinical and Diagnostic Research 4: 330–338.

Kumar VP, Chauhan NS, Padh H & Rajani M (2006) Search for antibacterial and antifungal agents from selected Indian medicinal plants. Journal of Ethnopharmacology 107(2): 182–188.

Lalitha KG & Sethuraman MG (2010) Anti-inflammatory activity of roots of Ecballium viride (Forsk) Merrill. Journal of Ethnopharmacology 128: 248–250.

Liu H, Chou GX, Guo YL, Ji LL & Wang JM (2010) Nor clerodane diterpenoids from rhizomes of Dioscorea bulbifera. Phytochemistry 71: 1174–1180.

MacEachren AM, Crawford S, Akella M & Lengerich G (2008) Design and Implementation of a Model, WebBased, GIS-Enabled Cancer Atlas. The Cartographic Journal 45: 246–260.

Mali PY & Bhadane VV (2007) Some rare plants of ethnomedicinal properties from Jalgaon district of Maharashtra. International Journal of Green Pharmacy 2: 76–78.

Mishra LC (2003) Scientific basis for ayurvedic therapies. CRC Press, Boca Raton, 656 p.

Mudaiya RK, Lale SK, Rama S & Dhiman KS (2016) Medicinal wealth of dindori forest division of Madhya Pradesh India needs protection and systemic Collection. World Journal of Pharmaceutical Research 5(2): 347–372.

Mustalish RW, Evans B, Tucker C, Klein K, Craker LE, Nolan L & Shetty K (1996) Development of a phytohabitat index for medicinal plants in the Peruvian Amazon. Acta Horticulturae 426: 123–131.

Nair RT, Kalariya S & Chanda (2007) Antibacterial activity of some plant extracts used in folk medicine. Journal of Herbal Pharmacotherapy 7: 191–201.

www.tropicalplantresearch.com
Patil MV & Patil DA (2005) Ethnomedicinal practices of Nasik District, Maharashtra. *Indian Journal of Traditional Knowledge* 4(3): 287–290.

Patecka J (2003) Biologically active pentacyclic triterpenes and their current medicine signification. *Journal of Applied Biomedicine* 1: 7–12.

Pullaiah T & Naidu KC (2003) *Anti-diabetic plants in India and herbal based anti-diabetic research*. Regency Publications, Englewood. [ISBN: 8187498676]

Quattrocchi U (2012) *CRC world dictionary of medicinal and poisonous plants: common names, scientific names, eponyms, synonyms, and etymology*. CRC Press, Boca Raton, Vol. 5: 3367.

Rajith NP & Ramachandran VS (2010) Ethnomedicines of Kurichayas, Kannur district, Western Ghats, Kerala. *Indian Journal of Natural Products and Resources* 1(2): 249–253.

Ramawat KG (2008) *Herbal Drugs: Ethnomedicine to Modern Medicine, 1st edition*. Springer Science & Business Media.

Rao JK, Suneetha J, Reddi TVVS & Kumar OA (2011) Ethnomedicine of the Gadbas, a primitive tribe of Visakhapatnam district, Andhra Pradesh. *International Multidisciplinary Research Journal* 1(2): 10–14.

Roy PS & Tomar S (2000) Biodiversity characterization at landscape level using geospatial modeling technique. *Biodiversity and Conservation* 95: 95–109.

Saadi SMAI, Mondal I, Sarkar S, Mondal AK & Bandyopadhyay J (2016) Detecting Medicinal Plants Species using GPS positioning in Vidyasagar University Campus, Midnapore, West Bengal, India. *Nature* 25(1): 49–56.

Sakinah S, Handayani ST & Azimahtol Hawariah LP (2007) Zerumbone induced-apoptosis in liver cancer cells via modulation of Bax/Bcl-2 ratio. *Cancer Cell International* 7: 1–11.

Schumaker NH (1996) Using landscape indices to predict habitat connectivity. *Ecology* 77: 1210–1225.

Sheth A, Mitaliya KD & Joshi S (2005) *The Herbs of Ayurveda*. Ashok Sheth, India, Vol. 4: 900–1200.

Shiddamallayya N, Yasmeen A, Gopakumar K (2010) Hundred general forest medicinal plants of Karnataka in primary health care. *Indian Journal of Traditional Knowledge* 9(1): 90–95.

Sperduto MB & Congalton RG (1996) Predicting rare orchid (small whorled pogonia) habitat using GIS. *Photogrammetric Engineering and Remote Sensing* 62: 1269–1279.

Swarnkar S & Katewa SS (2008) Ethno-botanical observation on tuberous plants from tribal area of Rajasthan (India). *Ethnobotanical Leaflets* 12(1): 647–666.

Vardhana R (2008) *Direct Uses of Medicinal Plants and Their Identification, 1st edition*. Sarup & Sons, New Delhi, India, pp. 382–385.

Varshney AK, Aquil M, Rahman W, Okigawa M & Kawano N (1973) Bi-flavones from *P. roxburghii*. *Phytochemistry* 12: 1501

Williams C (2013) An antipodean apothecary. In: *Medicinal plants in Australia*. Rosenberg Publishing Science, pp. 437–444.