



Geo-Hydrobiology and Geoinformatics Mapping of Ethnobotany in the Gandhamardan Hills, Odisha, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: The Gandhamardan Hills (GMH) range is a group of small mountains in Peninsular India in Balangir district in Odisha state in India. There is uniqueness in geology, geography, geomorphology, climatology, Hydrology, petrology, and lithology. The lithology, soil, water, geomorphology, and traditional use of plants in Ayurveda (India) have holistic medicinal/surgery. origin. Geo-hydro-biological amalgamation through Geological Information Systems (GIS) and chemical analysis is still being explored, and the present research emphasises such studies.

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Methods: Data about geo-hydro-biology through grapy, geology, geomorphology, hydrology, and traditional medicinal practices are implored from literature sources, using TOPO and Q-GIS maps and ERDAS software; their analytical interpretations were reported. The chemical analysis was conducted using X-ray fluorescence spectrometric studies of the water and soil of GMH, and the exuberance of ethnobotanical species in GMH was correlated.

Results

Laboratory analysis, literature studies, and interaction with Ayurvedic and Kaviraj practitioners, 154 popular species databases with their pharmacological applications reported for ordinary people. Many species have multidimensional applications that can transform Ayurveda into Materia medica.

Conclusion: This ethnobotanical study documented the use of plants by the local community. The natural medicinal plants are cheap for the rural communities. The information gathered can be used for further scientific investigation to develop new commercial plant-based medicines as they will be safer than synthetic drugs. SDGs 1 to 3 and 12, 13, and 15 will be satisfied if we can conserve and adequately manage the hub of medicinal plants in GMH.

Keywords: Ethnobotany; geomorphology; gandhamardan hills; plant species; XRF spectroscopy; GIS.

1. INTRODUCTION

Ethnobotany (Aboriginal Botany) is the scientific search for traditional flora's hands-on practice by Indigenous people, an age-old practice with conventional knowledge of medicine, pain relief, and curative applications. It can be described as the science of the plant used by people before commercialisation. Indian civilisation was established during the North-Grippean period, with about 5000 to 8000 KYBP, when people adopted medicines by Jadi-Butti (plants, flowers, roots and barks). Three primitive health care systems (Ayurveda/ Siddha) are accredited in India and are in present form the Surgery (By Susruta) and the medicine (by Charak) (Ethnobotany MSCBOT-608, [1], Singh, [2], Ralte et al., [3]).

1.1 The Study Area

The Gandhamardan Hills (GMH) form the natural boundary to the northwest of Balangir district, and in the southeast, the river Tel (Tributary to River Mahanadi), with a plateau at the top, allowing many rivulets/ falls to origin. GMH has scattered thick forests adorned with many faunal species like tigers, sambar, deer bison, etc. The Plateau is 16km long and average elevation of 914.4m. It is lofty, with thick vegetation and sporadic small settlements. Rivulets in the northern slope emerge from the range's crest near Nandupalla, the Harisankar, a famous tourist spot in Western Odisha. Similarly, waterfalls called "The Kapil Dhara" and "The Man Bhang" are housed in the foot-hills of the GMH at Narsinghnath Temple on the southern slope Fig. 1 and Fig. 2 (a) and (b).

1.2 Review of Literature

The Gandhamardan Hills (GMH) range (20°42' to 21°00'N lat. and 82°41' to 83°05'E long.) is the borderline to the Balangir and the Baragada district, adjacent to Eastern Ghats belt Hills (EGB Hills) of western Odisha, India Sahu et al., [4]. It was called "Gandha Giri or Parimalagiri", and Chinese pilgrim Yuan Chuang (AD 627-643) reported it as "Po lo mo lo ki li" during the reign of King Harshavardhan. This mountain comprises numerous hills; the highest is the Gandhamardan, and other mountains are Butel, Chandel, Thuta, and Bender, which have peaks with altitudes of 1004.6m, 813.82m, 801.6m, 626.67 and 585.22m, respectively Dist Gazettes Bolangir [5]. Gandhamardan Hills (GMH) range is between Balangir and Bargarh in western Odisha, India.

It is known as an ayurvedic paradise and has been designated as a "37th Biodiversity Heritage Site (BHS)" in India from 2023 by the Dept of Environment, Forest and Climate Change (MOEFCC) as per the Odisha Biodiversity Regulations Act (Section 37) Mohanty, [6], The Hindustan Times, <https://shodhganga.inflibnet.ac.in/bitstream/10603/464939/6/06> (Fig. 1).

As per the Botanical Survey of India (2006-2017), the ethnobotanical resources of Odisha report about 1158 plant types belonging to 615 genera (142 families). They have been enumerated the plants and investigated their use as food, fodder, fuel, medicine, veterinary, fabrics, etc. (Botanical Survey of India [7]. The forest products values, including Ayurveda and

ethnobotany products, can be correlated with the economic and societal status of aboriginals in Gandhamardan Hill Odisha, India, Mishra et al., [8], Rout [9]. The ethnobotany (medicinal plants)

users are the Indigenous communities of the Gandhamardan hills, which refrain from visiting Hospitals Mishra et al., [10], Pandey et al., [11].

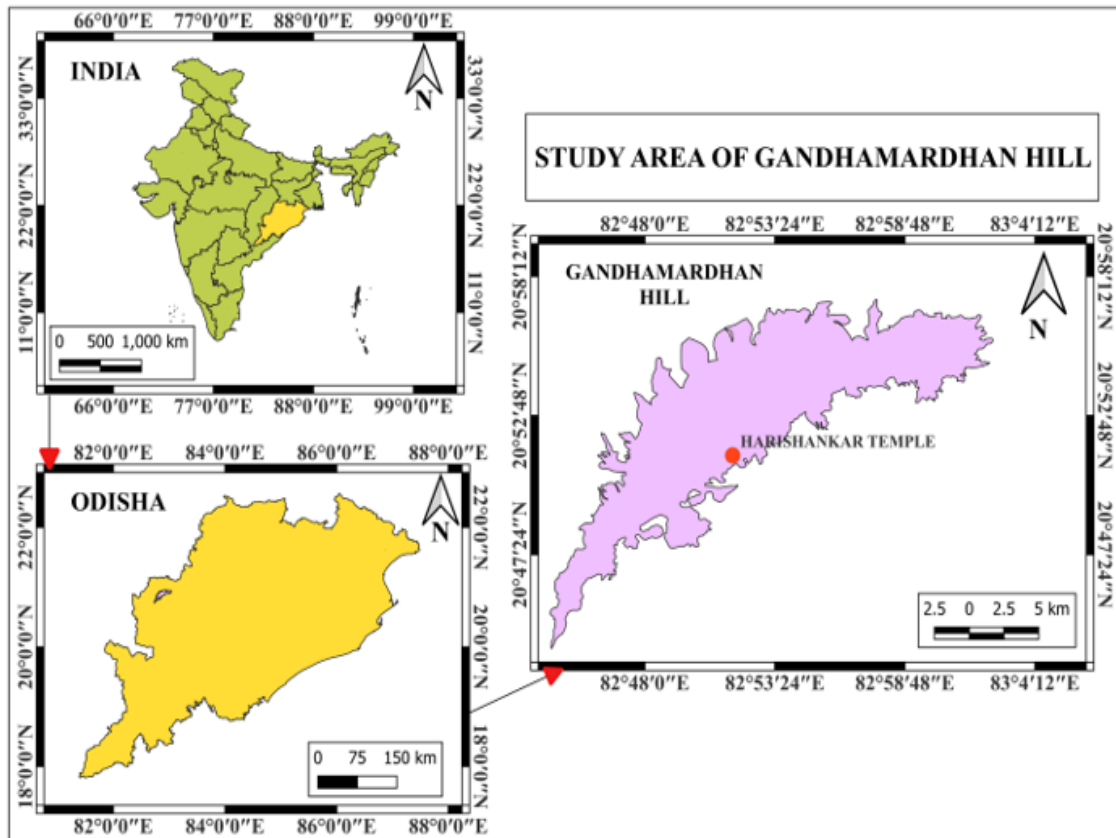


Fig. 1. The Index map of the Gandhamardan Hills in Western Odisha

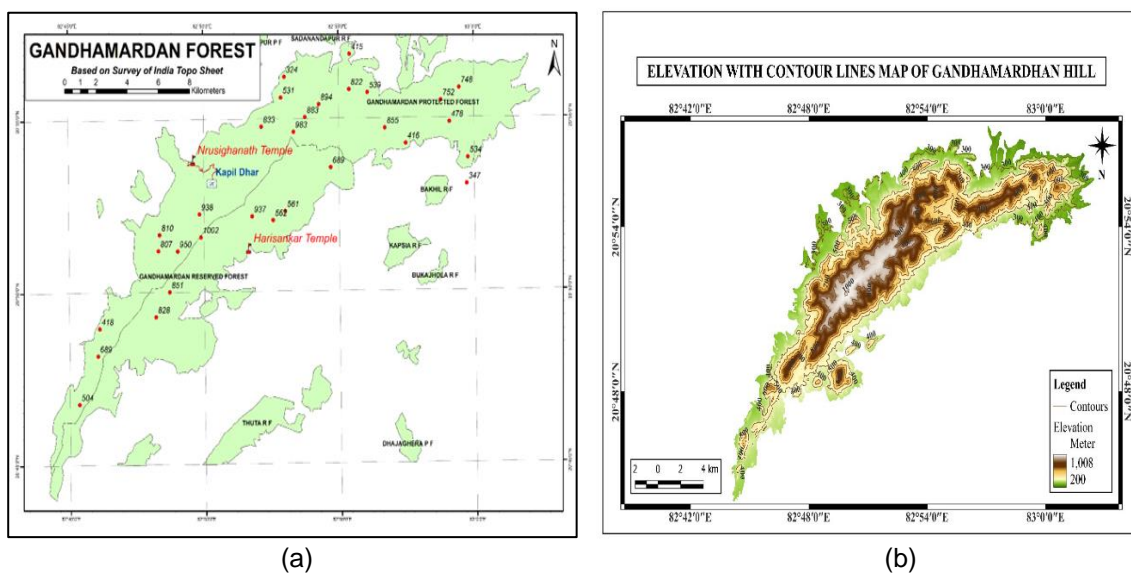


Fig. 2(a). The Elevation (b) the contour map of study the Gandhamardan Hills, Odisha

The stratigraphy and ecology under changing climate, the present time passes over geo- bio-hydro-aero spheres of the globe is the human activity changes in the Anthropocene epoch, Mishra et al., [12]. Turmeric rarely grows in GMH, Mishra. et al. [13].

The hotspot of floral species miscellany of the Gandhamardan Hills was found in places in Ayurveda and Naturopathy by the aboriginals but not scientifically pondered, and it was found in old printed literature. The geobotany and biogeochemistry of Gandhamardan Hill have a few studies, Bhadra et al., [14].

The GIS studies of the Gandhamardan Hills need more research, which is at par with nearby forests like Simili-Pal, Deomali Hills range in the eastern Ghats Hills, and coastal fronts, Bhitara Kanika and Rambha Hills. Many reports exist on the medicinal plants in Odisha's forests, Mishra et al., [15]. However, a research gap exists between these medicinal plants and geology, geomorphology, climate, geography, and geochemical studies of GMH.

1.3 Present Study

The present attempt is to conduct the generation of maps and in-situ field studies to investigate:

1. GIS mapmaking, analysis and interpretations of various map of the region so that the geomorphology can be known signatures of knowledge about geology, hydrology, and limnology) about the study area (Gandhamardan Hills)
2. The geo-hydro-biological studies of the GMH zone (Harishankar area). A quest for ethanol-botanical values of grasses, herbs, creepers, and trees in GMH has been done.

All-in-one baskets have been tried in the present work considering climate changes, anthropogenic interventions and vegetation losses.

2. METHODOLOGY

The physical, chemical, geological, geomorphological, and lithological studies of the flora, fauna, aquafauna, and avifauna of the Gandhamardan area were carried out. The land use and land cover (LULC) of the vegetation and other attributes of the region have been taken up by using the Geographical information system,

Q-GIS, and EREDAS software to know the geospatial loss of vegetation due to urbanisation and anthropogenic interventions over the hilly forests over the GMH Mountains. The workflow diagram is shown in Fig. 3.

The GMH ethnobotanical plants are searched in the villages, and local Vaidya's (Kaviraj) with the Balangir and Bargarh districts of western Odisha interact about medicinal plants. Bargarh and Balangir districts of Western Odisha. The data and information are also collected from the people, available literature, Journals and interviews with a few Aborigines. They are recorded and confirmed for a second opinion from Ayurvedic doctors. The work flow diagram shows the documentation of these established Ayurvedic, Naturopathic flora and fauna and their local, botanical or Latin/English names (Fig. 3).

The Survey of India (SOI) map 2005 is georeferenced, and the GMH elevation and the hills' maps were constructed. Landsat data is acquired from the US Geological Survey (USGS), www.glovis.usgs.gov. The Landsat 8 cloud-free image is georeferenced by OLI (Operational Land Imager). All the data about the study area are projected to a Universal Transverse Mercator (UTM) coordinate, Datum WGS 1984, zone 45N, by application of a 1:50,000 topographic map. Standard false colour composites (FCC) are constructed by extracting the satellite imagery on band combination with the help of ERDAS IMAGINE 9.2 software. The LULC and the NDVI are built from the multispectral RS image using separated bands, and the final map is prepared. The NDVI values are created manually using Arc GIS 9.3 software.

A Pan-analytical X-ray spectrometer (XRF (X-ray fluorescence)) is used to non-destructively rapidly analyse the composition or constituents of an element in a compound. It is used for archaeological analysis and medical, geological, forensic and environmental Engineering studies. This methodology has the disadvantage of high investment cost, X-ray management, spectral overlap, interferences, etc. This method of analysing the water and soil is easy, fast and accurate, and no chemical addition is needed.

Ethnobotany is the primitive practice against ailment by our ab-origines, is well-tested, and has fewer side effects. GMH is the treasury of plants that can be used for many diseases. Due to the geological location of GMH, these plants are creepers, bushes and mostly medium-sized

non-Sal plants. The treasure of ethnobotany must be explored, brought to the limelight, and converted to Allopathic medicine for the benefit of humanity.

2.1 Geography and Geology

Gandhamardan hills range was taken from the SOI Topo Sheet No 64L/13, extends in the NE-SW direction for a length of 9.8 km, width ranges from 0.4 to 2.6 km. and averages 0.75 km. The hills near Gandhamardan are Mahadasani in Gudvella (at Kandhan) and Bhim Dungri in Matkai. The GMH range extends until the Eastern Ghat Super Group, which consists of Khondalites, Gneissic rocks, Charnockites, and Migmatites, with small patches of Bengal Group rocks with exposures of quartz mica schist and hornblende schist towards the north-eastern corner of the district. The Iron deposits in the GMH area have two stratigraphies. The banded formations with irregular stratification exhibit fracture filling, and the other low-dipping sheets at the hilltop. Laterites cap the banded iron formation. Bauxite zones also occur at the top of the GMH by the weathering action of Bauxite rocks, Gallo et al., [16], Mishra et al., [17].

2.2 The Lithology of the Area

The GMH areas are of Recent and Sub-Recent formations of Alluvium in the plains, laterite

capping on the plateau top long with lower Gondwana sandstones Quartz, pegmatite, gneissic rocks, Liptinitic gneisses; Granulitic rocks (incl. charnockites); and Khondalites). They are widespread Archaean formations of the Eastern Ghats belt. The region shows the stones of the Khondalites Series and extends up to the western limit of the district. The Lower Gondwana Unconformity comprises Archaean rocks (Pre-Cambrian). The young geological formations in the GMH plateau are mostly laterite, followed by alluvium.

2.3 The Biological Hotspot

This is the 37th Biodiversity Heritage Site (BHS) in India, and the 3rd in Odisha are fragile ecosystems with diverse biodiversity. The GMH are classified according to the vegetation type in the lower elevation ranges. ii) Middle Elevation Range and Upper Elevation Range (LER: 340–547m),(MER: 547–754m), (UER: 754–top) respectively. The floral biodiversity accommodated in GMH is 1055 flora, including 849 angiosperms, 56 pteridophytes, 40 bryophytes, 45 lichens, two gymnosperms, and 63 species of macro-fungi. One angiosperm (*Ficus concertina* var. *daycare*) and one spider, *peacetime Harishankarensis*, are endemic to this hill, Bhadra et al. [18]. Mishra et al. [19], Mohanty et al., [6].

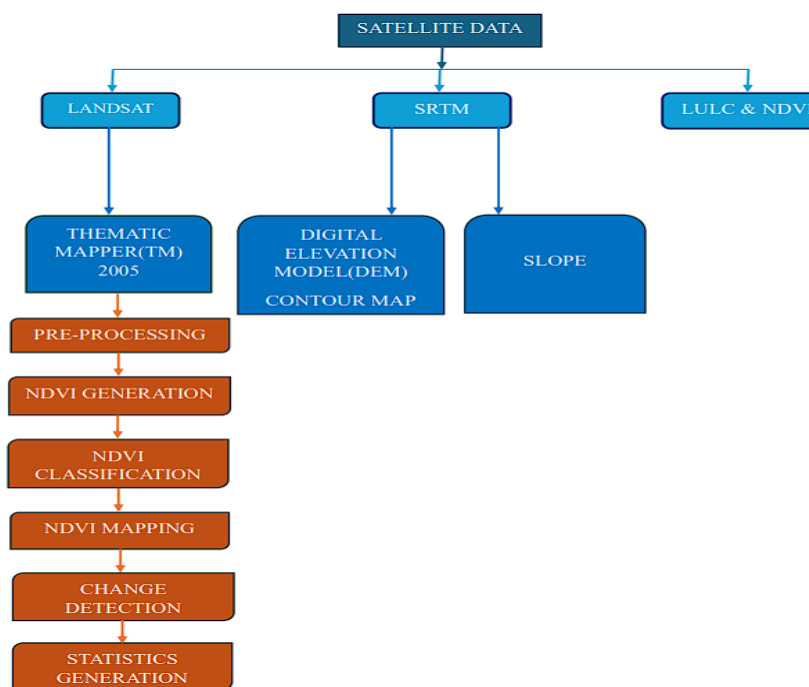


Fig. 3. The workflow diagram of the geo-hydro-biological studies of Gandha-Mardan Hills

2.4 The Nature’s Lash: Climate hazards Gandhamardan Hills

Balangir Dist. has confronted the deaths, sufferings, livelihoods and societal humiliations due to the distressing effects of drought, heavy rainfall, heatwaves, floods, fire accidents and lightning. Recently, the district has faced drought in 1996,1998, 2000, 2002, 2009, 2010, 2011, 2015, 2017,2018, and 2021, and Flood / Heavy rain in 2001, 2003, 2014 and 2019. This District is in the hot zone in the country, with the mercury reaching 45°C.

The climate of the hills range, though not recorded, is AW Savanna-type climate with minimum and maximum mercury lying between winter 7° C (Nov. to Feb.) to summer 48° C with high humidity (79%) (Mar. to June). The average rainfall in the district is 1289.8 mm, mainly due to its positioning below the Indian tropical convergence zone ITCZ (the band of low-pressure area encircling clouds), moon soon trough line, and nearer to the tropic of cancer and prevalence of SW monsoons. Winds are generally light to moderate, mainly in the directions between the north and northeast. The winds are variable in the summer and blow from Gandha Mardan Hills (Fig. 3a).

The district encounters medium to severe drought regularly, and the prominent drought years are 1996,1998, 2000, 2002, 2009, 2010, 2011, 2015,2017,2018, and 2021 and Flood / Heavy rain during 2001, 2003, 2014 and 2019 in the Balangir district. The impact of storms over the hill range is less, but it receives severe rain

during the passage of storms that slam the east coast of India. The rainfall trend line is polynomial over Gandhamardan is varying, and the befitting equation is $y = -2.3983x^2 + 65.068x + 917.71$ with R²-value is 0.237

2.4.1 The Land Use and Land Cover (LULC)

According to NRSC, the land use and land cover map is generated to get comprehensive information and understand the current topography and landscape used. Annual LULC data provides monitoring of chronological agricultural ecosystems, forest area conversions, and lacustrine areas of 2020. Present LULC depicts the earth's such as vegetation, forests, built-up areas, water, grassland, etc., Bid [20]; Barik et al., [21].

The Landsat Normalized Difference Vegetation Index (NDVI) quantifies green vegetation to know about vegetation density and plant health in the Gandhamardan canopy. The NIR is the spectral reflectance at the near-infrared band, while RED represents the red band. The Normal Difference Vegetation Index (NDVI) is

$$NDVI = (NIR - RED) / (NIR + RED) \dots\dots\dots(1)$$

The present NDVI map and the LULC map analysis indicate that the Gandhamardan Hills in the Eastern Ghats belt have sparse vegetation values of 0.27 to 0.36, and dense forests range from 0.36 to 0.74. The thick forests mean more vegetation and many trees. These trees are ethnobotanical. Hence, ethnobotanical studies are used at present Sarania et al, [22].

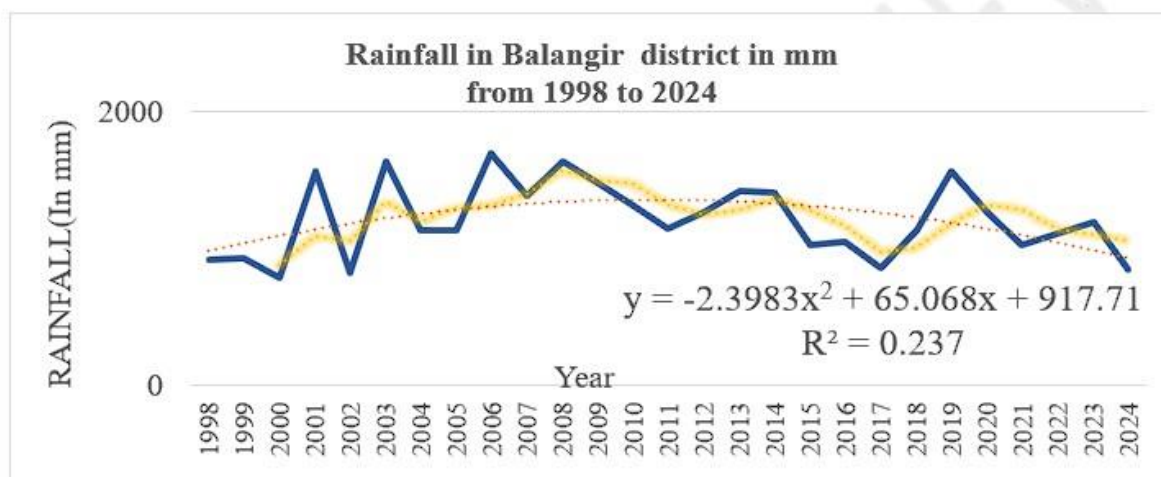


Fig. 3a. Annual rainfall of the Gandhamardan Hills in the Balangir district

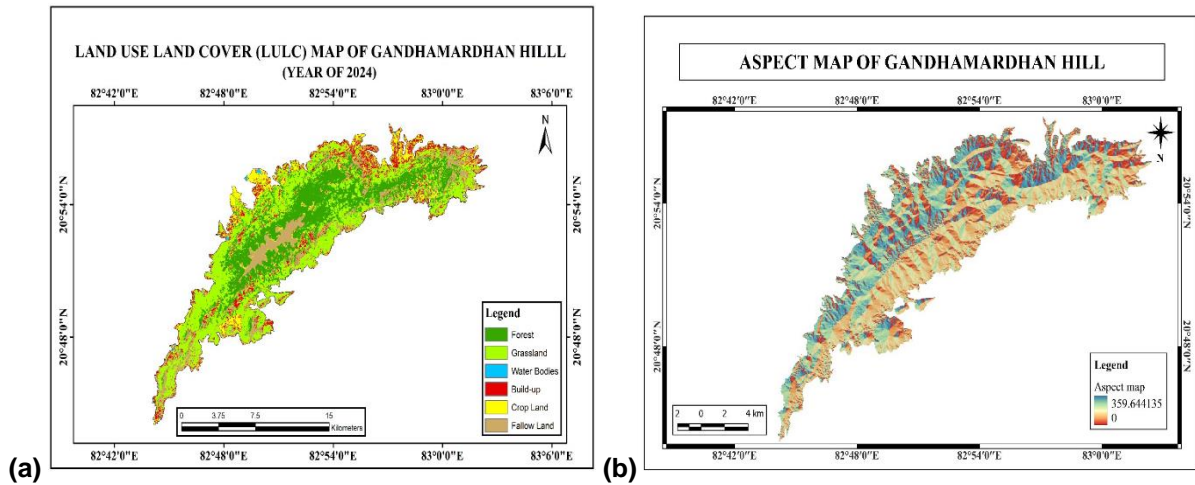


Fig. 4(a). The Land use and landcover (LULC) & (B) Aspect map of Gandhamardan Hills

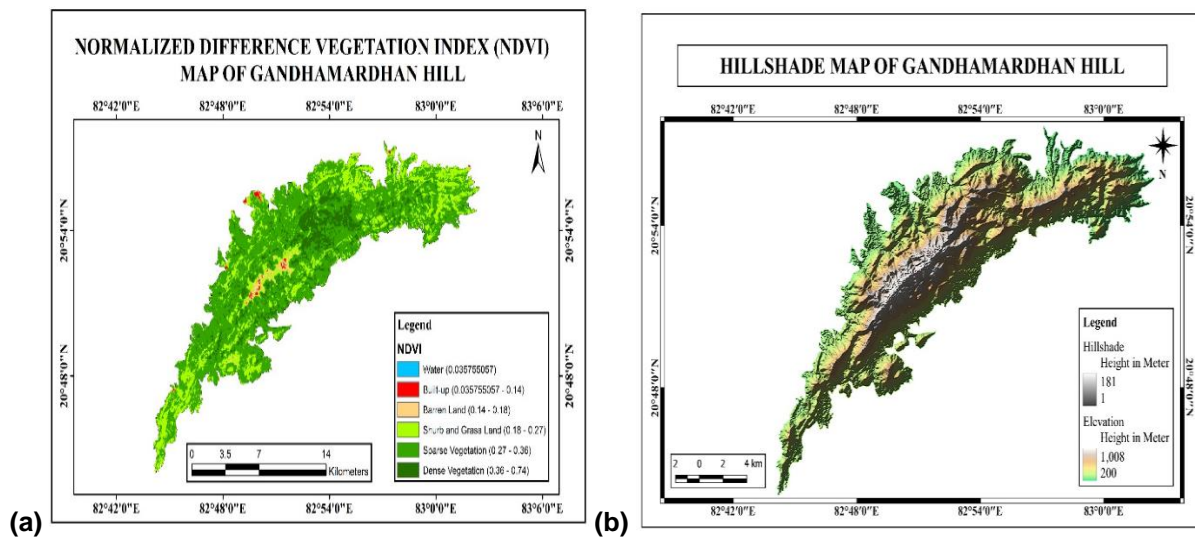


Fig. 5(a & b). The Normalised difference vegetation Index (NDVI) and (b)the Hills shade map of Gandhamardan Hills, Odisha

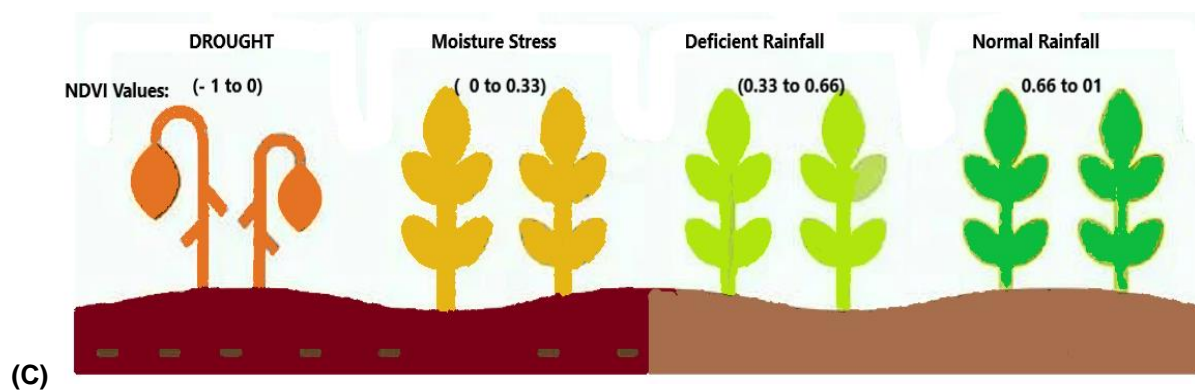


Fig. 5 (c). The LULC, The NDVI map of Gandhamardan Hills and the result interpretation. Source Modified: Team Cropin:17- 12-.2021

2.4.2 The riverine system

The Gandhamardan hills emanate two significant tributaries (Ong and Tel) of the River Mahanadi. The Tel River starts from the Nabarangpur district and passes through the Gandhamardan plains, joining the Mahanadi R. at Subarnpur. The prominent distributaries are the Udanti, Sutkel, Hatti, Indra, Lant, Ret, Raul, Uttei, and Khadago. The river Ong receives the runoff from the northern slope of the Gandhamardhan range, Fig. 6 (a), Mishra SP. [23].

The GMH is of 190sq. Km accommodates 1200 floral species, 500 faunal species, and many trees, herbs, ethnobotanical plants, etc. Other floral biodiversity hot spots in different hills of Odisha are Mahendra Giri Hills (Gajapati) and Mandasuru in Phulbani district, as per the State

Forest and Environment Dept. Odisha. The dwarf hills have sporadic trees at Patpani, Nandupalla and Chhatardandi, and the plateau is leafy in laterites 6 (b).

2.5 The Physicochemical Analysis

X-ray fluorescence (XRF) spectroscope is a physiochemically analytical method that determines the chemical structure of various soil, water, and metal samples and describes the composition of multiple constituents. The water and soil samples near the Harishankar area were collected and tested in the Centurion University of Technology and Management laboratory. XRF is a modern instrument used in various fields, like metallurgy, ecology, geology, and archaeology, Fig. 7(a),d Fig. 7(b), Das et al., [24], Singh et al., [25],

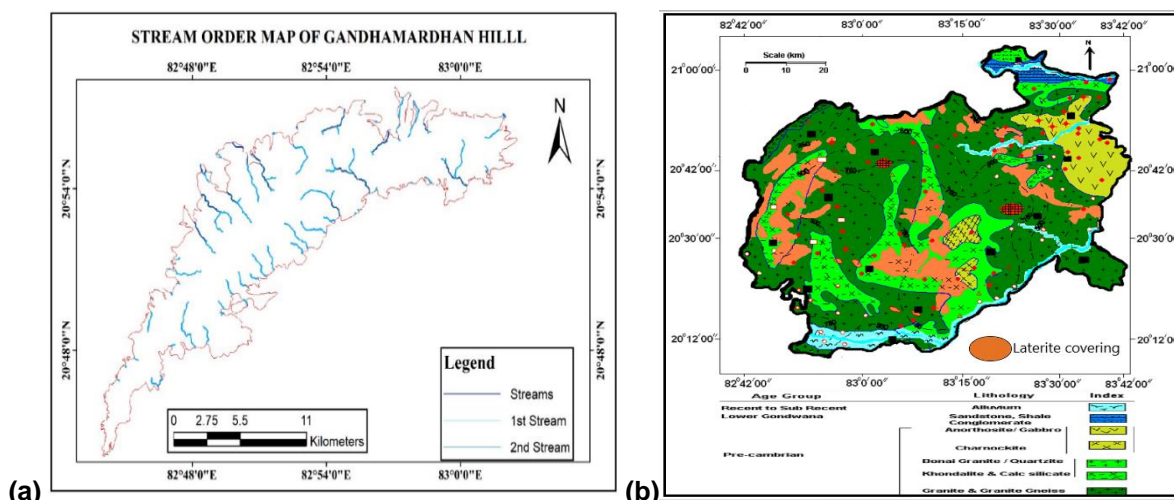


Fig. 6(a). The Stream order map and (b) Geology map of the Gandhamardhan Hills range in the Eastern Ghats belt, Source modified: "The District Disaster Management Plan 2024-25"

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Sample results

Sample ident												
Harishakar												
Application	<Omnian>											
Sequence	1 of 1											
Position	Large sample											
Measurement time	01-Aug-2024 16:40:17											
											Normalisation factor	1.319

Compound	Si	P	S	Cl	Ca	Mn	Fe	Br	Sn	Hg	Pb	H2O
Conc	725.3	452.1	0.0	219.0	173.8	0.0	33.0	0.0	41.8	227.7	0.3	99.813
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%

Fig. 7 (a). The water sample at Harishankar (OMNI) XRF spectroscopy analysis results

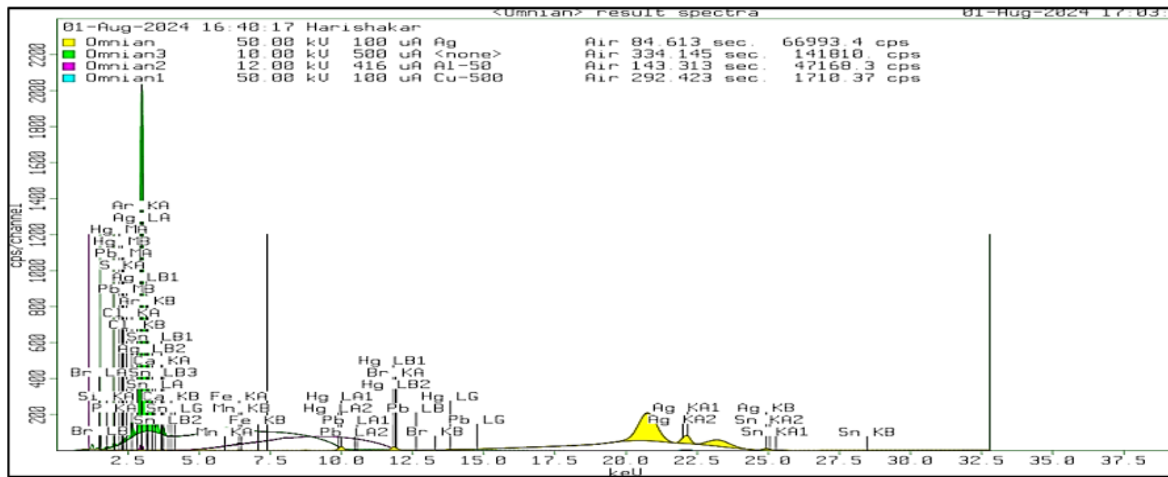


Fig. 7(b). The XRF Spectroscopic graph result of Water at Harishankar

03-Aug-2024 17:08:04 **Sample results** Page 1

Harisankar Soil

Sample ident

Application	<Omnian>	Normalisation factor	2.403
Sequence	1 of 1		
Position	Large sample		
Measurement time	03-Aug-2024 11:36:34		

Compound	Al2O3	SiO2	P2O5	SO3	Cl	K2O	CaO	TiO2	V2O5	Cr2O3	MnO	Fe2O3
Conc	23.179	51.442	0.653	0.0	0.122	3.828	1.088	2.291	460.7	255.3	0.403	16.406
Unit	%	%	%	ppm	%	%	%	%	ppm	ppm	%	%

Compound	NiO	CuO	ZnO	Ga2O3	As2O3	Rb2O	SrO	Y2O3	ZrO2	Nb2O5	BaO	Nd2O3
Conc	188.3	187.2	303.7	93.4	0.0	404.9	199.1	133.1	0.118	58.2	0.116	0.0
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	%	ppm

Compound	Eu2O3	Yb2O3	IrO2	PbO	CO2	Re
Conc	0.108	77.9	0.0	101.9	0.0	4.6
Unit	%	ppm	ppm	ppm	ppm	ppm

Fig. 7(c). The soil sample at Hari Sankar XRF Spectroscopy results

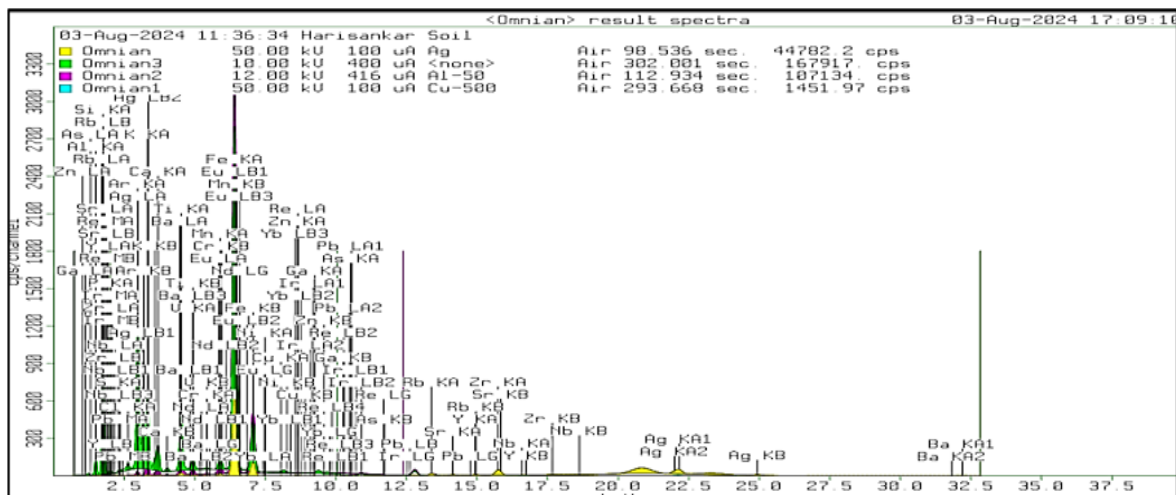


Fig. 7(d). The XRF Spectroscopic graph results of Harishankar Soil results

From the results of water and soil samples, an X-ray fluorescence spectrometer (CUTM Lab). It is observed that in the water sample, the objectionable elements present are in Table 1.

2.6 Bio-Geo-Chemistry of Gandhamardan Hills

At a high meditation, the soil contaminants that dismay the plant metabolism to reach the wilting point are Co, Cu, Mn, Zn, Ni and Boron. Bhadra [14]. The Oxides of elements As, Cd, Co, Cu, Mn, and Al have less variation in the Gandhamardan hills. The Zn has a substantial accumulation in the bark and roots of vegetation in Gandhamardan Hills. The As and Mn have higher concentrations due to more geospatial bioaccumulation in the soil stratum in the hills. The Gandhamardan soils have a higher accumulation of Al, Fe, As, Zn, and Cr at the top of the mountain at Upper Elevation Range (UER): 754–top), (ii) Cu, Zn, Fe in the mid-elevation region (MER): (547–754m). But at the foothills of Harishankar, LER: 340–547m, it is found that the oxides of five dominant elements are Cu, Zn, Ti, Ni, Sr, Pb and Fe. The gradation of the contaminants is Fe₂O₃ (16.4%) and Ti (2.29%).

The present study reveals that the Ti concentration found is 2.29%. Titanium (Ti) in soil enhances plant growth at low concentrations. This increases the process of photosynthesis, chlorophyll content, nutrient uptake, and better stress management, which augments plant growth and yield. Ca, K, and P's presence in the GMH enhances vegetation.

Iron (Fe) is an indispensable mineral for the growth of all plants. That enhances chlorophyll production and relieves the plant stress (moisture or salinity and drought, etc.), protein integral

structures, Cellular processes, etc. Iron deficiency invites reaching the wilting point by yellowing leaves. The presence of ferric oxide (Fe₂O₃) is 16.4%, which is abnormally high, so the plants in the Gandhamardan Hills are luxuriant and greenish.

From the XRF spectroscopic analysis, it is observed that the presence of Al, Fe, Cr, Mn, CU, Zn, Sr and Barium at higher concentrations initiates bioaccumulation/bio-adsorption in the plant at its roots, barks, wood, leaves, buds and flowers and adds to their ethnobotanical values. However, the surged weathering action on the top of the hills and elevation gradient degrades the trend of the ecosystem.

2.7 Ethnobotanical Values

The Gandhamardan Hills possess assorted. Ecological, biological, and socioeconomic importance. The biosystem accommodates about 1200 species of flora and 500 species of fauna, including 300 medicinal plants <https://www.sunyaias.com/blogs/gandhamardan-hill>. To know about the plant, the vernacular name, common name and botanical name of the plants and their components are searched from various kinds of literature, local people for enlightening researchers and naturopaths, and Ayurveda people for future health care researchers. The diseases and their characteristics are given in Table 2.

3. RESULTS AND DISCUSSION

After an intensive study using an X-ray Fluorescent Spectrometer, GIS studies, contact with local ayurvedic doctors or Kaviraj, and field studies of the Geo-hydro-Bio study reached the result, the Gandhamardan Hills and its flora and faunal kingdom have:

Table 1. The XRF elements beyond permissible limits Water Sample as per IS 12500-2012 [26]

Element /compound	Unit	Quantity present	Permissible limit	IS Code
Silicon (Si)	mg/l	725.3		
Phosphorous (P)	mg/l	452.1		
Chlorine (Cl)	mg/l	219	1000	IS 3025 (Part 32)
Calcium (Ca)	mg/l	173.8		
Iron (Fe)	mg/l	33.0	0.3	IS 3025 (part 53)
Strontium (Sn)	mg/l	41.8		
Mercury (Hg)	mg/l	227.7	0.001	IS 3025 (Part 48)/1994
Lead (Pb)	mg/l	0.3	0.01	IS 3025 (Part 47)

One ppm = one mg/lit; Hg, Fe, and Lead conc. are beyond permissible limits in water.

Table 2. The traditional ethnobotany of vegetation and its uses in Gandhamardan Hills. Atlas of Medicinal Plants [27], (<https://gandhamardan.coenpt.in/> [20])

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
1	Jangli Bhindi	Aibika; Jangli Bhindi	<i>Abelmoschus manihot</i> (L.) <i>Medik</i>	Bark	To treat wounds and cuts.
				Flower	To Treat chronic bronchitis and toothache.
2	Musk mallow	Latakasturi	<i>Abelmoschus moschatus</i>	Seed	Digestive, tonic, stimulant, antiseptic, antispasmodic, cooling, carminative,
3	Barkanghi,(Swee)	Indian Mallow	<i>Abutilon hirtum</i> Lam.	Plant/Root/leaf	Herb for cough, toothache, easy childbirth (expels the placenta.), Abscesses.
4	Kanghi	Atibal (Sans)	<i>Abutilon Indicum</i> L. (Sweet)	Plant	Used to treat Fever, Colic, Ulcer, and Cough. Leprosy, Infusion.
5	Gohira/ <i>Climber</i>	Chilati, Agla Bel	<i>Acacia pennata</i> (L.);	Plant	Counter digestive disorders, Curb stomach infections and pain, and lower Cholesterol.
6	Vachaa	Uragandha, (Sweetflag)	<i>Acorus calamus</i> L.;	Rhizome	Beneficial in colic, gout, cough, asthma, calculi, bronchitis, epilepsy, amentia etc.
7	Gokhura (Odiya)	Kaanthi(Hindi)	<i>Acanthospermumhispidum</i> DC.	Plant	Treats jaundice, malaria, vomiting, snake bite, headache, colic, convulsions, epilepsy, constipation, viral/ microbial infections
8	Toothache plant	Akarkara	<i>Acmella paniculata</i> .	Plant	Used for food /medicine and insecticide, toothache and oral infections.
9	Gorbach	Gorbach (herb)	<i>Acorus calamus</i>	Plant	Used for gastrointestinal (GI) problems (gastritis, anorexia, etc.
10	Apmaranga	Adhahshalya, kinihi	<i>Achyranthes aspera</i> L.;	Whole plant	Digestive, stomachic, carminative, boils, laxative, diuretic, expectorant, colic, cough, asthma, bronchitis, pneumonia, paediatric colic, piles, leprosy, vomiting, skin diseases, gonorrhoea, anaemia, etc.
11	Gopakana/Hanaspada	Ishar-mul/ Ishwari	<i>Aristolochia indica</i> Linn.	Creeper: Leaf/ root	Raise sexual desire, immunity, and menstruation; treat snake bites, intestinal / gallbladder pain, wounds, gout, arthritis, rheumatism, eczema, etc.
12	Bel	Bael	<i>Aegle marmelos</i> Linn.	Stem/bark/leaf /fruit/seed.	Antidiarrheal, antimicrobial, antiviral, radio-protective, anticancer, diuretic, antipyretic, ulcer healing, antigenotoxic, antifertility, anti-inflammatory
13	Madhu Malati	Malati: (Creeper)	<i>Aganosma caryophylla</i>	Leaves	Used for Pitta disease.
				Flower	Eye Disorder., Skin infection between toes
14	Pokasungha	Jangali Pudina	<i>Ageratun conyzoides</i> (L.)	Plant	Treat Pneumonia, burns, fever, colic, cold, rheumatism, headache, diarrhoea, spasm.
				Leaves	Treat brain malaria and common malaria.

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
15	Aisha	Ankola (Hindi)	<i>Alangium salvifolium (Linn.f.)</i>	Plant	Treat haemorrhoids, rheumatic arthritis, loose stools, herpes, blood disorders etc.
				Seed	Aphrodisiac and energize the body.
16	Sisrisha (Tree)	Siris (Hindi)	<i>Albizia lebbek (Linn.)</i>	Leaf/ Seed	Treat boils, cough, the eye, flu, gingivitis, lung problems, pectoral problems, tonic, abdominal tumours, and pest management.
				Bark	Treat inflammation.
17	Ghi-Kuanri	Kumari, / Aloe	<i>Aloebarbadensis Mill.</i>	Leaves, leaf-juice,	Carminative, colic, stomachic, burns, fertility, epilepsy. Anti-inflammatory, skin diseases, antibacterial, bowel disorders, dyspepsia, hypotensive, anti-spasmodic, dysuria, renal calculi tumours, dropsy, etc.
18	Chatiyana(tree)	Chitvan (Hindi)	<i>Alstonia scholaris L</i>	Bark Latex Leaves	Treating neuralgia and toothache. Beriberi, dropsy and congested liver., etc.
19	Guduri Sag	Gudrisag (Hindi)	<i>Alternanthera sessilis(L.)</i>	Herbs	Used to treat hepatitis, tight chest, bronchitis, asthma, Lung diseases, stop bleeding & hair tonic.
20	Jangali gailia	Gubal (Hindi)	<i>Alysicarpus vaginalis L.</i>	Root Seed	Treatment of coughs chewed during fevers. Used to treat dysentery and colic.
21	Olua	Stink Lily (Herb)	<i>Amorphophallus paenii fo liu,(Dennst.)</i>	Root Stem	Carminative, stomachic tonic. Curing dysentery. The fresh root is expectorant, & treats rheumatism, as well as snakebites.
22	Lanka Amba (Odiya)	Cashew (Indin)	<i>Anacardium occidentale Linn.</i>	Leaves Bark Serrup	Reduce fever, malaria, toothache, anaemia, and constipation. Lessen blood sugar & detoxify snake bites. used as relief from coughs and colds.
23	Chiretta / Bhuinnimba	Bitterweed (English)	<i>Andrographis paniculata (Burm. f.)</i>	Shrub	Treat cancer, diabetes, high pressure, ulcers, leprosy, bronchitis, skin diseases, colic, influenza, dysentery, dyspepsia, and malaria.
24	Apanga/Kala bhangra	Indian Catmint	<i>Anisomeles indica (Linn.)</i>	Shrubs	Analgesic, anti-inflammatory, spinach, snakebites, antioxidant, antimicrobial, anti-HIV, anti-Helicobacter, pylori and anti-cancer activity, chronic rheumatism.
25	Atta, Meghua	Sita Phala (Hindi)	<i>Annona squamosa Linn.</i>	Tree (Leaves)	Anti-microbial, anti-fungal, anti-cancer, anti-inflammatory, antiulcer, antidiabetic, antidiarrheals, antiplatelet, antioxidant, hepato-protective, neuroprotective
26	Jamrala/Marmuri	Amoori (Hindi)	<i>Antidesma acidum</i>	Tree	Plants are used to treat dysentery, pneumonia, sores and muscular pains.
27	Kaincha	Gunja (Climber)	<i>Abrus Precarorius (L)</i>	Root, Leaf, seed	used in skin diseases, wounds, alopecia, asthma, tubercular glands, stomatitis, hyperdipsia & fever.

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
28	Kanta Kusuma	Satyansi	<i>Argemone Mexicana L.</i>	Herbs	used by traditional healers in Mali to treat malaria.(Isolated from drugs)
29	Panasha	Kathal or jackfruit	<i>Artocarpus heterophyllus</i>	Tree	Used as especially anti-oxidant, anti-inflammatory, antimicrobial, anti-cancer and anti-fungal activity.
30	Musdanai	Samudrapalakah,Bastanbi	<i>Argerianervosa (burn f)</i>	Seeds	Treat Stomach disorder, debility
31	Bari	Satavari (Hindi)	<i>Asparagus racemosus Willd.</i>	Tree	Used for dyspepsia, constipation, spasms, ulcers, pain, anxiety, cancer, diarrhoea, bronchitis, alcohol withdrawal, diabetes, tuberculosis, dementia, etc
32	Bana Kulitha	ulthia	<i>Atylosia scarabaeoides Linn (Creeper).</i>	Stem & Leaves	Used for leg swelling, pain in pregnancy, night fevers, renal stones, eye diseases, dropsy, anaemia, hemiplegia, burns, wounds, small-pox, syphilis, gonorrhoea, gravel, cholera, dysentery, snake-bite, venereal diseases.
33	Neem	Indian Lilac/ Neem	<i>Azadirachta indica</i>	Root/seeds/leaf / Large tree	Digestive, treat bellyache/ gastritis. Roots include skin disorders, deafness, diabetes, and insecticides/ pesticides.
34	Dhaura	Dhaora	<i>Anogeissus latifolia Roxb.</i>	Large tree	Ayurveda medicine in cardiac disorder. UTI infections, skin diseases, liver complaints, fever, epileptic fits, etc.,
35	Khandakoli	Reetha	<i>Allophylus serratus Roxb.</i>	Plant/bark Leaves	used to treat analgesia, swelling, ulcers, investigated for its anti-inflammatory and analgesic activities in animal models.
36	Brahmi	Brahmi	<i>Bacopa monnieri (L.)</i>	Leaves	Memory-enhancing, anti-inflammatory, analgesic, antipyretic, sedative and anti-epileptic agent.
37	Donti	Danti (Shurb)	<i>Baliospermum montanum, W.</i>	Root/ Seed	Used for oedema and pain, blood purifier.
38	Bans	Bans (Large tree)	<i>Bambusa arundinacea (Retz.) Willd.</i>	Leaves/ stem/ Bark Leaf/roots	Used for cough, skin diseases, wounds, digestive disorders, nausea, gynaecological disorders, diabetes, fever, blood diseases, colic, syphilis, malarial, diabetes, stomach-ache, etc.
39	Koilekha	Bajradanti (Herb)	<i>Barleria prionitis Linn.</i>	Stem, flower	For oral health, pain relief, boils, digestive, tonic. Whooping cough, inflammations, jaundice, fever, eczema, gastric, diuretics, pimples, etc.
40	Poi	Poi/ Creeper	<i>Basella albaL.</i>	Leaf/Stem	Treat dysentery, Constipation, & Diuresis.
41	Kanchan	Kanchan	<i>Bauhinia purpurea L..</i>	Total Plant	Antibacterial, antidiabetic, analgesic, anticancer, anti-inflammatory, anti-diarrheal, nephroprotective regulate thyroid hormone, Carminative uses.
42	Magha latenga	Kurei (small sub-Herb)	<i>Bidens biternata (Lour.)</i>	Wwhole plant	Used against digestion, inflammation, infections, diabetes, malaria, leprosy, toothache, fever, cough,

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
					asthma, liver infection, toothache, and diarrhoea.
43	Chhota Lajakuli Lata	Lakchana, or, Lajalu (herbs)	<i>Biophytum sensitivum</i> Linn. Dc.	Decoction of roots, leaf /stem.	Treat gonorrhoea, bladder stones, chest complaints, tuberculosis, anti-inflammatory, sore throat, abscesses, chronic wounds, and fever. etc.
44	Jajan or Jhanjiki	Tikher or Suka surani.	<i>Breynia vitis-idaea</i> (Burm. f.)	Leaf Bark	used to treat boils and skin diseases. astringent and anti-inflammatory, used for rheumatism and to stop the bleeding.
45	Rakta trichuli, Kajan ;	Kangli or kambhi , Retund (Hindi)	<i>Breynia retusa</i> (Dennst.) (Shrub)	Whole plant Leaf	Fresh plant juice is given as eye drops for eye diseases and conjunctivitis. Treat skin diseases, analgesic, anti-infla-amatory, antimicrobial, swollen testicles.
46	Atikapudi Guodapuruni	Punarnava, Biskhapara, Gadahpurna	<i>Boerhavia diffusa</i> L. Herb	Leaves	used as an anti-diabetic, anti-inflammatory, hepatoprotective and diuretic, treating fluid accumulation, anaemia, and liver diseases
47	Ram Kanda	Seemar or Semal kanda	<i>Bombax ceiba</i> Linn.	Flower Root Gum	Astringent & treat Skin troubles. Roots are diuretic and tonic. Treat cholera, fistula, cough, urinary problems, abdominal pain, impotence.; Treats dysentery and menorrhagia. Influenza, Haemoptysis in tuberculosis,
48	Tala or Tal's palm	Tar (tree)	<i>Borassus flabellifer</i> Linn.	Root Flower Bark	Anthelmintic, diuretic, respiratory diseases. The ash of the flower is taken to relieve heartburn and enlarged spleen and liver. A tonic, diuretic, stimulant, laxative, anti-pragmatic, amebicide for liver disorders.
49	Salia	Shallaki	<i>Boswellia serrata</i> Roxb.	Sap, bark, and others	Treat brain injury, osteoarthritis, joint pain, rheumatoid, fluid-filled pads, tendons.
50	Palasa	Dhak or palasa	<i>Butea monosperma</i> Lam.	Leaves Seed	Treatment of diarrhoea and wounds. With honey as anthelmintic, anti-fungal, antibacterial purgative, etc
51	Shallaki or Salia	Shalai/ Shallaki	<i>Butea superba</i> Roxb.(Climber)	Leaves Root	Treats skin ageing during post-menopause used for Erectile dysfunction, easy delivery. Poisonous bites of animals.
52	Gilo/ Gila	Karanju, Kata karanja	<i>Caesalpinia bonduc</i> L.	Root Bark Seed Leaves	Treat fevers, asthma, cough, worms, colic, dyspepsia.: Elephantiasis, intestinal worms, fevers, hepatomegaly, amenorrhoea, etc./ Used in inflammations, cough, asthma, hydrocele, leukoderma, leprosy, skin, colic, diseases, fevers. Dyspepsia, dysentery, worms, diabetes,
53	Lata karanja	Katakarnja (Creoper)	<i>Cajanus scarabaeoides</i>	Fruit, leaves	Treat leg swelling, pregnancy pain, diarrhoea, renal stones, eye diseases, dropsy, anaemia, burns, wounds,

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
					smallpox, syphilis, cholera, gonorrhoea, dysentery, and snakebite.
54	Arakha (Bush)	Madar or Ark	<i>Calotropis gigantea or procera (Linn.)</i>	Root, seeds, Flower, latex	used for treating skin, digestive, respiratory, circulatory and neurological disorders, fevers, elephantiasis, nausea, vomiting, diarrhoea, cramps, joint pain, and Dried latex for fistula.
55	Dhony	Kokoray	<i>Calycopteris floribunda (Roxb.)</i>	Mainly leaves	Treat worms, colic, leprosy, ulcers, malarial fever, dysentery, and vomiting. The fruits treat jaundice, ulcers, pruritus and skin diseases.
56	Bhuni limba	Bhui Neem	<i>Canscora diffusa (Vahl)</i>	Whole Plant	Anti-inflammatory, analgesic, antitubercular, spermicidal, useful in allergy, ascites, fever, verminous, hepatopathy, skin diseases, laxative, stomachic, liver tonic, etc.
57	Kuruma, Jordaru, Karuna	Kuruma	<i>Canthium dicoccum (Gaertn.)</i>	Bark & Root	Used for the treatment of diabetes. The plant extract cures diarrhoea and fever. Anti-diarrheal, antipyretic, and febrifuge.
58	Karir or Krakara ; Ker	Ardanda Jhiris/Kair Tenti	<i>Capparis brevispina DC.</i>	Leaves Root/Bark	Cure testicle swelling, smallpox, boils, cholera, colic, pneumonic, neuralgia, and sores. Used in smallpox and swelling of testicles.
59	Pirika;	Kanthari; Heens	<i>Capparis sepiaria L.</i>	plant	used as a blood purifier, stomachic, tonic, appetiser, cough, toxemia, and snakebites.
60	Golia lata	Kitamari/r Godhapadi	<i>Cayratia pedata Lam.</i>	Leaves (rare)	used for treating ulcers, diarrhoea and inflammation; IUCN: Vulnerable (VU).
61	Haratali or Brahmi	Karnasphota or kapalphodi	<i>Cardiospermum helicacabum L.</i>	Hedge herb ; Leaves	Used for rheumatism, nervous disorder, snakebite, abdominal pain, lung diseases, rheumatism and stiffness of the ear ach and eye sore, cough,
62	Kumbha	Kumbhi	<i>Careya Arborea, R.</i>	trees/Bark	It treats ulcers, coughs, and wounds, promotes digestion, and relieves swellings.
61	Guachipo (herb)	Philippine tea;	<i>Carmona retusa Linn.</i>	Roots/fruits	Treat fever, scabies, and lung diseases.
63	Benimanj/Kakra	Chilla	<i>Casearia elliptica (W)</i>	Fruit	Anti-diabetic, anti-microbial, diuretic, Cures diabetes, fevers, ringworm, ulcers, snake bites
64	Banakolathi	Chakanu / Chakasu	<i>Cassia absus Linn.</i>	Leaves, Roots, seeds	Treat bronchitis, asthma, cough, renal, hepatic diseases, conjunctivitis, leukoderma, wound constipation, tumours, ulcers, and headache.
65	Sunari	Amaltas	<i>Cassia fistula Linn</i>	Seed	Laxative, febrifuge, tonic, anthelmintic, anti-inflammatory, antiperiodic, febrifuge, diuretic, ophthalmic, carminative, diuretic.
66	Patwaghas	Patwa Ghas	<i>Cassia mim-osoides, Linn</i>	leaves	Treat diarrhoea/dysentery/ intestinal problems.
67	Kasundri	Badakosandi	<i>Cassia occidentalis Linn.</i>	Leaves, Root,	Used to treat antibacterial, antifungal, anti-malarial, anti-

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
				Seed	inflammatory, antioxidant, hepatoprotective and Immunosuppression, etc.
68	Chakonda	Charota or, Chakvad	<i>Cassia Tora Linn.</i>	Seeds/ Flower	Treat skin diseases, leprosy, ringworm, itching, psoriasis, and snake bites.
69	Chakunda	Mukarasi,	<i>Cassini albums Retz.</i>	Seed	Extract used for parasitic worm infections.
70	Akashvuli	Akas Bel (Creeper)	<i>Cassytha filiformis L.</i>	Leaves, stem	Anthelmintics, Antimicrobials, Antifungal Oedema, Headache, Hepatitis
71	Sada bahar	Indian Periwinkle	<i>Celastrus paniculatus(Wild)</i>	Plant	Anti-arthritis, wound healing, hypo-lipidemic, antioxidant. Treat pain, gout, and rheumatism to surge sperm in semen.
72	Bornoptri	Priyangu; Beautiberry (Shrubs)	<i>Callicarpa tomentosa (Linn.)</i>	Leaves and roots	Ulcers. Fever. Hydrocele. Leucorrhoea. Liver Diseases. Malaria. Paralysis. Effective Liver Tonic. Anthelmintic, Antispasmodic etc.
73	Lobanga or Sirali	Safed Murga or Sarwari	<i>Celosia argentea(L.)</i>	Flower/ Seed	Medicine for uterine bleeding, leucorrhoea, dysentery, diarrhoea, and eye diseases.
74	Salvah	Sevar / Coontail	<i>Ceratophyllum demersum Linn.</i>	Aquatic ; leaves	Antimicrobial, antibacterial, antibilious, and purgative. Treatment of wounds, fever, burning sensation, haemorrhoids or piles,, etc.
75	Thalkudy; Srabani; Manduki	Brahmi or Mallari herb	<i>Cetella asiatica (Creeper)</i>	Leaf & Root Extract	Repair nervous tissue in spinal injury and neuromuscular disorders, increase brain function, memory, and skin conditions.
76	Sanapuspi	Banshan, Jhunjhunia	<i>Crotalaria verrucosa L.</i>	Root	Used as a treatment against fever and stomach pains, to purify blood and skin diseases.
77	Bana Maricha	Ban Tulsi	<i>Croton bonplandianus</i>	Seed/ leaves	Treat liver disorders, skin diseases, asthma, jaundice, swelling, ringworms, bronchitis, constipation, abscesses, etc.
78	Talamuli	Kalimusali	<i>Curculigo orchoidesG.</i>	Fruit Flower	Diuretics and laxatives Treat piles, cough, debility, jaundice, asthma, piles, etc.
79	Dhoboni/ Sujuni	takoli	<i>Dalbergia lanceolata</i>	Bark	Stem bark is pasted with water, and the lotion is applied externally to leukoderma.
80	Sisu	Shisham	<i>Dalbergia sissoo Roxb.</i>	Bark	Stem bark is pasted with water, and the lotion is applied externally to leukoderma.
81	Dhala Durdura	Dhatura	<i>Daturastram onium L..</i>	Leave Seed	Treat asthma and bone setting, antiasthmatic, antispasmodic, hypnotic and narcotic.
82	Salia, Dhaba Bansa,	Vansha	<i>Dendrocal mus strictus.</i>	Leaves, Plant	Anticarcinogenic, Decoction + honey+ jaggery for post-delivery problems
83	Madanga	Vrksadani or Banda Patha	<i>Dendrophthoe falcata (L.. f.)</i>	Plant paste/juice	Narcotics and diuretics treat pulmonary ulcers, tuberculosis, asthma, menstrual disorders, swelling

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
					wounds, renal vesicle calculi, etc.
84	Makarkendu /Mankada Kendu	Malabar ebony	<i>Diospyros malabarica (Desr.)</i>	bark, leaf, flowers, fruits	T treats diarrhoea/ dysentery. The bark treats boils/tumours; juice treats bilious fevers/ blood diseases, gonorrhoea, leprosy, snake bites, etc.
85	Kalicha, Kanchia	Sola tree	<i>Diospyros sylvatica Roxb</i>	Fruit/ Leaves Stem	Used to cure stomachache. Used as a laxative. Used as an expectorant. Used as a tonic for constipation, Stomach problems, diarrhoea, Malaria, fever, etc.
86	Bhringraj / Pita Bhringaraj	Bringraj/ keshraj	<i>Eclipta alba (L.) Hassk</i>	(Seed, Whole)	Protect Liver, antiviral, antibacterial, anticancer, antioxidant, Early hair greying & fall, disorders, jaundice, & skin diseases etc.
87	Amalia	Gobhi (Gojihva)	<i>Elephantopus scaber</i>	Root	Treat paediatric diarrhoea. Rheumatism. Root paste treats spermatorrhoea to loosen motion.
88	Bai bidanka/ Fatangdi	Babranga/Bhingi	<i>Embelia tsjeriam-cottom</i>	Plant	The fruits are anthelmintic, antispasmodic, and carminative ointments for treating toothache. The leaves with ginger gargled for sore throats.
89	Hidimichikaa	Hilamochi, arkuch sag ;	<i>Enydra fluctuans L..</i>	Whole Plant	Used as antioxidative and analgesic; dropsy, anasarca and snakebite.
90	Dhaniya /Jangali Dhaniya	Wild Coriaender	<i>Eryngium foetidum</i>	Leaves	Treat burns, earaches, fevers, hypertension, worms, constipation, fits, asthma, stomach-aches, infertility, snake bites, diarrhoea, malaria, appetiser, etc.
97	Khirsag Chitakuteai	Bidarie, Dudhi	<i>Euphorbia hirta</i>		Treat female disorders like cough, bronchitis, asthma, worm children, dysentery, jaundice, pimples, gonorrhoea, digestive, tumours, etc.
98	Khadisiju, hadabhanga	Milk bush/Amar	<i>Euphorbia tirucalli</i>	The paste	Treat rheumatism, warts, cough, asthma, earache, toothache, fever, bronchitis, etc.
99	Sweta puruni / Neelchampa	Phooli, Sankhaholi	<i>Evolvulus alsinoides</i>	Whole plant	The plant is passed on to skin diseases. Brain tonic treats nervous debility, dysentery, etc.
100	Hidimichika, Hidimicha	Harkutch, Hilmochika	<i>Enhydra fulctunas L..</i>	Juice of plant	Inflammation, cancer, diarrhoea, microbial infection, diabetes, wounds, constipation etc.
101	Raj Dimari	Phagoora/Timila	<i>Ficus auriculata</i>	Fruit	Delays ejaculation and increase sexual power.
102	Dharmaoar	Pukar/ Banij	<i>Ficus benjamina Linn.</i>	Fruit	Its latex/fruit extracts treat skin disorders, inflammation, piles, vomiting, leprosy, malaria, nose diseases, cancer, general tonic, antimicrobial, antipyretic, anti-dysentery, etc.
103	Dimri, Kharsan	Gobla, Kagsha,	<i>Ficus hispida Linn.</i>	Fruit & Bark	Purgative: Decoction from the fruit or bark treats jaundice, piles, and abdomen pain.
104	Jari/Pippal/ Aswastha	Pipal	<i>Ficus religiosa (L)</i>	Leaves, bark/	Treat asthma, diabetes, diarrhoea, epilepsy, gastric

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
				root	inflammations, and sexual disorders.
105	Bainchokoli	ramontchi, and Indian plum	<i>Flacourtia indica (Burn. F.)</i>	Fruit	Appetising and digestive, diuretic, in jaundice enlarged spleen. Bark: intermittent fever. Roots: spermatorrhoea and rheumatism.
106	Brahman Jhati	Bhalia Bisbut	<i>Fleminga macrophylla</i>	Root	Treatment of spermatorrhoea and rheumatism.
107	Sugandhraj	Gardenia /cape jasmine,	<i>Gardenia jasminoides</i>	Root	Treat headaches, dyspepsia, nervous disorders, jaundice, kidney diseases, lungs etc.
108	Gambhari	Gamhar	<i>Gmelina arborea R.</i>	Leaves Root	Leaves: appetitive, Colic and after delivery as an appetiser. Juice: for fever, liver complaints for eczema and skin affections, treat diarrhoea, coughs, rheumatism, anaemia, jaundice, etc.
109	Agni kumari/ Bajramula	Akhatari	<i>Grangea maderaspatana (Linn.)</i>	Leaves, root, fruit etc.	Considered antipyretic, astringent. antiseptic Root: diuretic, anthelmintic and stimulant, Leaf: stomachic, deobstruent, antispasmodic,
110	Pita sag	Jima	<i>Glinous oppositifolius L.</i>	Leaves	Antibacterial, Anti-diabetes, anti-microbial, fever, Arthritis, Diarrhea, Stomach upset, Jaundice, inflammation, malaria, and wounds.
111	Dhamuraa, Dhaman	Dhanurvks, Sutejana,	<i>Grewia tillifolia vahl.</i>	Bark, fruits.	Treating non-healing wounds, ulcerative colitis, menorrhagia, and cough.
112	Gudamari	Gurmar:	<i>Gymnema sylvestre (Retz.)</i>	Leaves/ roots	Lower Blood Sugar Levels. Maintaining insulin levels, digestive, eye pain, snake bite, cholesterol, triglyceride levels etc.
113	Jarajaati; Gharpodia	Pitpapra/ Parapata	<i>Hedyotis corymbosa (Linn.)</i>	Leaves	Antitoxic, anti-oxidant, antibacterial, antirheumatic, anthelmintic, depurative, digestive, activates blood circulation, appendicitis, hepatitis, pneumonia, urinary infection, cellulitis and snake bites.
114	Hatisundha, Kaf Gajri	Hatisundhi/ Chanchuphal	<i>Heliotropium indicum</i>	Plant Leaves	Plant: treat diarrhoea, diabetes, venereal diseases, urination frequency, eye infection, asthma, ulcers, dysentery, colds, wound healing, bronchitis boils, fractures, menstrual or nerve disorders, kidney problems, etc. Leaves: Cough, treat eye pain, etc.
115	Anantamul	Indian Sarsaparilla, and Sariva	<i>Hemidesmus indicus (Linn.)</i>	Root	Diuretic, tonic, anti-pyretic, blood purifier. Treat leprosy, skin diseases, fever, asthma, syphilis, bronchitis, urinary diseases, rheumatism, etc..
116	Jangal Bhindi	Natanageswari	<i>Hibiscus vitifolius;</i> <i>Hiptage benghalensis L.</i>	Leaves Seed	Leaves are pasted, boiled with castor oil, and applied to the rheumatic part of the body. Seeds are pasted with honey and applied on the eyes' inner lids to treat cataracts.

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
				Leaves	used to treat cutaneous diseases.
117	Koilikhia/ Gandha Tulasi/ Koelekha	Talimakhana	<i>Hygrophila auriculata</i> <i>Hyptis suaveolens</i>	Root	Root: Treat blennorrhoea, hydropsy and anuria, stomach ache; leaves/stem: ulcers and rheumatic; Seeds: diuretic, fever, analgesic, enhanced blood circulation, decongestant, etc.
118	Suamnai/ Syamolota or Madhodi	Kali-dudhi, Krishna Sariva	<i>Ichnocarpus frutescens</i>	Whole Plant	Treat dysentery, glossitis, haematuria, measles, atrophy, convulsions, cough, measles, tuberculosis, tumour, diabetes, skin disease, bleeding gums, etc.
119	Painlaha/ Panikoda	morning glory	<i>Ipomoea hederifolia</i> Linn.	Roots/ seeds	It acts as an oxytocin, anti-cancer, anti-oxidant, antipsychotic, anti-inflammatory, anti-microbial, stomach aches, diuretics, etc.
120	Banamali	Nevaari, Nepaali, Saptalaa,	<i>Jasminum arborescens</i> Roxb.,	Leaves & roots.	Treats menstrual disorders, miscarriage, colic, flatulence & debility etc. Roots: ringworm, eczema, fruit as a tonic, etc.
121	DhadaJadaJahazigaba	Curcas nut, Bagranda,	<i>Jatropha curcas</i>	Root/ Latex	Fruits - roots -boiled with castor oil to treat joint rheumatism. Latex: spermatorrhoea.
122	Baigaba	Ratanjot/ purging nut	<i>Jatropha gossypifolia</i>	Root / Latex	Roots with castor oil to treat joint rheumatism. Stem: bleeding; Latex: : spermatorrhoea.
123	Jati/ Jaiphula	Maalati, Spanish jasmine	<i>Jasminum grandiflorum</i> L.;	Root, leaves, Aromatic flowers.	Roots: headache, paralysis, mental debility, constipation, sterility, ulcers, corns, Menstrual disorder, ringworm, leprosy. Leaves: dental pains, stomatitis, ulcers, wounds, leprosy. Flowers: headache, skin diseases.
124	Vasak, Basanga (Shrub)	Malabar Nut/ adulsa, /vasa,	<i>Justicia adhatoda</i> Linn.	Deco. of Leaves	Fever, hepatitis, typhoid, cough suppressant, bronchodilator,
125	Amarpoi	Amarpoi	<i>Kalanchoe pinnata</i> (Lam.)	Leaves/ stem	Treat gastric ulcers, COPD, boils, wounds, gastric ulcers, rheumatoid arthritis, kidney stones, pulmonary infection, rheumatoid arthritis, etc.
126	Manjuatii	Mehendi	<i>Lawsonia inermis</i> Linn.	Plant	Plants are antibacterial, antifungal, antiparasitic, antiviral, anticancer, antidiabetic, tuberculostatic, anti-inflammatory, antifertility, wound healing, etc.
127	Jivanti (climber)	Dori	<i>Leptadenia reticulata</i> (Retz.)	leaves	Control stomach diseases, facilitate abortion and, provide contraception, use t for diabetes.
128	Samar khaya	"Upanya" or Thumbai	<i>Leucas mollissima</i> Wall. ex.(B.)	Flower Leaves Roots	Used as a tonic, flower for fevers, Leaves cure wounds(eyes and nose), and skin diseases (psoriasis/ scabies. , fevers, colds, rheumatism, snake bites, etc. Roots for gout, rheumatism
129	Kaitho	Dadhitha, Malura	<i>Limonia acidissima</i> , L	Fruit	Digestive, appetiser, diuretic, stomatitis, tumour bronchitis, debility, hiccough, cardiac pharyngotympanic,

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases & haemorrhoids etc.
130	Garuda Govinda / Medha	Menda, Chandana, Maidalakri	<i>Litsea glutinosa a(Lour.)</i>	Plant	Bark/leaves: diarrhoea, dysentery, cut wounds. Stomach-ache, indigestion, gastric. Seeds: trauma, fracture and traumatic injury.
131	Ashoka	Hemapuspa, Ashok	<i>Saraca asoca (Roxb). Wilde</i>	Bark, flowers, seeds.	Treat liver disorders (jaundice, dysentery), scabies, strangury, dyspepsia, diabetes, bone fractures etc.
132	Baghanakhi	Cats law	<i>Martynia annua Linn.</i>	Leaf/ Fruit	Treating epilepsy, inflammation, sore throat, burns, itching, skin infection, tuberculosis, etc.
133	Achu, Noni	Akasika, Morinda	<i>Morinda pubescens Sm. in Rees.</i>	Roots, fruits, leaves	Treat leprosy, skin diseases, dysentery, leaves (tonic), digestive inflammations. ulcers gout,, Carminative, wounds, stomatitis, fever, etc.
134	Baaidanka	Aatmagupta, Vaanari./ Cowhage	<i>Mucuna pruriens (L.) DC.</i>	Root/leaf, leaves, seeds, hairs.	Febrifuge, Laxative, nephropathy, strangury, dysmenorrhoea, elephantiasis, dropsy, ulcers, neuropathy, helminthiasis, cephalalgia, sterility gonorrhoea, , parkinsonism & debility etc.
135	Barbari; Durlava	Tungi, Arjaka Sweet Basil	<i>Ocimum basilicum L.</i>	Whole Planrt	Aromatic, digestive, stomachic, carminative, sores, cardiogenic, expectorant, diuretic, burning, wounds, seminal weakness, dysentery, debility, etc.
136	Changheri/ Ambiliti	Amlapatrikaa, Changeri	<i>Oxalis corniculata L.;</i>	Whole plant	Digestive, carminative, corns, warts, constipating, liver tonic, diuretic, anti-bacterial, antiseptic, I.Q. promoter, diarrhoea, gout, anaemia, scurvy, ulcers, toxicity, menstrual disorders, etc.
137	Pasaruni	Prasaarini, Puti gandhaa	<i>Paederia foetida L. ;</i>	Root, stem, leaves	anti-inflammatory, antispasmodic, Anti-cancer, colic rheumatic arthritis, flatulence, fever, , calculi, gout, herpes, diarrhoea, etc
138	Anlaa	Dhatree/ Amla	<i>Phyllanthus emblica L.</i>	fruits. (Vit-C)	Antioxidant, anti-diabetic, Antimicrobial, Hair tonic, Anti-ageing, anti-inflammatory Antiaging, Antidiarrheal,
139	Bija / Piasal	Bijaka, Pitashaalaka	<i>Pterocarpus marsupium Roxb</i>	Leaf, heart wood,flower, gum.	Urinary, fracture, leprosy, skin diseases, leukoderma, asthma, gout, diabetes, arthritis, cough, bronchitis & greyness of hair. Leaves: boils, sores, boils, & skin diseases, ulcers, Flowers: appetising, gleet, anorexia, fever. um: liver tonic, diarrhoea, psoriasis, wounds, etc.
140	Karanja	Naktamala/ Indian beech	<i>Pongamia pinnata (L.) Pierre</i>	Plant & oil oil.	Antipyretic, hypotensive, sedative, anti-tubercular, ophthalmopathy, cough, intestinal disorders, gonorrhoea, rheumatologic, diabetes, hydrocele, anaemia, fever & herpes.
141	Jadaa	Castor ;	<i>Ricinus communis L.</i>	Plant & oil.	Constipation, inflammations, fever, bronchitis, cough, skin diseases, colic, colitis, etc.

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
142	Bhalia; Bhallataka	Marking nut; Aruskara, Agnika	<i>Semecarpus anacardium L.f.</i>	Seeds	Digestive, carminative, purgative, liver tonic, expectorant, antiseptic, cardio-tonic, treat beriberi, sciatica, neuritis, leprosy, leukoderma, GIT/ urinogenital disorders, etc.
143	Chandan	Chandana; sandal wood	<i>Santalum album L. ;</i>	Heartwood ; Oil	Aromatic, cooling, deodorant, diuretic, disinfectant, antibacterial, antiviral, cough, antifungal, tonic, jaundice, cough, bronchitis, dysentery, leprosy, skin diseases, etc.
144	Bisiripi	Vaatyaalikaa (Country mallow),	<i>Sida cordifolia L.;</i>	Plant,	Cardiotonic, appetiser, conceptive, colic diuretic, antipyretic, treat debility, sciatica, rheumatism, spondylitis, gonorrhoea, etc.
145	Gajapipali	Gaja Pipali Ibhakanaa,	<i>Schindapsus officinalis (Roxb.)</i>	Dried	stimulant, expectorant, digestive, cough, carminative, sudorific, anthelmintic, tonic. Treat diarrhoea, bronchitis, etc.
146	Tunda podia	Tiksnaasya, (Forest Pepper)	<i>Toddalia asiatica (L.) Lam</i>	Root, leaf, flower, fruits.	Aromatic, digestive, constipating, expectorant, antibacterial, tonic & treat paralysis, malarial, colic, dyspepsia, diarrhoea, cough, nausea, ulcers, wound, bronchitis, epilepsy, gonorrhoea, debility, etc.
147	Guluchi / Koilsutaa	Guduchi / Giloy (Climber)	<i>Tinospora cordifolia (Willd.) Miers</i>	Root, stem, leaves.	Antimicrobial, antipyretic, diuretic, gout, antiallergic, anti-inflammatory, analgesic, antistress, antioxidant, ophthalmic, antitumour, expectorant, anti-diabetic, hypotensive, etc.
148	Brhati / Dhengabheji	Raastrikaa, Simhi, Vaarttaaki	<i>Solanum violaceum Orteg.</i>	Root, leaf.,fruit, flower	Digestive, carminative, diuretic, Cardio tonic & treat dyspepsia, colic, cough, asthma, fever, bronchitis, skin diseases, bronchopathy etc.
149	(Gokhura (Small or large) /Bada gokhura	Swaadukantaka,/ puncture vine	<i>Tribulus terrestris L./ Pedalium murex L.</i>	Fruits, whole plan	Diuretic, asthma, appetiser, digestive, cough, depurative, anthelmintic, tonic, expectorant, anodyne, anti-inflammatory, laxative, calculi, cardiotonic, stomatitis, anorexia, arthritis, etc.
151	Haridaa	Abhayaa, Pathyaa, (Haritaki)	<i>Terminalia chebula Retz.</i>	Fruits	Stomachic, laxative, diuretic, digestive, purgative, carminative, cardiotonic, antiseptic, tonic, epilepsy ophthalmic, GIT /renal/ urogenital disorders, cardiopathy, neuropathy, & general debility etc.
152	Bahada	Bibhitaki, Aksa; Bibhitaka	<i>Terminalia bellirica (Gaertn.) Roxb.</i>	Fruits, seeds, bark	Digestive, expectorant, ophthalmic, purgative, antifungal, anti-spasmodic, antibacterial, bronchitis, amoebicidal, Anti-inflammatory, BP, & treats cough, asthma, insomnia, dyspepsia, skin diseases, etc.
153	Ashwagandha, Askanda	Vajigandhaa : Winter cherry	<i>Withania somnifera (L.) Dunal</i>	Root, leaves, seeds.	Stimulant, diuretic, tonic, hypotensive, respiratory stimulant, ulcers antibacterial, obesity, immuno-stimulatory, anti-inflammatory, analgesic, antipyretic,

#	Phonetics Odiya	Common or Hindi	Botanical Name	Parts Used	Properties/ Can by Used to treat diseases
154	Dhaaiphula	Dhataki; DhaatupuspiTaamrapu spi,	<i>Woodfordia fruticosa</i> (L.) Kurz	Flowers	fever, antiarthritic, sedative, cardiotropic, cardioprotective, asthma, etc. Uterine sedatives, constipation, urinary problem. Treat leprosy, skin diseases, diarrhoea, dysentery, wounds, diabetes, fracture, etc.

Source: CABI digital Library, Kavita et al, 2022, India Biodiversity Portal, USDA Plant database, World Flora online, e-Charak, India flora online, 110720221483458139_Visual_Guide_to_Wild_Medicinal_Plants_of_Orissa (1); Tropical plant database, Botanical survey of India, <https://gandhamardan.coenpt.in/bindex.html>, Hand Book on - Weed Identification. Pdf,, Naidu et al, 2012 [28],



Fig. 8. Plants, leaves and barks of Gandhamardan Hills with ethnobotanical importance

3.1 Hubs of Naturopathy

Traditional indigenous acquaintance is delimited to a specified locality or region. The present venture is to acquire and spread knowledge from local experts to popularise information on the efficient meditational values of forest resources. The uses of the plant species and their doses may need to be authenticated. Ordinary people and the Aborigines use these plants to treat primary health care etc.

3.2 Lack of Efficacy

However, the naturopaths decide the doses, methodology of injection or application of the decoction, extract, direct use or in powder form, or use with some additives as ingredients as per their experience but have yet to be scientifically confirmed. As in naturopathy, there is a delayed speed of action/ effectiveness. It is due to actions needing more evidence, ignorance of side effects due to supplements and detox diets, untrained practitioners, and lack of adequate quality control and specifications.

3.3 Primaeval Medical Practices

With medicinal plants' plenty and luxuriant growth, about 100 traditional healthcare practitioners (Vaidya and Kaviraj) practice within and around the outskirts of the GMH, serving around 65 thousand tribal and economically backward people. These naturopaths are available in all settlements. There are two Ayurvedic colleges cum hospitals constructed on both the Harishankar flange in the Balangir district and the Narsinghnath side in Baragada District.

3.4 Abolition of Quackery

The exclusive versatile floral biodiversity of the therapeutic use of the meditational plants and their availability in various elevations are analysed and reported for the knowledge gain of the economically and socially backwards uneducated people. The authors request that people using the forest wealth consult with certified Ayurvedic/naturopathy doctors who deal with naturopathic medicines.

3.5 Wise use of Nature's Wealth

These medicinal, quasi-medicinal, and economically vital plants are freely available to them at no cost. However, ayurvedic production units like Himalaya, Dabur, Zandu, and many ayurvedic pharmaceuticals have ethnobotanical plant collection centres situated in villages like Khandijharan, Magurmal, Manbhang, and Cherengajhanj for their growth employing local collectors. But these people are ignorant and are low-paid.

3.6 Proper Documentations

Indigenous information about the variable of remedial flora and faunal species keeps a million-dollar value. Their priceless ethnobotanical importance and therapeutic applications by the aboriginals and local naturopathic importance need documents and provide vital information for where modern health care is inaccessible and scarcely available.

3.7 Societal Values

Allopathy is based on modern medicine but is costly beyond poor people's reach. Allopathy is in wide use and dominates the use of ethnobotany with the development of skills and expertise. The Ayurvedic/ Naturopathic medicinal use is lessened due to taste, availability, and acceptance by ordinary people Abbasi et al., [29].

3.8 Pros and Cons

The ethnobotany uses are of minimum risk of adversative reaction, affordable, customisable, variety of treatment options, complement to allopathic medicine, etc., so have great societal values despite proper clinical studies and research. All the traumas caused by the use of ethnobotanical medicines, though time-consuming, are not covered by insurance and have possible side effects. Very few local trainers like Vaidya's of the past are in practice and have stopped their Vaidya Sala, and ignorant Aboriginals are collecting the ingredients of the medicinal species.

3.9 Climate Change in Gandhamardan Hills

The GMH in Odisha is encountering challenges of climate change accompanied by anthropogenic stresses. The erratic Indian

summer monsoon and unusual behaviour of the Indian tropical climate zone (ITCZ) have invited frequent droughts that deplete the GBM vegetation. The anthropogenic stresses are unplanned mining, poaching of elephants, illegal chopping of trees for construction, forest fire, and faulty harvesting of medicinal plant vegetation, which have transformed the deep forests into sparse ones, Applequist et al., [30].

3.10 Medicine Plant Protection

Local communities and the Aboriginals who know the value of these plants can be managed from their over-exploitation and conserve them for future generations. The conservation process involves Identification, protection, and sustainable cultivation for better yield. Some protected zones, herbal gardens, or ethnobotanical hubs must be created, and vulnerable medicinal species may be cultivated for future use, Mulhauser et al., [31].

3.11 Management and Recording of Medicinal Plants

Medicinal plant species parallel to Homosapien's development in almost all cultures. The great Charak, and Sushrut, are well-known as the men with medicine and surgery from history. The reporting is available from ancient times, but new medical inventions need big data sets to maintain identification records of the scientific name, including genus, species, subspecies, variety, author, family, etc, for each ethnobotanical species, with local and common name. The details of extinct plant species or vulnerable must be recorded Kunwar et al., [32] Ameca et al, [33].

3.12 Sustainable Development Goals

Ethnobotany contributes towards Sustainable Development Goals (SDGs) to address global challenges by emphasising the Indigenous people/Local Communities (IPLC) knowledge through no poverty (SDG 1), zero hunger (SDG 2.5), good health and well-being (SDG 3). Improving the food system and promoting cooperation to protect our planet, Kumar et al, [34]. The other SDGs covered to take care of the traditional ethnobotanical knowledge covers (TEK) are Responsible consumption and production (SDG 12), Climate Action (SDG 13), and Life on land (SDG 15). Pei et al, [35], Sharma et al, [36],

4. CONCLUSION

Ethnobotanical species are reducing gradually due to anthropogenic activities and forestry exploitation in the GMH. The present study reveals that the geological housing of the GMH is predisposed by the activities of the Tropic of Cancer, the Intertropical Convergence Zone ITCZ, which gives a good amount of rainfall.

Quantitative ethnobotany of medicinal plants used by indigenous communities of Gandhamardan Mountain Chains. It is our responsibility, connectively, for NGOs and the government to inherit the TEK from tribal communities and various residential settlements, Vaidya's, and Ayurvedic practices and have recourse over it. Novice plants' insight must be brought to the limelight and preserved officially with proper recording for future generations. The conservation of medicinal plants in GMH can complement many SDGs like SDGs 1 to 3 and 12, 13, and 15.

DECLARATION

All plants and medicinal approaches are collected from various sources for ordinary people's knowledge perspective. Any suggestions for correction may be made to the author within one month. Request to use any ethnobotanical medicines may only be made after consultation with an authorised Ayurvedic doctor.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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