Autecological and Ethnomedicinal Study of *Madhuca indica* Gmel. in Chhatarpur District, Madhya Pradesh: A Phytochemical and Quantitative Approach

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***Abstract*—Madhuca indica Gmel., commonly known as Mahua, is a multipurpose indigenous tree with high ecological and ethnomedicinal value. This study investigates the autecological parameters, phytochemical constituents, and ethnobotanical uses of Madhuca indica across five locations in Chhatarpur District—Chhatarpur, Bada Malhera, Baxuwaha, Bijawar, and Ghuwara. Through structured interviews with 150 informants and ecological assessments, the study quantifies the species' use value (UV), fidelity level (FL), and informant consensus factor (ICF). Phytochemical screening of bark, leaves, and flowers revealed the presence of flavonoids, tannins, saponins, and triterpenoids. The study underscores M. indica's cultural and pharmacological importance and suggests conservation priorities in response to anthropogenic pressures.**

***Index Terms*—Madhuca indica, phytochemistry, ethnobotany, autecology, Chhatarpur, Mahua, medicinal plants, UV, FL, ICF**

1. INTRODUCTION

Madhuca indica Gmel. (Sapotaceae), commonly referred to as Mahua, is an indigenous tree of immense cultural, ecological, and ethnobotanical importance in central and eastern India. Found predominantly in dry deciduous forests, the species belongs to the family Sapotaceae and is well integrated into the traditional knowledge systems of tribal and rural communities in Madhya Pradesh (Bajpai et al., 2020; Adhikari et al.,2021; Chauhan, 2013 and Patel et al., 2018). The flowers are used in local alcoholic fermentation, the seeds yield oil used in cooking and healing wounds, and its bark and leaves are ingredients in traditional medicine (Sinha & Sinha, 2013).

Despite its significance, few studies combine both the autecological attributes and ethnomedicinal relevance of *Madhuca indica*. This study aims to bridge this gap through an integrated assessment in Chhatarpur district, Madhya Pradesh, across five locations—Chhatarpur, Bada Malhera, Buxwaha, Bijawar, and sGhuvara—by investigating habitat features, phytochemical composition, and traditional uses, backed by quantitative ethnobotanical indices and ecological parameters.

Indigenous groups utilize its flowers, seeds, and bark for food, fuel, fermentation, and medicine (Dwivedi & Shrivastava, 2020). Despite its ecological dominance in dry deciduous forests, *M. indica* is under anthropogenic stress, warranting ecological and ethnobotanical assessments.
This study combines phytochemical analysis, traditional knowledge, and autecological data to examine the role and status of *M. indica* in five tehsils of Chhatarpur District, Madhya Pradesh.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in five ecogeographically distinct locations: Chhatarpur, Bada Malhera, Baxuwaha, Bijawar, and Ghuwara (24.9°N–25.4°N and 79.6°E–80.4°E). The region features tropical dry deciduous forests, annual rainfall of 800–1200 mm, and red to black soils.

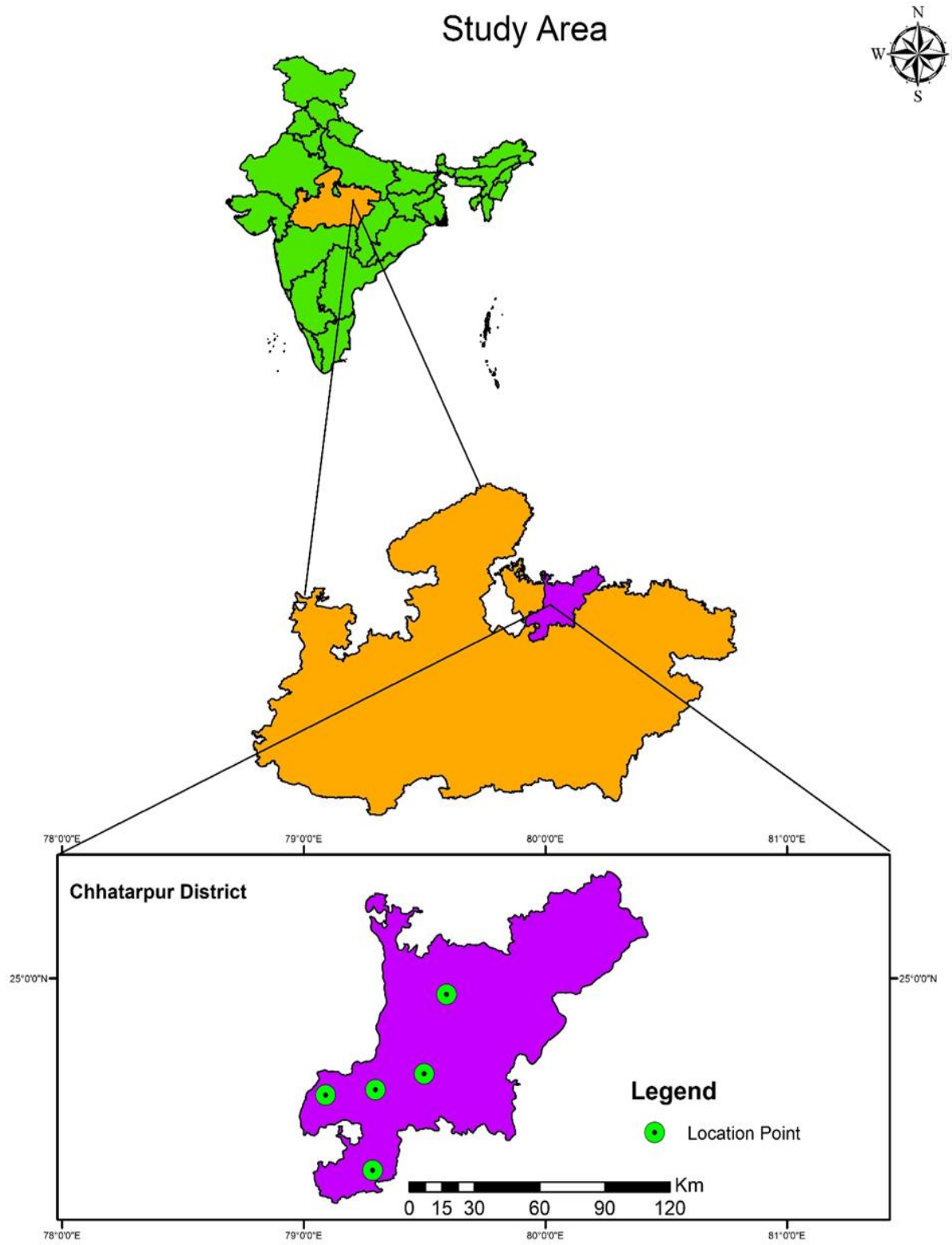

Figure1: - Study Area Map with GPS Locations

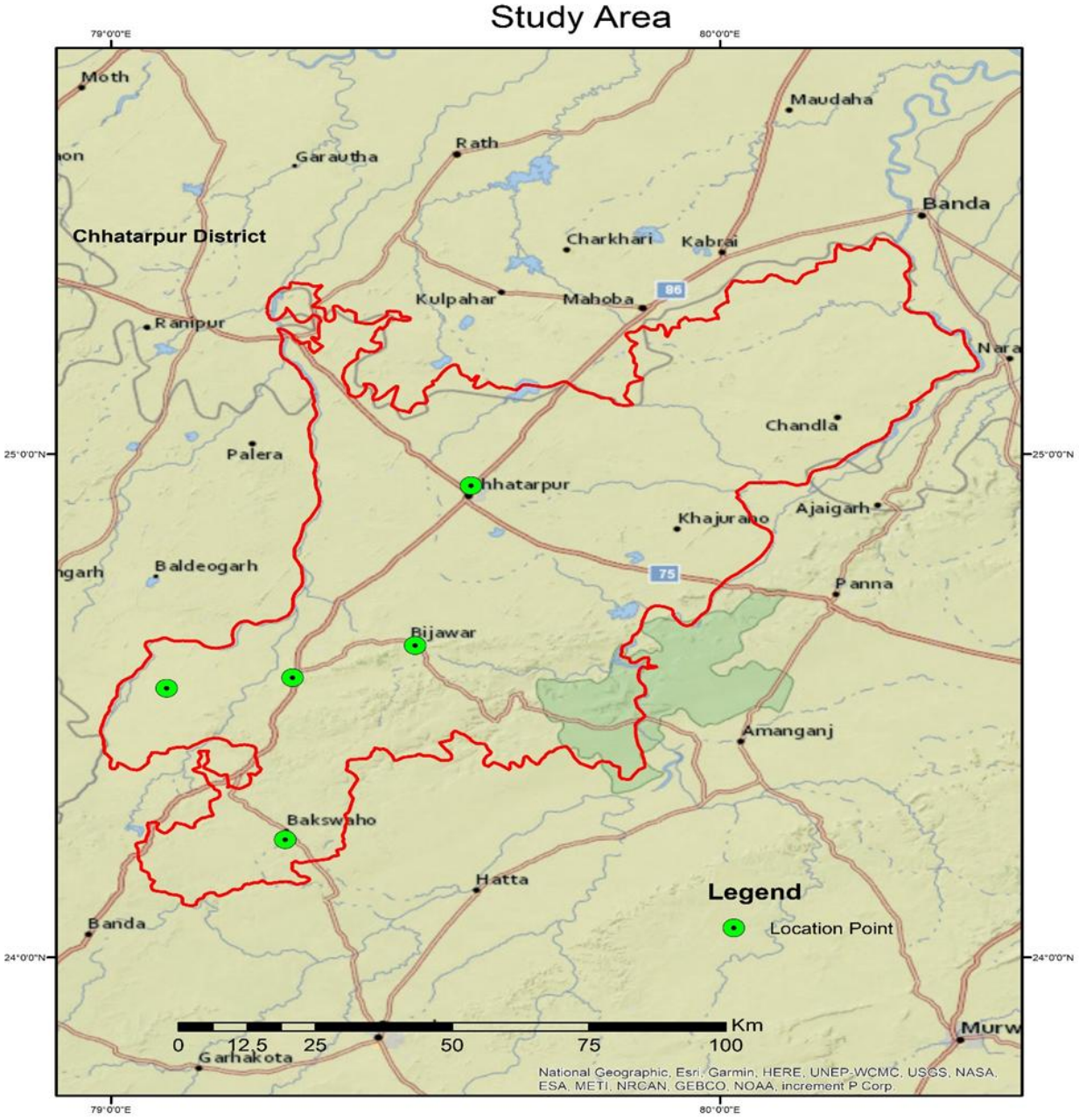

Figure 2: - Study Area Locations

2.2 Ethnobotanical Data Collection

- Informants: 150 (30 per location), including local healers, tribal elders, and women.
- Tools: Semi-structured interviews, free listing, participant observation.
- Consent: Verbal prior informed consent was obtained.
- Indices Applied:
  - Use Value (UV) = ∑U/N
  - Fidelity Level (FL%) = (Np/N) × 100
  - Informant Consensus Factor (ICF) = (Nur – Nt)/(Nur – 1)

2.3 Autecological Survey

- Population density, frequency, and basal area were measured using the quadrat method (10 × 10 m).

- Soil samples were collected and analyzed for pH, moisture, organic content.

Figure 3: - Plant Photographs

2.4 Phytochemical Analysis

- Plant parts (leaves, bark, flowers) were shade-dried and subjected to:
  - Alkaloids (Mayer's test)
  - Flavonoids (Shinoda test)
  - Tannins (Ferric chloride test)
  - Saponins (Frothing test)
  - Steroids and triterpenoids (Liebermann–Burchard test)

3. RESULTS

3.1 Systematic Position of The Plant: -

Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Eudicots
Clade: Asterids
Order: Ericales
Family: Sapotaceae
Genus: Madhuca
Species: *Madhuca indica* Gmel.

3.2 Ethnomedicinal Uses of *Madhuca indica*

Plant Part	Ethnomedicinal Use	Mode of Application
Flowers	Tonic, laxative, cooling	Dried and powdered, consumed orally
Bark	Astringent, ulcers	Decoction
Seeds	Anti-rheumatic, skin diseases	Oil massage
Leaves	Skin ailments, anti-ulcer	Poultice

Most Cited Use: Flower as a tonic and fermenting agent for beverages.

3.3 Quantitative Ethnobotany

Location	UV	FL (%)	Most Common Use
Chhatarpur	0.82	92.4	Flower tonic
Bada Malhera	0.79	88.7	Seed oil
Baxuwaha	0.86	94.1	Bark decoction
Bijawar	0.75	85.0	Fermented liquor
Ghuwara	0.81	90.6	Flower tonic

ICF (overall): 0.87 (high consensus among informants)

3.4 Autoecological Data

Parameter	Value Range
Density (ind./ha)	56 – 72
Frequency (%)	44% – 71%
Basal Area (m²/ha)	0.47 – 0.82
Soil pH	6.1 – 6.8
Organic Matter (%)	1.2 – 2.5

M. indica prefers slightly acidic to neutral loamy soil with moderate organic matter.

3.5 Phytochemical Screening

Plant Part	Flavonoids	Tannins	Saponins	Alkaloids	Triterpenoids
Leaves	+++	++	++	-	++
Bark	++	+++	++	-	+++
Flowers	+++	+	++	-	++

(+ indicates relative abundance; +++ = high, ++ = moderate, + = low, – = absent)

4. DISCUSSION

The study reaffirms the wide cultural and therapeutic relevance of *Madhuca indica* in the Bundelkhand region. The high UV and FL values across villages indicate robust traditional knowledge (Singh et al., 2018). Phytochemical presence of saponins, flavonoids, and triterpenoids supports its use in liver protection and inflammation (Kumar & Reddy, 2016). Ecological data show that *M. indica* maintains stable populations but is threatened by overharvesting and land-use changes.

5. CONCLUSION

Madhuca indica is an ecologically adaptive, culturally essential, and pharmacologically potent species of Chhatarpur district. High informant consensus and phytochemical richness call for integrative conservation strategies and sustainable harvesting practices.

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7. CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

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