Annals of Plant and Soil Research 27(1): 105-110 (2025)
https://doi.org/10.47815/apsr.2025.10442

Dye-yielding plants of gomarda wildlife sanctuary, Chhattisgarh, India

SARVESH KAUSHIK PATEL[1*], V.K. KANUNGO[2] AND GAURAV NAG[2]

[1]Department of Botany, Government Rajeev Lochan Post Graduate College, Rajim, Dist. Gariyaband, Chhattisgarh, India 493885

Received: November, 2024; Revised accepted: March, 2025

ABSTRACT

The Gomarda Wildlife Sanctuary is situated in Sarangarh-Bilaigarh district of Chhattisgarh state in India. Its name is derived from the village name Gomarda, situated inside the sanctuary. The Sanctuary is located 15 km south of Sarangarh town on NH 153, which bisects the sanctuary. The current study is focused on documentation of natural dye-yielding plants. Dyes are intensely colored substances that are applied to a substrate such as fiber, paper, wall, cosmetics, hair, etc. to provide color and can be obtained from the root, stem, fruit, bark, leaf, flower, fungi, and lichens by various extraction and collection methods. Natural dyes are increasingly in demand due to increased knowledge of their beneficial nature. Therefore, it has been important that proper documentation and conservation measures be implemented in order to conserve these natural dye-yielding plants. A total of 54 dye-yielding plants belonging to 25 families and 46 genera have been documented. The present study is an attempt in this direction, to explore and record the availability of natural dye-yielding plants in the Gomarda Wildlife Sanctuary.

Keywords: Chhattisgarh, Conservation, Dye-yielding plants, Natural dyes, Traditional knowledge

INTRODUCTION

India is not just one of the world's twelve megadiversity countries but also one of the eight key hubs for the origin and diversification of domesticated species due to its great biodiversity. Chhattisgarh, is the twenty sixth state, located in the south-eastern part of the Madhya Pradesh state in central India between 21°27'87'' N and 81°86'61'' E, and acquires 135,192 km^2 of geographical area. The state is largely covered by moist and deciduous forests. Central India's diverse climatic, edaphic, and geographic conditions have paved the way for the establishment of its floral wealth. Gomarda Wildlife Sanctuary is one of the important protected aresa in the state because of its floral, faunal, and topographical diversity. It coordinates 21°22' to 21°38' North latitude and 83°26' to 83°15' East longitude. The sanctuary was established in 1975 by the state government. Average temperature ranges from 07°C - 45°C and rainfall is about 1500 mm annually. It comprises of 277.82 km^2 of forest. "Laat river" and "Manai nala" flows through the center of the sanctuary which are the major source of water for wildlife. Natural dyes play a significant role in human civilization, and plants that produce color were likely first identified through human curiosity, use, and experiment (Canon and Cannon 2003; Dogan *et al.* 2008; Tiwari *et al.* 2008). Plant derived-colors have an important role in human life because of their safe and eco-friendly nature (Aggarwal, 2021). Natural dyes have been less popular since synthetic dyes were discovered. However, numerous studies have revealed that synthetic dyes are harmful for the environment and human health (Kwok *et al.* 1999, Mahanta 2005, Varghese 2022). Natural dyes are kind to the environment and the skin; for instance, turmeric, the most vivid naturally occurring yellow dye, has significant antibacterial properties and revitalizes the skin, while indigo produces a cooling sensation (Pullaiah 2000, Siva 2007, Parisara 2016).

Gomarda Wildlife Sanctuary is a unique ecosystem that supports a diverse range of flora and animals while also providing habitat for various indigenous communities. The sanctuary's primarily tribal groupings include the Binjhwar, Baiga, Gond, and Sanwra populations. These indigenous people have a long history of sustainable use of the sanctuary's natural resources, including the extraction of natural dyes from various plant species. The current study aims to document the diverse range of dye-yielding plants found

[2]Department of Botany, Government Nagarjuna Post Graduate College of Science, Raipur, Chhattisgarh, India 492010
Corresponding author: Sarvesh Kaushik Patel, Department of Botany, Government Rajeev Lochan Post Graduate College, Rajim, Dist. Gariyaband, Chhattisgarh, India 49388, e-mail: sarveshsomu@live.com

within Gomarda Wildlife Sanctuary, including the specific plants used, the parts used for dye extraction, traditional methods of processing, and the cultural significance associated with these practices. The documentation not only serves to conserve traditional knowledge, but it also underscores the significance of these plants in tribal life, highlighting the ecological and cultural value of Gomarda's biodiversity. Such findings can also help to promote sustainable practices in natural dye extraction and aid conservation efforts in the sanctuary.

MATERIALS AND METHODS

Study area

Gomarda wildlife sanctuary (GWS) was established by the state government in 1972. The GWS spread over an area of 277. 82 km^2. Centre of the sanctuary (Rest House, Madosilli waterfall) coordinates 21.45773° N, 83.17783° E. The climate is dry, humid, tropical and consists three major seasons rainy, winter, and summer. Sanctuary is covered mostly by tropical dry deciduous forests. The majority of the ground layer dominated by herbaceous plant and vegetation cover is made up of *Shorea robusta* C. F. Gaertn., *Tectona grandis* L. *f*., *Terminalia elliptica* Willd., and *Pterocarpus marsupium* Roxb.

Field survey and data analysis

Present study was carried out in eight villages, namely; Chhinchpani, Gomarda, Lurka, Khamharpali, Kanakbira, Tamtora, Ramtek and Gandhrachuan situated inside the sanctuary. The study has been conducted following the methods developed by Jain and Rao, (1977). The information was recorded by conducting interviews, direct observation and discussion, questionnaire, and social interaction. Consultation with old tribal knowledgeable persons was also done to know about the tribal culture and social customs of the area. After collection of data each species was identified with the help of Flora of Madhya Pradesh Vol. I Verma *et al.* (1993), Flora of Madhya Pradesh Vol. II Mudgal *et al.* (1997), Flora of Madhya Pradesh Vol. III Singh *et al.* (2001) and online portal of Royal Botanic Gardens, Kew- Plants of the World Online (POWO). All the plant species were arranged alphabetically according to their botanical name.

RESULTS AND DISCUSSION

The study revealed the 54 species of dye-yielding plants that were traditionally used by the habitants of Gomarda Wildlife Sanctuary. Many of these plants were common to all communities living inside the study area. The list of natural dye-yielding plants, along with its botanical name, common name, family, dye-yielding part, dye produced and habitat are recorded (Table 1).

Table 1: Dye yielding plants of

S. No.	Botanical name	Local name	Family	Dye yielding part	Dye produced	Habit
1.	*Achyranthes aspera* L.	Chitchita	Amaranthaceae	Whole plant	Black and Brown	Wild
2.	*Aegle marmelos* (L.) Corrêa	Bel	Rutaceae	Bark	Red	Wild/Cultivated
3.	*Allium cepa* L.	Pyaj	Amaryllidaceae	Red scales	Yellow, Brown, and Bright Red	Cultivated
4.	*Anacardium occidentale* L.	Kaju	Anacardiaceae	Fruit	Black	Cultivated
5.	*Artocarpus heterophyllus* Lam.	Kathal, Phanas	Moraceae	Wood	Yellow	Cultivated
6.	*Barleria prionitis* L.	Malti	Acanthaceae	Flower	Yellow	Wild
7.	*Bauhinia variegata* L.	Koliyar	Fabaceae	Leaf	Purple	Wild
8.	*Bauhinia vahlii* Wight & Arn.	Mahul, Sihadi	Fabaceae	Bark	Brown and Black	Wild
9.	*Beta vulgaris* L.	Chukandar	Amaranthaceae	Root	Red	Cultivated
10.	*Bixa orellana* L.	Sinduri	Bixaceae	Seed	Red and Pink	Wild
11.	*Butea monosperma* (Lam.) Kuntze	Palash	Fabaceae	Flower	Yellow and Orange	Wild
12.	*Butea superba* Roxb. *ex* Willd.	Lata palash	Fabaceae	Flower	Yellow, Red and Orange	Wild
13.	*Celosia argentea* L.	Silyari	Amaranthaceae	Flower	Pink and Red	Wild
14.	*Clitoria ternatea* L.	Shani	Fabaceae	Flower	Blue	Cultivated
15.	*Curcuma aromatica* Salisb.	Ban haldi	Zingiberaceae	Tuber	Yellow	Wild
16.	*Curcuma longa* L.	Haldi	Zingiberaceae	Tuber	Yellow	Wild/Cultivated
17.	*Diospyros melanoxylon* Roxb.	Tendu	Ebenaceae	Bark	Black	Wild
18.	*Erythrina suberosa* Roxb.	Gadha palash	Fabaceae	Flower	Dark brown	Wild
19.	*Garuga pinnata* Roxb.	Kekad	Burseraceae	Leaf	Red	Wild
20.	*Heliotropium indicum* L.	Hathi phool	Boraginaceae	Leaf	Black	Wild
21.	*Hibiscus rosa-sinensis* L.	Gudhal	Malvaceae	Flower	Red	Cultivated
22.	*Holarrhena pubescens* Wall. *ex* G. Don	Korea	Apocynaceae	Leaf	Blue	Wild
23.	*Indigofera cassioides* Rottler *ex* DC.	Neeli	Fabaceae	Flower	Blue	Wild
24.	*Indigofera tinctoria* L.	Neeli	Fabaceae	Flower	Blue	Wild
25.	*Justicia adhatoda* L.	Adusa	Acanthaceae	Leaf	Orange, Yellow and Green	Wild
26.	*Lannea coromandelica* (Houtt.) Merr.	Moyan	Anacardiaceae	Bark and Fruit	Yellow and Brown	Wild
27.	*Lawsonia inermis* L.	Mehandi	Lythraceae	Leaf	Orange, Brown and Red	Wild/Cultivated
28.	*Leucaena leucocephala* (Lam.) de Wit	Subabul	Fabaceae	Bark and Leaf	Red	Wild
29.	*Madhuca longifolia* (L.) J.F.Macbr.	Mahua	Sapotaceae	Bark	Yellow and Grey	Wild
30.	*Mallotus philippensis* (Lam.) Müll.Arg.	Sindur	Euphorbiaceae	Fruit	Red and Orange	Wild
31.	*Mangifera indica* L.	Aam	Anacardiaceae	Bark and Leaf	Black	Cultivated
32.	*Opuntia elatior* Mill.	Nagfani	Cactaceae	Fruit	Dark red	Cultivated
33.	*Phyllanthus emblica* L.	Amla	Phyllanthaceae	Fruit	Brown	Wild/Cultivated
34.	*Pithecollobium dulce* Benth	Ganga imli	Fabaceae	Bark	Black	Wild
35.	*Pongamia pinnata* (L.) Pierre	Karanj	Fabaceae	Seed	Brown	Wild/Cultivated
36.	*Pterocarpus marsupium* Roxb.	Beejasal	Fabaceae	Bark	Red	Wild
37.	*Punica granatum* L.	Anar	Lythraceae	Flower	Yellow	Cultivated
38.	*Rubia cordifolia* L.	Mandar	Rubiaceae	Whole plant	Red	Wild
39.	*Semecarpus anacardium* L.*f.*	Bhelwa	Anacardiaceae	Fruit	Black	Wild
40.	*Senegalia catechu* (L.*f.*) P.J.H.Hurter & Mabb.	Khair	Fabaceae	Bark	Brown	Wild
41.	*Senegalia rugata* (Lam.) Britton & Rose	Shikakai	Fabaceae	Seed	Black	Wild
42.	*Shorea robusta* Gaertn.	Sarai, Sal	Dipterocarpaceae	Bark	Red and Black	Wild
43.	*Syzygium cumini* (L.) Skeels	Jamun	Myrtaceae	Bark and Leaf	Red	Wild
44.	*Tectona grandis* L.*f.*	Sagon	Lamiaceae	Leaf and Wood	Dark red and Deep orange	Cultivated
45.	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	Kahua	Combretaceae	Bark	Red	Wild/Cultivated
46.	*Terminalia bellirica* (Gaertn.) Roxb.	Baheda	Combretaceae	Fruit and Seed	Black	Wild
47.	*Terminalia chebula* Retz.	Harra	Combretaceae	Fruit	Black and Yellow	Wild
48.	*Terminalia elliptica* Willd.	Saja	Combretaceae	Bark	Red and Brown	Wild
49.	*Vachellia nilotica* (L.) P.J.H.Hurter & Mabb.	Bamri	Fabaceae	Seed	Brown and Black	Wild
50.	*Ventilago denticulata* Willd.	Keonti nar	Rhamnaceae	Bark and Root	Blue	Wild
51.	*Woodfordia fruticosa* (L.) Kurz	Dhawai	Lythraceae	Flower	Red	Wild
52.	*Wrightia tinctoria* (Roxb.) R.Br.	Indrajan	Apocynaceae	Seed	Blue	Wild
53.	*Zingiber officinale* Roscoe.	Adrakh	Zingiberaceae	Rhizome	Brown	Cultivated
54.	*Ziziphus mauritiana* Lam.	Ber, Boir	Rhamnaceae	Bark and Leaf	Red and Pink	Wild

Gomarda Wildlife Sanctuary, Chhattisgarh, India

The documented plant species belongs to 25 families and 46 genera of angiosperms (Table 2). Among these families Fabaceae was found to be the most dominant with 15 species followed by Anacardiaceae and Combretaceae represented by 4 species each. Whereas Amaranthaceae, Lamiaceae and Zingiberaceae represented by 3 species each; while, Acanthaceae, Apocynaceae and Rhamnaceae were represented by 2 species each. Rest of the families (64%) were represented by single species each (Figure 1).

Table 2: Taxonomic analysis of the data

Taxa rank	Number
Family	25
Genera	46
Species	54

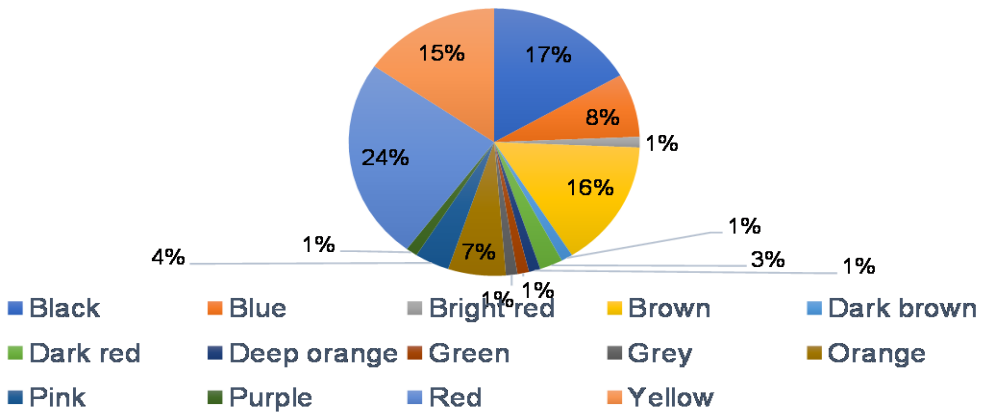
Dyes were produced by different underground and aerial parts of the plants like bark (26%), flower (18%), fruit (13%), leaf (18%), red scales (1%), rhizome (2%), root (3%), Seeds (10%), tuber (3%), wood (3%) and even whole plant (3%) (Table 3). The important dyes extracted from underground parts included *Curcuma longa* L., *Ventilago denticulata* Willd. etc. Bark, stem or woods were important dye source viz. *Aegle marmelos* (L.) Corrêa, *Artocarpus heterophyllus* Lam., *Bauhinia vahlii* Wight & Arn., *Lannea coromandelica* (Houtt.) Merr., *Terminalia elliptica* Willd. Leaves were found to be preferred to extract dye from a large number of plants like *Bauhinia variegata* L., *Holarrhena pubescens* Wall. *ex* G. Don, *Justicia adhatoda* L., *Lawsonia inermis* L., *Ziziphus mauritiana* Lam. Etc. Flowers of *Barleria prionitis* L., *Butea monosperma* (Lam.) Kuntze, *Clitoria ternatea* L., *Hibiscus rosa-sinensis* L., *Indigofera cassioides* Rottler *ex* DC. and *Woodfordia fruticosa* (L.) Kurz were found to be the major source of natural dyes. Fruit rind and pulp of *Anacardium occidentale* L., *Mallotus philippensis* (Lam.) Müll.Arg., *Phyllanthus emblica* L., *Terminalia chebula* Retz. were also used as dyes even whole plant was also used to extract the dye like *Achyranthes aspera* L. and *Rubia cordifolia* L.

Table 3: List of plant part used for dye yielding

Plant part	No. of Species	Percentage
Bark	16	26
Flowers	11	18
Fruits	8	13
Leaves	11	18
Red scales	1	01
Rhizome	1	02
Roots	2	03
Seeds	6	10
Tubers	2	03
Whole plant	2	03
Woods	2	03

The ethnic communities extracted and processed the natural dyes in their own way. The extraction techniques for dyes are determined by the particular part of the plant resource. There are various techniques employed for different plant parts. To extract dye from an underground parts, bark or stem, the material was found to be broken into pieces and steeped in water for two to three days before being mashed into a paste. Following squeezing and filtration, the entire extract is heated and condensed by repeating heating, as needed. For fruits, the material was noticed to be pressed into juice and mixed with the

Figure 2: Percentagewise dye production from the plant parts



appropriate amount of water. This solution was stored in iron or metal pots for 5-7 days. Ethnic people employed the dye produced from plant for a variety of daily activities such as coloring food and clothing, making cosmetics, fashion jewelries etc. Dyes produced from different plant parts were weak in nature, and their permanence was found to be based on the plant and traditional preparation processes. The usage of different plant parts in a specific ratio may sometimes extend the lifespan of dye. Plant selection was observed to be additionally affected by color preference, product kind, and function

In present study a total of 14 distinct colors were recorded to be obtained from 11 different plant parts, with red being produced by the greatest number of plants (24%) followed by black (17%), brown (16%), yellow (15%), blue (8%), orange (7%), pink (4%), dark red (3%), while, bright red, dark brown, deep orange, green, grey and purple recorded 1% each (Figure 2). The current record of 54 dye-yielding plant species was significantly greater than the 10 species reported from Lateritic Zone of West Bengal by Das and Mondal, (2012), 39 species from Northeast India Tripura Sutradhar *et al.,* (2015), 46 species recorded from Garhwal Himalaya by Antima *et al.,* (2012) and less than the documentation of 201 dye-yielding plants from Andhra Pradesh investigated by Rani *et al.,* (2002) and 195 species from Maharashtra by Patil *et al.,* (2019).

Results of the present study highlighted the potential resources of dye plants, which have enormous scope and prospects in small-scale. However, indigenous knowledge of processing and applying natural colors from plants must be maintained and need to be enhanced or value added to merge with modern product development.

CONCLUSION

A wealth of traditional knowledge about dye-producing plants and their use has remained limited. The availability of low-cost chemical dyes, as well as the traditional method of dye preparation and application, are all losing favor. It has been noted that traditional dye producing knowledge is now only practiced by older adults. Natural dyes derived from plants are both biodegradable and non-toxic. Indigenous traditional knowledge on dye-yielding plants is critical for community-based development, future bioprospecting, and eco-friendly products. Indigenous knowledge systems of traditional bio-resource exploitation of the state's ethnic groups must be documented in order to prevent them from being lost forever. Overall, organized approaches with scientific inputs would aid in the conservation of valuable plant resources, in addition to the indigenous knowledge base confined to Gomarda Wildlife Sanctuary's indigenous community.

ACKNOWLEDGEMENT

The authors are grateful to the Principal Chief Conservator of Forest (Wildlife), Chhattisgarh to grant permission for this study. They are also thankful to Dr. R. Diwan, Former Head of the Department, Dr. S. Bajpai, Head of the Department and all the faculty members of

Department of Botany, Government Nagarjuna Post Graduate College of Science, Raipur, Chhattisgarh. Special appreciation is extended to all the informants from various groups for their active engagement and knowledge sharing during the field study.

REFERENCES

Aggarwal S. (2021) *Indian dye yielding plants: Efforts and opportunities*. In Natural Resources Forum. Oxford, UK: *Blackwell Publishing Ltd.,* **45**(1):63-86.

Antima S, Dangwal LR, Mukta D. (2012) Dye yielding plants of the Garhwal Himalaya, India: A case study*. Research Journal Biological Science*, **1**(4):69-72.

Cannon J, Cannon M. (2003) *Dye Plants and Dyeing*. Timber press in association with the Royal Botanic Gardens, Kew.

Das PK, Mondal AK. (2012) Biodiversity and conservation of some dye yielding plants for justification of its economic status in the local areas of lateritic zone of West Bengal, India. *Advances in bioresearch*, **3**(1):43-53.

Das H, Kalita D. (2016) Fibers and dye yielding plants of north East India. *Bioprospecting of indigenous bioresources of north-east India,* Springer, 77-99.

Dogan Y, Baslar S, Ozturk, M, Mert, HH. (2008) *Plants used as dye sources*. (eds. Peter KV) Underutilized and Underexploited Horticultural Crops, **3**:109-145.

Jain SK, Rao RR. (1977) *A handbook of field and herbarium methods.* New Delhi. India: Today and Tomorrow's Printers and Publishers, 1-150.

Kwok WY, Xin JH, Chong TF. (1999) Environmental compliance for Hong Kong textile dyeing industry. *Research Journal of Textile and Apparel*, **3**:9-15.

Mahanta D, Tiwari SC. (2005) Natural dye-yielding plants and indigenous knowledge on dye preparation in Arunachal Pradesh, northeast India. *Current science*, 1474-1480.

Mudgal V, Khanna KK, Hajra PK. (1997) *Flora of Madhya Pradesh.* Vol, II, Botanical Survey of India, Calcutta.

Parisara N, Kiran BR. (2016) A Preliminary Study on Dye Yielding Plants of Bhadravathi Taluk, Karnataka. *International Journal of Scientific Research in Science, Engineering and Technology,* **2**:86-89.

Patel N, Patel S.K, Patel S.S, Dixit A.K. (2024) Enumeration of tree species in Guru Ghasidas Vishwavidyalaya Campus, Koni-Bilaspur, Chhattisgarh. *Annals of Plant and Soil Research*, **26**(2): 341-344.

Patil SH, Kurlapkar DD, Gaikwad DK. (2019) Dye-yielding plant resources of Maharashtra, India: A checklist. *Biodiversitas Journal of Biological Diversity*, **20**(1):250-266.

Pullaiah T, and Rani S.S. (2000) *Dye yielding plants in India*. Flora of Ranga Reddi District Andhra Pradesh, India, 24.

Singh NP, Khanna K.K, Mudgal V, Dixit R.D. (2001) *Flora of Madhya Pradesh*. Vol. III, Botanical Survey of India, Calcutta.

Singh SP, Singh K.K, Kumari B, Kumar P. (2024) Distribution and ethnomedicinal significance of family Euphorbiaceae in the Rohilkhand region of Uttar Pradesh, India. *Annals of Plant and Soil Research,* **26**(3): 537-544.

Siva R. (2007) Status of natural dyes and dye-yielding plants in India. *Current science*, 916-925.

Sutradhar B., Deb D., Majumdar K., Datta B.K. (2015) Traditional dye yielding plants of Tripura, Northeast India. *Biodiversitas Journal of Biological Diversity*, **16**(2):121-127.

Tiwari SC, and Bharat A. (2008) Natural dye-yielding plants and indigenous knowledge of dye preparation in Achanakmar-Amarkantak Biosphere Reserve, Central India. *Indian Journal of Natural Products and Resources,* **7**(1):82-87.

Varghese R, Doss CGP, Rajasekaran C, Seenivasan R, Senthilkumar T, Ramamoorthy S. (2022) Conservation of Plant Genetic Resources: A Special Reference to Dye-Yielding Plants. In: Ramamoorthy, S., Buot, I. J., Chandrasekaran, R. (eds) *Plant Genetic Resources, Inventory, Collection and Conservation.* Springer, Singapore, 425-461

Verma DM, Balakrishnan NM, Dixit RD. (1993) *Flora of Madhya Pradesh*. Vol. I, Botanical Survey of India, Calcutta.