

derived from such hydrogen, would also be required to replace fossil hydrocarbons in the industry and heavy cross-country transport domains. Production of hydrogen in required quantities would need high-temperature heat either from concentrated solar thermal or high-temperature nuclear reactor sources, and technology to carry out the thermochemical splitting of water. A shorter-term possibility is to carry out steam electrolysis using clean electricity. In either case, this would lead to significantly enhance the share of electricity in the overall energy demand. The share could tend to be most of it, in case electricity has to be used for production of hydrogen. A higher share of electricity would also lead to additional demand for renewable and nuclear energy resources. The encyclopedia extensively covers various technologies such as high-temperature nuclear reactors, thermochemical splitting of water, steam electrolysis and the use of hydrogen in different industry segments.

Applications of nuclear energy go well beyond established electricity production or supporting the hydrogen economy. There are several applications of nuclear reactors such as supporting research, district heating, desalination of sea water, marine transportation both on the surface and under water, space transportation and others. Besides, there are applications for electricity production using radioisotopes. Fusion energy may well be the next energy frontier for human survival in the future. Besides fission and fusion energy, radiation applications have made important contributions in sectors such as medicine, agriculture, industry and others. They have made tremendous impact not just in advanced countries, but also in developing countries of the world. All these are well covered in the encyclopedia.

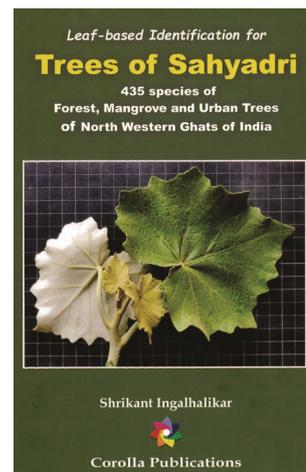
Nuclear fuel and special materials used in nuclear energy-related activities, their manufacturing cycle as well as aspects of nuclear waste management are covered in the encyclopedia. These technologies as also allied subjects like radiation effects on living and non-living matter, radiation dosimetry, radiation protection are also comprehensively covered.

Search for energy and its use along with related technologies has been a prime driver of rising human capability. The increasing demand for energy and finiteness of energy resources has led to energy transitions in the past. Waste arising because of increasing use of energy and its impact on the earth's environment have also become a

matter of serious concern. Global warming due to greenhouse gas emissions, primarily because of fossil energy use, has brought the world close to a catastrophe. Even so, there is a larger part of the world still suffering from energy deprivation. There is thus a dual challenge of providing the deprived world with the required amount of clean energy, while at the same time driving a new energy transition that effectively realizes the global net-zero emission by the year 2050, the date determined through studies by the Intergovernmental Panel on Climate Change. It is now becoming increasingly clear that nuclear energy is important in this context. Greenspan has devoted a significant portion of his introduction to this aspect and this seems to have significantly impacted the development of the contents of the encyclopedia. It is interesting that apart from many articles dealing with various aspects of energy transition where nuclear energy can play a significant role and the sections devoted to issues of safety and waste management, the encyclopedia has a full section on social issues of nuclear energy and even an article titled 'Environmentalist's dilemma'. After all, given the fact that the net additional energy needs would be much larger in the developing countries, most of which would have to be derived from nuclear energy, this clearly is a complex issue requiring a well-informed comprehensive debate involving the youth who are going to be the most affected. The publisher and the editors should be commended for their vision to transfer knowledge to the younger generation in the overall context of clean-energy transition in which nuclear energy would necessarily play a key role.

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Leaf-based Identification for Trees of Sahyadri: 435 Species of Forest, Mangrove and Urban Trees of North Western Ghats of India. Shrikant Ingahlalikar. Corolla Publications, 12, Varshanand Society, Pune 411 051. 2021. 400 pages. Price: Rs 1500.

Identifying floral elements and documenting their abundance/rarity, and distribution in the form of floras or field guides is a prerequisite for resource awareness and conservation. It is tough to identify and distinguish any live plant from others by its correct name based on a single or multiple attributes of a single organ. This happens when leaf morphology is chosen as the basis for identifying one tree species from others. The task would be more challenging if the same leaf features were applied to larger aggregations such as families or genera. As plant life fascinates one and all, amateurs often attempt such documentation with interest and commitment. The present attempt by Shrikant Ingahlalikar concerns tree recognition based on the application of leaf features and without the support of floral morphology. One conceivable reason for thinking of recognizing trees based on leaves may be that many trees present themselves in a vegetative state for a major part of the year. Hardly a few trees exhibit year-round flowering, but hide the inflorescences in distant and dense canopies. Only some deciduous trees, in contrast, flower profusely when they are leafless, and then the flowers could become the basis of recognition. Another good reason could be to bring awareness among common people who can use leaf morphology relatively easily and can circumvent more complicated conventional terminology used by taxonomists in species identification.

Though leaves are ever-present and reachable, one significant constraint with them is that they tend to vary in shape, size and colour in accordance with the age, habitat, season, region and position on the stem. Leaves may convey the primary impression of the identity, but they lack the key features for authentication found in reproductive structures such as flowers and fruits. It is a rule of thumb that taxonomists should not venture to authenticate any sterile specimen with a name, as it may later prove to be incorrect for several reasons. It is imperative in taxonomic practice that the plant specimens submitted for identification include a leafy twig bearing flowers and/or fruits. Further, information about the plant's habit, size, habitat, nature of the roots and the scent of flowers is desirable to arrive at a correct identity and authentication. However, as an exception and for situational compulsions, identification based on leaves has been in practice by palaeobotanists since flowers are hardly preserved due to their delicate nature, and it has been adopted here in this field reckoner.

The author has chosen northern Western Ghats (a map given with collection localities), which is known to be rich in plant diversity. Tree samples were considered for identification from divergent habitats. These include evergreen and semi-evergreen forests (30 locations), deciduous forests (15 locations), mangrove habitats which are found in intertidal situations (about 16 locations), the freshwater swamp forests, chiefly composed of *Myristica* species (seven locations), and lastly trees from urban areas. Thus, the attempted habitats are so divergent, but then, separate keys were given for different habitat groups. The author could have presented the same work with greater clarity had he attempted these groups separately. No specimens were collected or preserved for reference, which have been accounted for in this field reckoner.

The author has hinged on multiple characters of leaves and their combinations to recognize tree species. The terminology used in morphological descriptions has been explained at the beginning of the book. The features concerning the simple/compound nature of leaves, their shapes, sizes, margins, bases and apices, venation, indumentum, petiole attachment to lamina, stipules, glands and phyllotaxy have been taken into account. Pictorial and text glossaries are given to explain botanical terms.

In total, 435 tree species have been chosen for diagnostics. A tree diagram is given for species identification based on habitat type, leaf type, key group (based on the nature of leaves) and species key and, finally the species. The close-up images of leaves of about 360 species are given in groups of dominant families. Each photograph has a scale in the background and is accompanied by descriptive data such as latitude, longitude, (missing altitude, why?), status, size, vegetation type, flowering period and flower colour. The author had earlier published three field guides for the flowers of Sahyadri. He could have used the flower photographs alongside the leaf images published in this book and also the images of bark to provide greater validity to the identification.

Species are divided according to the habitat group they belong to. They come primarily from forests (348 species), mangroves (23 species) and trees introduced in urban areas (48 species). Habitat groups are split into multiple levels (colour-coded) based on leaf features, and the user is supposed to navigate through these levels using 'diagnostic' features. Keys in conventional taxonomy have a series of pairs of contrasting statements or propositions known by couplets. Each statement in the couplet is called a 'lead'. The user can make comparisons based on statements in the key with the related features in the material to be identified. By making the correct choice at each level of the key, one can eventually arrive at the name of the plant to be identified. Keys have been prepared slightly differently here, and how one should go about using the key has also been explained (p. 13). Small, illustrative sketches have been provided to identify the main leads to make them user-friendly. Furthermore, validation of the identity can be confirmed by comparing it with the given leaf images. Certain genera (*Bauhinia*, *Diospyros*, *Ficus* and *Syzygium*) are well represented with a considerable number of species in this enumeration. The leaves of a few rare species are not photographed, and these species are listed in the index as 'excluded species' (excluded from what?). Surprisingly, no index is given for the botanical or local names listed in the work. Some of the flaws noticed in the keys are given here.

Though the author has applied multiple characters and their combinations, he has not used fully the multiple variations of each of the chosen characters thoroughly. Features that are trivial and difficult to

judge, such as 'leaves odorous' or 'leaves not odorous', or 'leaves glaucous' or 'leaves not glaucous', are used to delineate taxa at higher levels. Certain main leads such as 'nerves lateral' or 'nerves basal' or 'nerves converging at base' are not differentiated with clarity (pp. 21–22). *Ehretia laevis*, *E. indica*, *E. aspera*, *Gomphandra tetrandra*, *Hydnocarpus pentandrus*, *Nothapodytes nimmoniana* and *Strombosia zeylanica*, which exhibit leaves with secondary veins lateral to the mid vein, are placed under 'nerves converging at base' group. Keys are found failing occasionally. Many species of *Ficus*, like *F. benjamina*, *F. elastica* and *F. religiosa*, do not exhibit basal-nerved leaves as stated in the key (check key: 'nerves basal' on p. 27). The leaves of *F. amplissima*, *F. tinctoria*, and *F. recemosa* are mentioned to have basal nerves, but their images (pp. 179, 187 and 190) show otherwise. Leaves of *Grewia serrulata* and *Sterculia guttata* are described as cordate (heart-shaped), but this is not the case. Leads in some couplets are neither opposing nor comparable; the leaves of *Morinda pubescence* are tomentose beneath, while those of *Lagerstromia macrocarpa* (in the opposite lead) are mentioned to be reticulate beneath (p. 180). Many binomials have been appended with a word after a comma, e.g. *Buchanania cochinchinensis*, Charoli; *Holigarna arnottiana*, Ranbibba; *Lannea coromandelica*, Moi (pp. 28–29 and p. 32). They are not author's names of the binomial, but appear to be local names of the referred species. What is missing in this work is rigorous botanical editing, and I trust this will be taken care of in the next edition of the book. Except for these omissions, the book is useful to tourists, foresters, students, researchers, field botanists, ecologists and conservationists interested in the trees of this region. It is handy and helps in spot identification, as the book is supported by numerous quality photographs. Thanks to the advanced digital technology in mobile cameras, many photographs have been shot using a mobile phone. The author deserves appreciation for publishing this work in an innovative way, but certainly with limitations.

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