

Towards Rational Utilization of Indigenous Plant Resources

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The world has huge floral diversity, whereas there often is poor and irrational utilization, especially of indigenous plants and residues from agricultural processes. Trees, shrubs, and herbs can have multiple uses at different levels as medicines and sources of lignocellulosic materials. A fuller and more rational utilization is needed, with interaction of international and national communities, to raise the awareness of local people, governments, and industrial entrepreneurs of the floral wealth that is waiting to be utilized more effectively.

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Lignocellulosic Materials with Untapped Potentials

Much has been published on the utilization of plants and lignocellulosic materials. It is well known that medicinal plants can be applied to cure ailments, especially in rural areas of underdeveloped countries in Africa and Asia (Sudan as an example). This reliance on indigenous medicinal plants often can be attributed to a lack of medical doctors and unaffordable prices of pharmaceutical products, as well as people's faith in the benefits of traditional medicine. An example is the herb *Aristolochia bracteolata* (umglalagil), which has been used to cure malaria in traditional medicine. Now it has been shown to negatively affect the kidney. As another example, *Jatropha curcas* is a small shrub that has been mainly planted as a source of biodiesel fuel. *Jatropha* species have traditionally been used in basket making, tanning, and dye production. Local healers in Sudan advise people to eat the seed with dates to cure sexual debility; however, *Jatropha* contains compounds that are highly toxic, especially for livestock. *Lawsonia alba* (henna), which has green-brown leaves, provides orange crystals, which can be used as dye for body and hair. *Senna acutifolia* or *Cassia acutifolia* is a small herbal plant having the local name senna or senna-makkhi. It is widely used as an anthranoid drug and has been used for centuries in Western and Eastern systems of medicine as a laxative and a source of anthraquinone. *Senna obtusifolia* (Kawal) is a small herb; its leaves and seeds have been used for treatment of jaundice and flavor for traditional food. The seed of the *Cucurbita pepo* pumpkin, having the local name Graa, is used traditionally for healing diabetes. The seed of the shrub *Senna occidentalis* (Bun balash or soreib) are used for the same purpose. The herbal aerial parts of *Geigeria alata*, having the local name gadad, are used as traditional medicine for epilepsy, spasms, pneumonia, rheumatism, and diabetes. On the other hand large trees such as *Adansonia digitata* (tabaldi as tree, gongolaise as fruit) has very useful properties in many aspects: Leaves are eaten as salad, fruits used as nice drink, and recently it has been discovered to reduce cholesterol levels and therefore could be adopted to cure some types of heart diseases.

The huge hollow stem of *Adansonia* can be utilized as tanks for drinking water in the Kordofan region during the hot dry season. *Acacia Senegal* is a small tree that has been mainly planted to obtain high quality gum Arabic, which has known applications in the manufacturing of soft drinks, drugs, pharmaceuticals, and a number of fast foods. This gum is used locally to cure hematuria with infusion and toothache by filling the tooth cavity with gum powder. Also it is well known that the *Acacia senegal* tree yields gum when it is seven years old; however, when it becomes older it will stop producing gum and become useful as raw material for charcoal or for pulping and papermaking.

The Diversity of Sudanese Flora

Sudan is a prime example of a region with a rich variety of lignocellulosic resources. In this discussion, “Sudan” will include both “Republic of South Sudan” and the rest of the country, which retains the older name “the Republic of Sudan”. Together, Sudan can be regarded as the largest country in Africa and the tenth in the world, boasting an area of 2.5 million square kilometers and spanning diverse terrains and climatic zones. The vegetation is diverse, ranging from desert and semi-desert in the north through the equatorial in the central part to the extreme humid equatorial in the south. Such conditions favor diverse vegetation, comprising 3,137 documented species of flowering plants belonging to 170 families and 1,280 genera, 15% of which are exotic.

Some remote areas deserve to be studied carefully. For example, there is much to be learned about the herbs and shrubs of northern Sudan, which is characterized with a dry and hot climate. *Salvadora persica* occurs in sandy lowland plains in a semi-desert vegetation type. The stems and even the roots are widely used as a toothbrush. *Salvadora persica* is considered now as one of threatened medicinal plants due to the extensive cutting of stem without rational rehabilitation. *Aloe sinkatana* occurs in sandy lowland plains and khor beds in semi-desert terrain. This xerophytic plant is decreasing due to its extensive use. *Phoenix dactylifera* (date palm) is a common monocot tree in northern regions of Sudan. Normally the wood is used as beams and rafters. The leaves are used as raw materials for rural industries. The rachis and leaves also can be very good raw materials for pulp and paper with good yield and strong pulp properties.

The Nuba Mountains in south Kordofan have diverse flora with different uses. The highlands in the upper parts of these mountains have indigenous plants that still have not been reported. In the south Blue Nile state, the Angassana hills region is considered a closed area, with protection of multi-traditional habits and herbal medicines. Dinder national park, located in east south Sudan, has a variety of flora including *Acacia seyal* (red talh), *Acacia seyal fistula* (white talh), *Acacia mellifera* (kitter), *Acacia nilotica* (sunt and grad), *Anogeissus leiocarpus* (sahib), and *Ficus sycomorus* (gemaees). Protected areas such as Elradoum forest in south Kordofan are characterized by diverse types of trees, *Acacia oerfota* (laoat), *Boswellia papyrifera* (tarag tarag), *Combretum aculeatum* (shihait), *Combretum hartmannianum* (habeel), and *Commiphora gileadensis* (gafal). In the eastern part of Sudan where the Red Sea hills and Erkawiet plateau has desert and semi desert vegetation one finds *Salvadora persica* shrubs, *Capparis decidua* (tundob), *Ziziphus spina-christi* (sidr or nabag), and members of the plant family Cactaceae (cactus species). New approaches are needed for their rational utilization. The same can be said for the flora of Jebal Marra Mountain in southwestern Sudan (South Darfur); these remote areas need to be rediscovered from the point of view of the floral resources.

Some Sudanese Raw Materials for the Pulp and Paper Industry

While Sudan is widely regarded as an agricultural country, there has been relatively little development of modern industries to convert byproducts of agricultural residues to commercial products. Various indigenous or exotic species need to be evaluated for pulp and paper applications, including the hardwoods *Balanites aegyptiaca*, *Acacia seyal*, *Acacia nilotica*, *Acacia mellifera*, *Eucalyptus* species, *Moringa oleifera*, *Phoenix dactylifera*, *Ailanthus excelsa*, *Crateva adansonii*, *Albizia lebbek*, *Prosopis juliflora* and softwoods such as *Pinus radiata*, *Cupressus lusitanica*, and non-woody plants such as *Oxytenanthera abyssinica*, *Bambusa vulgaris*, *Hibiscus cannabinus* (Kenaf) *Typha domingensis*, and agricultural residues such as cotton stalks, cotton straws, stems of *Ricinus communis*, stems of *Cajanus cajan*, stalks of okra, stalks of *Hibiscus sabdariffa* (karkady) bagasse as an agricultural industry residue, the herbs of the Nile, including papyrus, as well as other raw materials not mentioned. There is a vast range of available fiber lengths and different yields with pulping processes from soda, Soda-AQ, AS-AQ, and ASAM kraft methods, which may be suitable for diverse end products.

Questions Deserving Research Attention

The examples cited in the foregoing sections prompt some questions about possible future development of uses for flora growing in diverse habitats:

- Starting with the topic just discussed, it is worth noting that the tropical and temperate zones in South America have become well established as sources of wood products and pulp fibers. Accordingly, can planners envision a parallel development of major new industrial facilities in other biomass-rich regions, such as central Africa, that do not yet have such facilities? What challenges need to be overcome, such as in transportation, incentives, policies, and trade arrangements to make such development happen?
- Is there a workable system of partnership whereby major pharmaceutical companies can share the monetary benefits with local communities while isolating and characterizing natural compounds that have been used in traditional medicine?
- At a smaller scale, what indigenous resources can be better utilized by local artisans and healers? Is there a better way to share information about benefits and hazards of traditional medicinal plants? Can more effective markets be developed for plant-based indigenous craft products?
- Does there need to be an adversarial relationship between scientific progress and traditional approaches in rural areas concerning curing of diseases such as evil eye and sexual debility? Can education play a role in limiting the likelihood that practitioners of traditional medicine unintentionally expose people to toxins or ineffective treatments?
- Can a balance be achieved between effective utilization of indigenous plants and protection of regional ecosystems?
- What is the role of international community to solve problems related to the development of plant resources in cases where the national and local communities by themselves are not able to resolve such problems?