Coconut coir: not just a beautiful doormat

Coconut is one of the most versatile fruits with amazing medicinal properties and astonishing health benefits. Even the coconut coir is extensively used for making doormats, decorative items and in upholstery industry. No wonder coconut palm is called the 'tree of life'. More recently, remarkable applications of coconut coir and coir dust in diverse fields are emerging.

Coir dust and biochar obtained from coconut fibre serve as a good peat substitute[1,2]. Biochar, a carbon-rich material that is porous with oxygen functional groups and aromatic surfaces is obtained from thermal degradation of organic materials such as crop residue, forest residue, wood, manure and other materials. Moreover, biochar locks up rapidly decomposing carbon in plant biomass in soils for hundreds or thousands of years. It improves the structure and fertility of soils, thereby improving biomass production. It not only enhances the retention and thus efficiency of fertilizers but also decreases fertilizer run-off[3]. Besides, coir pith has been found to harbour useful microorganisms with potential use as plant nutrient, including nitrogen-fixing bacteria[4].

A wide variety of heavy metals and organic chemicals originating from industrial effluents are potentially toxic, owing to their detrimental effects to humans and other living organisms. One of the promising remedies for their removal is using coconut coir pith, especially in the form of biochar for adsorption technology. In spite of proven efficacy of activated carbon as an adsorbent for metal removal, its high cost has restricted its pervasive use. Due to high surface-to-volume ratio and substances inherently associated with cellulose such as lignin, tannin and pectin, which contain polyphenolic and aliphatic hydroxyl and carboxylic groups, biochar can be a potential sorbent for heavy metals as well as organic pollutants, particularly planar aromatic compounds. Lignocellulosic biomass obtained from coconut is an attractive precursor for biochar preparation, as it shows high porosity. Coir-based biochars manifest as cost-effective scavengers for chromium (VI), mercury (II), etc.[5,6]. On the other hand, different chemical activating agents can be used for improving the adsorption properties of these carbons and they include KOH, $ZnCl_2$, H_2SO_4, H_3PO_4 and HNO_3.

In the construction sector, eco-efficient materials obtained from coconut coir can innovatively substitute some traditional construction materials like particleboards having applications as insulating ceiling and walls. Consequently, wax can be added to composite boards to increase the resistance to absorption of liquid water. In order to improve physical and mechanical properties of these panels, adhesives like castor oil-based polyurethane, urea formaldehyde, phenol formaldehyde and isocyanate can be used. Using such panels with low thermal conductivity will decrease the energy consumption of building facilities (air-condition), since they reduce heat transfer into space[7,8]. Also, coir dust extract acts as a good corrosion inhibitor for acid-induced corrosion of aluminium via adsorption of the extract components on the metal surface through the functional groups present on the extract. Its inhibition efficiency increases with increase in extract concentration and with temperature[9].

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Denuded type locality of endangered dwarf grass *Isachne mysorensis* Sundararagh. – its reoccurrence in western Karnataka

The members of Poaceae constitute one of the most fascinating groups of flowering plants with wide, ubiquitous distribution and immense diversity. The tropical and subtropical genus *Isachne* R. Br. has maximum representation in India, with 32 species out of 106–115 species distributed worldwide[1–4]. Of these, 21 species are endemic to India, suggesting this as the probable centre of proliferation, diversification and evolution of the genus. The species *Isachne mysorensis* Sundararagh. is an amazing, curious, miniature grass endemic to western Karnataka. It grows in moist, rocky crevices on gentle slopes, in association with *Canscora* spp., *Hedyotis* spp., *Impatiens* spp., *Lindernia* spp., *Murdannia* spp., *Neanotis* spp. and *Utricularia* spp. Measuring 4–8 cm, it is the smallest of all *Isachne* species (12–200 cm).

The only report[5] of the occurrence of *I. mysorensis* was from the type locality in Kundadagudda near Agumbe, Shimoga district, Karnataka. Lacuna existed in further scientific research on the species, which prompted the present lead

author to survey and study the type locality in 2006 and for five consecutive years till 2011, during the flowering and fruiting season (August–September), for fresh collections. However, it was noticed that there were no more individuals extant and the type locality was completely denuded. This was due to severe anthropogenic disturbances, such as clearing of the natural forest for development of picnic spots, grazing and cutting of roads, etc. As a result, the type locality got transformed into bare grassland with a dearth of rocks and rivulets that serve as natural habitat of the grass, and eventually its extinction in wild.

During the extensive floristic surveys, the authors inadvertently embarked upon a dwarf grass specimen from Kollur forest, near Souparnika River, in Mookambika Wildlife Sanctuary, Udupi district, Karnataka (13°42′–13°59′N lat. and 74°39′–74°50′E long.). The detailed morphological study and perusal of the literature revealed this to be the poorly known species *I. mysorensis* Sundararagh., strictly endemic to Karnataka. Its miniature size, concealed habitat within the fine rock crevices and broad ovate–chordate leaves were diagnostic characters (Figure 1). Embedded in the forest on the western edge of the Western Ghats, which comprises nine districts of Karnataka and six of Maharashtra, the current population is the only extant locality of the species as all other adjoining 15 districts were thoroughly surveyed and found to be devoid of any other population. The current population comprises 93 individuals occupying a small area of *c.* 2 m^2. The small population amidst the natural forests of Kollur district is also exposed to severe threats due to anthropogenic disturbances such as forest clearing for developmental activities, grazing, setting fire for local destruction of dry fallen leaves and encroachment into the forest for broadening of roads, etc. A necessity for conservation of *I. mysorensis* is now urgently realized as it is already extinct in the altered type locality, currently extant and strictly endemic to the Kollur forest in Mookambika Wildlife Sanctuary. Hence this forest pocket within the sanctuary needs to be conserved as the natural habitat of the otherwise extinct miniature grass. Further, the narrow, restricted population size (93 individuals) calls for studies on reproductive biology with the aim of its multiplication under *ex situ* conditions and rehabilitation in the wild. The new locality reported here is almost adjacent to the type locality, which could possibly be within the normal seed dispersal range of the grass in the forest. It is also probable that the current population existed even when the type locality was established, but went unnoticed as the Mookambika Wildlife Sanctuary remained taxonomically unexplored. The prospects of this locality being an extension of the type locality or vice versa, through two-way normal seed dispersal distance, cannot be ruled out. But under the present scenario, as the species has become extinct in the altered original type locality, the Mookambika Wildlife Sanctuary is the only extant locality of *I. mysorensis*, now categorized as critically endangered on the basis of critical population estimates.

Figure 1. Habit of *Isachne mysorensis* Sundararagh.

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River Sarasvati

Giosan *et al.*[1], while commenting on Valdiya's article[2], point out that sentences from another source have been misattributed to them by Valdiya. I want to clarify that I am the author of those sentences. Those sentences are from my blog post[3] on Harappan fluvial history published on 15 June 2012. I alone am responsible for them and that I have no connection with Giosan or his co-authors. Valdiya identifies S. Kalyanaraman, an active contributor to the 'India Archaeology' forum, as his source of these sentences.

Taken in isolation these sentences may be construed as a criticism by me of all Indian geologists working on the Saraswati/Ghaggar river. On the contrary, my blog posts[4] on this issue have highlighted the work of Indian geologists studying this problem. Valdiya stresses[2] that hundreds of Indian geologists have been working on this problem for over 50 years. It is important to clarify that not all of them agree with Validya's conclusions about the presence of a glacial Saraswati during Harappan times. Valdiya cannot speak for them or other independent studies, but he keeps using the words 'our conclusions' and 'we'. It appears that he has assumed the responsibility of speaking for all Indian geologists.

For example, Saini *et al.*[5] in their article on fluvial activity in Haryana do not speculate that sediments were deposited