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Study, design and analysis of sustainable alternatives to plastic takeaway cutlery and crockery

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Abstract

Most of the take away materials used today is made of plastic. This presents a huge challenge in terms of waste management and pollution. It is widely known that plastic takes several hundred to thousand years to decompose, releasing toxic substances in the process. Therefore, the aim of this work was to analyze alternatives to plastic takeaway cutlery, crockery from areca palm and coconut tree by products. This focuses on reviving the methods and knowledge that existed in the southern and central parts of the Indian subcontinent for making sustainable cutlery and crockery products used in everyday life. A market analysis, design, life cycle analysis and deeper research on the fabrication will be briefly presented.

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1. Introduction

In the last few decades, the plastic industry has taken us by storm and most things are packed and processed in plastic containers. One of the most important example is that of the take-away industry and of the disposable cutlery/crockery industry.

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Apart from polluting, plastic waste is dangerous to the environment and can cause adverse health issues. It is also clear that the plastic waste patch in the middle of the ocean is posing a big threat to us in terms of ecosystem and micro plastics accumulation [1].

It is estimated that billions of Styrofoam coffee cups are thrown away every year [2]. The huge issue facing us is recyclability. It is estimated that close to 40 billion individual plastic utensils are produced every year. About 64 billion paper and 73 billion Styrofoam & plastic cups and plates were thrown away in 2003 in the USA, single-use food/drink containers disposal is at about 140,000 each second [3]. These end up in the oceans and landfills/dumping sites.

Per a 2009 survey conducted by IPSOS [4], 79% of consumers would rather buy from companies doing their best to reduce their impact on the environment with a competitive price. It is evident that a rising number of consumers judge a business based on how green they feel it is. This presents a huge opportunity for establishing a sustainable solution. This work will focus on using the knowledge of sustainable product design and raw material usage from the Indian subcontinent and other Asian countries.

2. Raw materials and extraction methods

The materials discussed for making sustainable take-away containers are Areca palm (*Areca catechu*) sheaths, Sal (*Shorea robusta* Gaertn. f.), leaves, *Bauhinia vahlii* leaves, coconut (*Cocos nucifera*) fiber/coconut shells and banana fibers (*Musa acuminata*). Most of the material is extracted manually, hence the energy and the impact involved is minimal. Palm *Areca* sheaths, coconuts and Sal leaves are primarily extracted by hand. Extracting the fibers involves dehusking, followed by natural retting or mechanical drawing. Most energy is spent in transportation materials for processing and people for extraction.

2.1. Areca nut

The *Areca* trees are cultivated extensively for beetle nut production. The sheath that cover the leaves are extracted by hand and used as a base for making several products like bags, plates, cups and wrapping. The sheath is attached to the leaves, once collected they are generally dried in shade to remove excess moisture and sent for processing.

2.2. Sal leaves

Sal forests cover over 11 million ha in India, Nepal and Bangladesh, and these forests are conventionally managed for timber. During the peak season of May to July, leaves are collected by tribal communities (Fig. 1). Only the leaves that are mature are collected by hand by the tribal communities in the forests, hence making the process sustainable. The picked leaves are then sent to nearby homes for being stitched, or undergo pressing in a heated press and sold.



Fig. 1. (a) Extracted *Areca* palm sheaths; (b) A tribal woman picking Sal leaves; (c) Bundled Sal leaves for plates

2.3. Coconut fibres

Coconuts that fall or picked coconuts can be used to extract fibre, green coconuts that are picked are the best for making fibre coir. The outer layers covering the coconut seed are processed and spun into fibres commonly known as coir (Fig. 2). Ripe coconuts are husked immediately, but unripe coconuts may be seasoned for a month by spreading

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