COCONUT AND RUBBER AS ECOFRIENDLY AND SUSTAINABLE CROPS

P.K.RAVI, SENIOR SCIENTIFIC OFFICER, CCRI, KALAVOOR

Coconut and Natural Rubber Plantation are important cash crops that support the life of more than 15 lakhs Indian growers. Coconut and rubber plantations have generally a positive impact on the environment. Agro-forestry system with coconut and rubber trees could be used for stabilization of degraded water-catchments. Acreage under coconut and rubber cultivation has been making steady progress. As a key industrial raw material, the coconut and natural rubber provide livelihood to thousands of workers in the industrial and rural sectors.

Our, rural areas need means for socially and environmentally sustainable development. Coconut and rubber plantations can be considered a production system which is socially desirable and environmentally positive, particularly, if agro-forestry principles are applied. The social and environmental benefits of coconut and rubber plantations have clearly out weighed possible ecological problems.

Coconut is cultivated in 93 countries in the world and India is the largest coconut producing country in the world. Even though production of coconut is confined to 18 states in the country, coconut and coconut products enjoy consumer demand throughout the country. Coconut cultivation and allied activities provide continuous employment and revenue to more than 10 million people in the country. It is a fibre yielding crop to the coir industry giving employment opportunities to nearly 6.75 lakh workers of which 80% are women folk. The coconut is cultivated in 1.94 million hectares in India with a production of 15,840 million nuts in the year 2008-09.

India has around 5.83 lakh hectares under natural rubber cultivation. Once planted, rubber trees take 6-7 years to mature and to start yielding latex and goes on to give yield for about 22 to 25 years. Between the age of 25 to 30 years, latex production is not economical and given for slaughter tapping which means that taping in the last season before it is cut and removed. India is the 3rd largest producer of natural rubber with a production of 8,57,000 tones in 2008-09 and has a rich source of timber of plantation origin.

Natural Tropical Forests-Need for Preservation

For centuries man was dependent on forests for his requirements of timber. Giant trees that have lived through several generations were cut down from the forests to meet the needs of mankind at different points in time. With each passing day, the rate of depletion of forest resources has become more and more alarming. The alarming rate at which the forest cover in the world is depleting has raised serious concern of the impact on world climatic conditions. Fears and concerns on global warming have been expressed from several quarters as 15 million hectares of forest cover gets depleted each year and in India it is estimated that on an average about 45,000 acres of tropical forest being cleared every year and the Honorable Supreme Court of India has in a recent judgment, banned felling of trees from natural forests to conserve tropical evergreen forests.

The Tropical Forests have a special role in the conservation of biodiversity which shelter 70% of the world's plants and animals. It, invariably, influenced the local and global climates. Forests absorb atmospheric carbon and replenish the oxygen in the air we breathe. Forests regulate stream flows by intercepting rain fall, absorbing the water into the underlying soil and gradually releasing it into the streams and rivers of its watershed. Tree roots enhance soil porosity, reduce compaction and facilitate infiltration. They not only meet the economic needs for food and shelter but the forest also forms an integral part of the culture and spiritual traditions of native people who rely on the forests for their way of life. Forests also give a wide range of non-timber forest products such as fibres, resins, latex, fruits, traditional medicines and food stuffs.

Importance of Coir & Rubber as Wood Substitutes

The major available replacement for wood products is plastic, metals and few other products. Coir, a byproduct of coconut and rubber wood, a byproduct of the rubber plantation industries and therefore, considered as an eco-friendly alternative to natural forest based timber.

When coir and rubber wood are substantially produced from plantations, they can substitute logs and fuel wood, otherwise exploited from natural forests. The economically available volume of rubber wood logs and coir and its utilization therefore can reduce the pressure on natural tropical forests and contribute towards biodiversity conservation.

One unit of coir ply with a production capacity of 40 cubic meters a day would be able to save about 22 trees per day which means 6,600 trees per year. Assuming that one such tree requires 40 sq.meter, then it would be 25 trees in one acre so that one coir ply unit could save about 264 acres of tropical forest in every year. If 10% of coir fibre produced is utilized in the manufacture of coir ply, it would save about 8, 80,000 tropical trees per year which corresponds to 8,800 acres of tropical forests per year.

Correspondingly, a rubber tree could yield about 0.57 cubic meters of timber (20 cft.). The yield per hectare is about 150 cubic meters (5295 cft.) and hence the current availability has been estimated at 1.6 million cft. per year which means that the rubber plantations have become a good eco friendly source of timber. From the point of view of the national economy rubber wood processing industry performs the vital function of saving precious foreign exchange used up in the import of timber. The 45 rubber wood processing plants that are in operation at present consumes only 11% of the stem wood that is available here. It has been, therefore, estimated that the industry can expand substantially, if proper expertise, finance and government support are forthcoming. Such an exercise could save foreign exchange to the tune of US$ 200 million and generate direct employment of the order of 2 lakh.

Coir ply made from coir fibre and phenol formaldehyde resin is an innovative wood substitute. It is a composite board and other hard fibres such as sisal and jute etc. and pre-treated plantation rubber wood veneers could be incorporated The diversified new uses of coir composite and rubber wood will save the tropical forests, increase rural employment opportunities and also promote agriculture leading to sustainable development.

Rubber Wood

It was in the latter half of the 20th century that growing eco-concerns the world over channeled research and resources into a product called rubber wood. In India, the initial attempts to process rubber wood were made in the mid – 1960's but the industry had to wait for the closing years of the 20th century to gain momentum through larger investments from private investors. However, the main hurdle in the wide spread use of rubber wood is the lack of awareness about its versatility among the public. Today, there, are nearly 45 rubber wood processing units of varying size in the country.

Like coconut palm, almost all parts of rubber can be put to commercial use. The major industrial products of rubber are automobile tyres and tubes, cycle tyres and tubes, footwears, surgical gloves, condoms, electrical grade rubber mats, latex threads, medical equipments, toy, balloon etc. The non-traditional use of rubber includes rubberisation of roads and as seismic bearings used in soil stabilization and vibration absorption.

Apart from latex and honey from rubber plantations, the rubber wood industry performs the other vital function of being an additional source of revenue to the growers. The trees, at the end of their economic life, are cut down and form the feed stock of the rubber wood industry. Rubber tree has in more ways than one revolutionized man's life. But it is the use of the tree as timber that has now captured the imagination of millions of people. Apart from being another source of income for growers and employment for workers in the industrial sector, the process of value addition has offered the home and office segment with stylish products.

Advantages of Rubber Wood

1. The treated rubber wood is cheaper to teak wood by 30 – 40%
2. Eco friendly
3. Gives better colour and finish to the users
4. Its light colour and uniform structure allows for easy acceptability of any dye or staining to any desired wood colour
5. Good lustre.
6. Can be planed, grooved and sanded easily
7. Sawing, cross cutting, machining etc. are smoother and easier
8. Better nailing and screw holding properties and gluing characteristics.
9. Working characteristics of rubber wood are comparable to soft woods.
10. Its smooth texture makes it easy to work on.

Due to its versatile properties, rubber wood is used for furniture, furniture parts, flooring, ceiling, paneling, molded components, internal door and window shutters, fancy and utility products, laminated and finger jointed panel boards. The small cuttings and wastes of rubber wood can also be used for particle boards, medium density fibre boards, wood cement boards etc. It is being widely used for interior décor in office and home environments. Wood carvings, veneer and plywood, block board and flush doors, pulp and paper, bent wood articles, packing cases etc. are the other lines of

use of rubber wood. More over its plantation origin has made it an eco friendly substitute for conventional wood like teak, mahogany, rose wood, etc.

Building materials from Coconut Palm

Given coir's close resemblance to wood in its chemical composition and the availability of renewable fibre every 45-60 days, it would be a good replacement for tropical timber. The increased use of coir composite and rubber wood as alternatives for forest timber, plastics, asbestos etc. encourage sustainable development

The coconut shells are used mainly in fuel, activated carbon and shell flour. It was reported that coconut shells were used in building construction either as a primarily structural material or as a filter material. It is also used beneath the ground floors in predominantly water-logged areas in order to resist the upthrust due to water pressure and incorporated in roof weathering cores to increase thermal insulation, producing hardboards, thermal insulant slabs. The cior pith is used for producing hard boards, thermal insulant slabs and bricks.

The coconut wood has been used for roofing components like rafters, beams, joints, purlins. Compared with conventional furniture timbers, coconut wood, because of its abrasive nature, has less desirable working qualities. Coconut stem wood does not suffer from degrading defects such as knots. This could facilitate stem bending and use of curved profiles. Coconut stems are ideally suitable as natural round timber because the strongest wood is in outside surface of the stem.

For purposes like rural houses, temporary sheds, cowsheds, workshop buildings, farm buildings, small and rural buildings, where some wood in unfinished form could be used, coconut wood is the most suitable material cost wise.

Only the first 8 to 10 meter of the mature and over matured coconut trees will be worth sawing. About 0.15 to 0.2 m^3 of sawn sizes will be available from an average size of mature trees.

Coir Composites

Coir composites belong to the fibre reinforced resins and the fibres are embedded in a polymer matrix so that the former forms a discontinuous phase in the continuous phase of the latter. The resinous matrix is the material used to envelop the reinforcement. The material are superior to conventional metallic materials, wood and timber which are mainly used in civil engineering, building and construction, chemical, transportation, marine and off-shore engineering and sports good applications.

Coir composites can be made using coir as reinforcing material with or without plantation timber veneer like rubber veneer, bamboo, jute, glass in-between as a secondary reinforcement and then impregnated with polymeric matrix material like phenolic, polyester, epoxy etc. and processed under controlled temperature and pressure.

The primary advantage of the coir composite is due to the coir, which is a natural, eco-friendly and abundantly available material. Coir is very strong due to its high content of crystalline alpha cellulose and lignin. It is highly resistant to borer, termite, water and other natural elements. The coir fibre being very strong and flexible, it can easily replace the glass fibre or can be hybridized in required ratio with the glass fibre.

The coir reinforcement fibre could be of coir felt, coir rope or coir sliver, etc. Additional reinforcement fibres such as glass, bamboo and jute fibre could also be used for improving the structural performance. The resultant coir fibre composites offer several advantages such as light weight, high strength and stiffness, non- corrosive, water resistant, long durability, low cost, etc. Coir composites are highly suitable for building and construction and transportation applications for cost effective substitute to wood and timber.

Advantages of Coir Composites

1. 100% wood substitute product – prevents felling of trees.
2. Biodegradable
3. Coir and jute are agro based materials – provide more employment in rural area
4. Coir is available throughout the year
5. Termite and borer resistant
6. Better screw and nail holding properties.
7. Flame retardant
8. Boiling water resistant.
9. Very good appearance due to oriented jute layer and can be used without painting.
10. Can be finished, painted, polished and laminated.
11. Normal carpenter's tools can be used
12. Clear cut edge.
13. Anti fungus.

The coir composite has been approved by Bureau of Indian Standards, Indian Railways, DGS & D, CPWD, Road Transport Corporation and it has been approved for roofing. Coir ply has also been used as shelters for the earth quake affected victims of Gujarat and has been proved as earth quake proof shelters.

Properties of Coir Composite without Plantation Veneer.

Density	: 700-800 kg/m^3
Modulus of rupture	: 35-40 N/mm^2
Modulus of elasticity	: 3000 – 3500 N/mm^2
Shear Strength	: 20-25 N/ mm^2
Screw holding strength	: >2000 N
Nail holding strength	: >1500 N
Moisture	: 10-15 %

Depending on construction, coir composites are classified into Coir ply, Flush / Panel door, Coir gypsum board, Packaging material, Coir cement tiles, Panels and blocks, Rubberised coir etc.

Fabrication Process of Coir ply

Fabrication of coir felts is made in Needled felt plant. Coir available in bale form is opened by bale opener. If the moisture in coir is very high it has to be dried. Then the opened coir is passed through the feeding system consisting of more openers, distributors and conveyors. The uniform coir web of required width formed by the feeding system is then needle punched with a needle punching machine consisting of reciprocating needle board, stripper plates and base plates. The needles having bars push some of the fibres vertically down, the fibres form loops below the web bottom surface by which the fibres are mechanically entangled. Then a discontinuous web of coir becomes a continuous felt which can be handled easily. After needling, the edges are trimmed and if required cuts are made by adjustable rotating cutters. Finally it is rolled by winder which always maintains constant speed in winding in spite of continuous increase in roll diameter. When a particular length is wound, the roll is removed from the winder and core of the next roll is put. Depending on the weight per square meter, the feeding and distribution are adjusted. The density of coir needled felt can be controlled by the amount of fibre going through the needle board or by overlapping needled felts to give the desired density.

Comparison of Properties of Coir Ply to Other Boards

	Coir-Ply	Plywood	Medium Density Fibre Board	Particle Board
Tested as per IS.No	IS-1734	IS-1734	IS-2380	IS-2380
Density(kg/mtcu)	748	400-+700	750-850	700-800
Moisture (%)	6.50%	5-15%	5-15%	5-15%
Glue shear strength (N/mm^2)	1720	1200-1750	N.A	N.A
Water resistance (8 hrs. boiling	No delamination	No delamination	Disintegrates	Disintegrates
Tensile strength (N/ mm^2)	23.6	35.55	7.0-8.0	4.0-4.5
Compressive strength(N /mm^2)	51.02	29.24	N.A	N.A
Modulus of elasticity (N/ mm^2))	6440	3500-7400	N.A	N.A
Modulus of rupture (N/ mm^2))	47.5	29.49	25.28	12.5-15.0
Nail holding power (in kg)	50	125	N.A	N.A
Screw holding power (in kg.)	245	300	125-150	85-125
Surface strength (kg/ cm^2)	30	N.A	30	30

Coir Composites in Packaging

Rigid sheets of coir composites can substitute wood/ plywood in various packaging applications. Besides mechanical properties, due to binding resins, the board can offer resistance to water, moisture and fungus, a requisite for any packaging medium.

Rubberised coir sheet is used for packaging for absorbing shocks and vibrations in transit. It is a high quality packaging and upholstery material made from curled coir bonded together by rubber latex. When natural rubber latex is employed as the binder, improved load bearing capacity and excellent resistance to compression set are imparted to fibrous structures. Such properties ensure that after

compression of any extent or duration whether due to shock or static loading, the structure rapidly recovers to its original shape, a pre-requisite of any good upholstery or packaging material. The main asset of rubberised coir is in its versatility. Rubberised coir is used as mattresses and cushions for homes and hospitals, industrial packaging, air filters and ventilating screens, thermal and acoustic insulation pads, carpet underlays, industrial cushioning for bus seats, automobile cushioning and railway seats.

.

Kerala is the only state which whole heartedly supported the rubberized coir industry since they knew the significance of the coir industry in providing rural employment with low capital investment by exempting from sales tax. Other states could not fully appreciate the benefits and did not provide the deserving attentions.