Int. J. Exp. Res. Rev., Vol. 5: 33-35 (2016)

International Journal of Experimental Research and Review (IJERR)

ISSN: 2455-4855 (Online) ***Short communication***

Received: 2nd May, 2016; **Accepted:** 29th May, 2016; **Published:** 30th June, 2016

Living Root Bridge: A potential no cost eco-technology for mitigating rural communication problems

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Abstract

The prop roots of *Ficus elastica* Roxb. (rubber plant) are trained over 15-20 years to form the natural living bridge to cross rivers and streams found in Cherrapunjee areas of Meghalaya, the wettest place in the world due to highest rainfall. These bridges grow to approximately 50 to 100 feet long and have strong and deep interwoven prop roots providing a boat shaped stable foothold. Key advantages of the living root bridges include exceptional structural robustness and resilience, progressive increase in load bearing capacity with time and use, development of eco-friendly and sustainable infrastructure, remedial impact on surrounding soil, water and air, and grass root community involvement in this ethno-bio-engineering process.

Keywords: Cherrapunjee, Ficus elastica, living root bridge.

The modern civilization develops day by day based on concrete using cement, iron rods, sand and stone chips by exploiting our hills, mountains and natural mining resources. There are many unexplored remote places in India without having road communications due to flowing rivers and streams. Road bridges are needed to reach these remote places. It is difficult to transport the bridge materials to the remote places and construction of concrete bridges in these areas. These areas can be connected by applying bio-engineering where living root bridges are constructed utilizing the aerial prop roots of Indian Rubber plant (*Ficus elastica*).

Imagine about a bridge, which has life. Though it's very difficult to imagine but in reality it is not impossible as shown by the local villagers of near Cherrapunjee in Meghalaya. They constructed stout, robust bridges over the rivers (Fig.1) by interwoven living prop root of Indian Rubber plant (*Ficus elastica* Roxb.) belonging to the fig family (Moraceae).

Wondering ethno-bio-engineered bridges of different shape and size are constructed by villages near Cherrapunjee in Meghalaya. This

Fig. 1. Root bridge over stream

Fig. 2. *Ficus elastica*

Fig. 3. Preparing root bridge on rusted cable bridges.

Fig. 4. Double decker root bridge

hilly terrain is known as one of the wettest place of world, Mousinram, a adjoining village of this area receives highest rainfall of the world (1,250 cm approx/year). This huge amount of rainwater drains out from this region through numerous streams and rivers which obstructs the communication of the local villagers. It is difficult to construct concrete bridges in these areas due to constrains of transporting the building materials through very poor road network and flash floods in the rivers.

Ficus elastica (Fig. 2) a large tropical tree with much spreading, is found in dense evergreen forests, particularly along river banks. It is well adapted along the fast flowing mountain streams. It grows comfortably on huge boulders along the river banks and luxuriant secondary roots (prop roots) are grown from its trunks (Fig.2). It also helps to hold the boulders and prevent land slide.

Investigating the growth and physiology especially morphology and biomechanics of the aerial root fibres of *Ficus elastica* along with their inosculation is a prerequisite to understand, improve and replicate the performance of these plant based structures. Research on plant systems has revealed that a high degree of redundancy at multiple scales within the hierarchical arrangement of cells and tissues produces sufficient excess capacity for adaptation to changing environmental stresses (Shankar, 2015).

The local people have used the tree to serve their need for making bridges to cross unfriendly rivers and streams. They directed the young tender thread like prop roots of the tree through hollowed out betel nut (*Areca catechu*) tree trunks, which were longitudinally sliced and placed in the desired position (Fig. 3).

When the growing roots reach the other end of the river or stream, they were allowed to penetrate the soil (Mathew, 2005). These bridges usually have more than two base spans. Stones and wood slices are used to fill any gaps in the base spans and over the period they get embedded in the floor of the root bridge. Some of these bridges have roots brought down from branches to join the middle of the bridge as support spans (Fig. 4).

The roots keep growing in strength and it takes 10-15 years for a bridge to be fully functional. Some of these root bridges are made by entwining the roots of two trees planted on opposite banks or in the middle of the river on huge boulders. These bridges may be 50-100 feet in length and are strong enough to carry more than 50 people at a time. One such bridge near Nongriat village (25°14'51.60"N 91°39'37.08"E) of Meghalaya has two bridges stacked one above the other over the river Umsiang, popularly known as double decker living root bridge (Fig. 4) (www.cherrapunjee.com).

The life span of these bridges is thought to be between 500-600 years. There are some iron cable bridges are present but these are in dangerous condition having rusts due to heavy moist environment. The people of this area strengthening these cable bridges with the living root bridge technology (Fig.3). Some of the old rusting iron cable bridges are now replaced with the root bridges. These root bridges are very unique and our country can be proud that their ancestors knew all about bioengineering and biotechnology and practiced it much ahead of the others (Mathew, 2005).

This bio-engineering technology can be applied in remote unapproachable regions. There are many remote places in the world without having road communications due to fast flowing rivers and streams. These areas can be connected by applying bio-engineering where living root bridges are constructed utilizing prop roots of Indian Rubber (*Ficus elastica*). For the developing countries it is very suitable as because it is a no cost technology, no construction and maintenance cost is required. The only requirement is time and caring of the plants.

By adopting this technology we may cut down the use of nonrenewable natural resource. In the earthquake prone areas where permanent construction of concrete bridge is not possible, living root bridge is very much appropriate. Through this type of unique construction Eco tourism can be promoted, which will strengthen the socio-economy of those remote areas. This technology can be developed over ponds and lakes at different parks to attracting tourists.

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