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BAMBOO: THE VERSATILE GRASS

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Introduction

Bamboos are perennial evergreen flowering grass that belongs to family *poaceae*. They are confined to the tropical and sub-tropical regions of the world. They are very unique in their flowering habit that is they flower only once in their life time in 50 years. There are around more than 1462 known species of bamboo in the world under 115 genera (Ohrnberger D.,1999). The origin of bamboo is uncertain but studies show that the word came from Dutch or Portuguese language that may be borrowed from Malay or Kannada. It is one of the fastest growing grasses in the world as they have a very unique rhizome development system. Their inter nodal length varies from 10 millimeters to 2.5 meters (Lessard and Chouinard, 1980). Bamboos are very versatile as it has many applications in our day-to-day life from being used as a source of a food to construction material. They also form an integral part of many tribal communities living in the forest. The quick growth provides a good advantage of using them in the purpose of afforestation, land restoration and carbon sequestration (Zhihua *et al.*,2013). Due to its versatile nature, it can also be used as a plantation crop that can be utilized to generate a good income by processing it to a finished product. There are many bamboo products available in the market from a small comb to big baskets.

Soil erosion and land degradation has been the major problem in the world. According to National Bureau of Soil Survey and Land Use Planning around 30% of soil is degraded in India (Mishra *et al.*, 2014). Land degradation has been a serious topic of discussion as such lands could not be utilized in the agricultural production, hence there would be a loss of income to the farmers and a direct loss in terms of yield. Now a days land degradation and soil erosion has been accelerated due to anthropogenic actions that has led to the disturbances that cannot be restored by the land naturally. Intensity of soil erosion depends on many factors that include slope of the land, intensity of the rainfall in the area, agricultural practices, human interventions and many more.

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Hence to conserve the productive soil we need to take measures that ensures the security of the lands that are of paramount of importance to the human beings.

Ecological restoration is the process of helping a damaged ecological system return to a stable, healthy, and sustainable condition. It may also be thought of as helping an ecosystem recover that has been destroyed, degraded, or damaged. The basic idea behind recovering any degraded land is to accurately identify and monitor the problem's current state, including its origins and effects. This includes taking steps to preserve nutrients in degraded lands. The approaches for the eco-restoration of degraded lands include engineering approach, biological approach, agronomical approach, soil amendments for increasing soil structure, sequential land use planning, use of agroforestry and afforestation.

Engineering approaches are employed in those areas that are highly degraded, where other approaches are not possible, these are much expensive and requires timely maintenance. Due to good ability to maintain soil, biological methods are more cost effective for restoring degraded areas, and they work best when combined with mechanical techniques. A thoughtful land use pattern that maximizes output from land may also be taken into consideration. Mining areas can try to be ecologically restored using plants that have economic benefit to the local community. Due to its improved physical, chemical, and biological qualities, soil amendments are another method of restoring degraded land (Zhang *et al.*, 2007). From the view point of hydrology and erosion management, agroforestry and afforestation are the most essential approaches. However, what matters most is that all of the needs of farmers including fuel, food, fodder are supplied by one land only. Since the biological technique is the most efficient and cost effective, it is imperative to introduce quickly growing bamboo species when restoring degraded lands. An effort has been made to address the significance of bamboos in the ecological restoration of damaged areas in this article.

Bamboos are being widely cultivated in diverse environmental conditions from heavy rainfall areas to the areas of high wind velocity. In India bamboo cultivation is confined to the north eastern India and in some forests of the southern India. They are known for their adaptive ability, nutrient and water conservation ability, hence makes them utmost suitable for the restoration of degraded lands (Desh R., 1989). Morphologically they have a dense foliage system that enables them to maintain thick layer of litter. They have a dense rhizome system that helps in the dense growth of shoot and culms.

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Extensive root systems, helps bamboo plants in their cultivation on the hilly slopes of degraded jhum lands that would help in the regulation if soil erosion and runoff. Various bamboo species have shown varying effects on soil qualities. For example, some have shown to boost microbial biomass in the rhizosphere zone by offering a broad root surface, which contributes to increased soil fertility (Arunachalam *et al*.,2002). Studies conducted by (Venkatesh *et al*.,2005) concluded that from 11 species, D. *gigantells*, D. *hookerii* and B. *nutans*, were found to be better species in controlling soil erosion and maintaining soil fertility status in the north eastern Himalayan region. In a study conducted during three consecutive years from 2009-2011 by (Singh *et al.*) at the Yamuna ravine system conclusion drawn out indicated that planting of *Dendrocalamus strictus* proved a viable alternative for gully stabilization, control sloping land erosion and a fast-growing vegetative cover. Study conducted by (Kaushal *et al.*,2021) for conservation of in-situ soil moisture noted that out of two bamboo species D. *strictus* and D. *hamiltonii* and different rain water harvesting trenches (rectangular, semi-circular, V-shaped) D. *hamiltonii* in conjunction with semi-circular trenches proved to be a good strategy for land reclamation.

Study conducted at M. P. K. V. Rahuri, Maharashtra by (Kale *et al.*,2022) on effect of different bamboo species on the soil properties. Out of the seven species used as different treatments *Bambusa nutans* recorded highest organic carbon content (8.07 g/kg) and soil under *Bambusa tulda* recorded highest available soil nitrogen phosphorous and potassium that is 191.83, 8.37, 410.33 kg/ha respectively. The study conducted with the bamboo species *Bambusa cacharensis* one of the dominant species in the north eastern India by (Nath *et al.*,2015) found that the organic carbon content nutrient level and soil runoff was reduced significantly when combined with appropriate measures. Another study from Central India by (Kala *et al.*,2020) revealed that bamboo helped in reducing the runoff from 9.6 to 1.8% and soil loss from 4.2 to 0.6 t/ha/year during a four yearlong study. It also revealed that cultivation of bamboo in gullied lands of ravine area has the potential for good earning to the resource poor farmers and improving livelihood.

The ability of bamboo to conserve soil and reclaim land is being attributed by the extensive fibrous and inter connected root system. Moreover, the thick foliage growth also diminishes the impact of raindrop on the soil surface by slowing down its intensity. Studies also suggested that roots and rhizomes of bamboo are mainly confined to the top layer of the soil from 0-30 cm, (Singh *et al.,* 2012) which helps in conserving soil very easily. The year wise growth of new culms provides the opportunity of harvesting bamboo without affecting biomass and soil.

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The areas where there is a rapid flow of rivers bamboo plantations in such areas may help in decreasing the speed of river as well as conserve the soil from being getting eroded. They are also known to increase tree species in coastal forest shelterbelts. The most successful method for reducing soil erosion was discovered in a model that showed how bamboo groves were interplanted with folder grass. (Tiwari *et al.*,1998) also carried out a number of investigations and discovered that, over time, enhanced soil health was a result of the conservation impact of bamboo plantations.

Importance of bamboo as a Nutritional Aspects

1. **Bamboo Shoots as Food**:
    - Bamboo shoots, the young sprouts of the bamboo plant, are edible and widely consumed in many parts of Asia.
    - **Low in Calories**: Bamboo shoots are low in calories, making them an excellent choice for weight-conscious individuals.
    - **Rich in Fiber**: They are a good source of dietary fiber, which aids digestion and promotes gut health.
    - **Vitamins and Minerals**: Bamboo shoots contain essential nutrients, including:
        - **Vitamin B6**: Supports brain health and metabolism.
        - **Vitamin E**: Acts as an antioxidant.
        - **Potassium**: Helps regulate blood pressure.
        - **Calcium and Magnesium**: Support bone health.
    - **Low Fat Content**: Their minimal fat content makes them heart-healthy.
    - **Plant-Based Protein**: Bamboo shoots offer a modest amount of protein, suitable for vegetarian diets.
2. **Bioactive Compounds**:
    - Bamboo shoots contain **phenolic acids**, which have antioxidant properties that combat free radicals and reduce inflammation.
    - They also possess **phytosterols**, known for lowering cholesterol levels.
3. **Detoxifying Properties**:
    - Bamboo shoots have been linked to detoxification benefits due to their high fiber content, aiding in toxin removal from the digestive tract.

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Other importance of Bamboo

1. **Environmental Benefits**:
    - **Sustainability**: Bamboo is a highly renewable resource, growing much faster than trees (some species grow up to a meter a day).
    - **Carbon Sequestration**: It absorbs large amounts of carbon dioxide, helping to combat climate change.
    - **Soil Health**: Bamboo helps prevent soil erosion and improves soil fertility through its extensive root system.
2. **Economic Importance**:
    - Bamboo supports numerous industries, including construction, furniture, textiles, and paper production.
    - In rural communities, it provides livelihoods through handicrafts, mats, baskets, and other goods.
3. **Medicinal Uses**:
    - Bamboo leaves and shoots are used in traditional medicine.
    - Extracts from bamboo are believed to have anti-inflammatory, antibacterial, and diuretic properties.
4. **Construction and Architecture**:
    - Bamboo is a durable, lightweight, and flexible building material.
    - It is used in scaffolding, flooring, and furniture, particularly in eco-friendly construction.
5. **Cultural and Artistic Significance**:
    - Bamboo holds symbolic value in many cultures, representing strength, resilience, and flexibility.
    - It is a medium for art, music (flutes), and other creative endeavors.
6. **Textile and Paper Industry**:
    - Bamboo fibres are used to make eco-friendly clothing and fabrics.
    - It is also a source of high-quality paper, reducing dependence on tree-based paper production.
7. **Animal Habitat**:
    - Bamboo is a vital food source for animals like pandas, elephants, and gorillas.

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- Its dense growth provides shelter for various species in tropical and subtropical ecosystems.

Conclusion

Bamboo is a versatile and ecologically significant resource that holds immense potential for restoring degraded lands. Its adaptability to diverse environmental conditions, rapid growth, and extensive root systems makes it an effective tool for soil conservation, erosion control, and land reclamation. Bamboo plantations not only stabilize soils on hilly slopes and riverbanks but also enhance soil fertility through increased organic carbon content and microbial biomass. Studies have consistently highlighted the effectiveness of bamboo species, such as *Dendrocalamus strictus* and *Bambusa nutans*, in improving soil health and reducing runoff, demonstrating their value in ecological restoration. Apart from its environmental benefits, bamboo also offers substantial economic and nutritional advantages. Its shoots are a rich source of essential nutrients, antioxidants, and dietary fiber, making them a healthy addition to diets. Economically, bamboo supports industries like construction, handicrafts, furniture, and textiles, providing livelihoods for rural communities. Furthermore, its cultural significance and use in traditional medicine underscore its broader importance. In the context of land restoration, bamboo's role extends beyond soil stabilization. Its ability to sequester carbon and conserve water aligns with global efforts to combat climate change and promote sustainable practices. The integration of bamboo plantations with measures such as rainwater harvesting and agroforestry has proven successful in enhancing soil moisture, reducing erosion, and supporting biodiversity. Engaging local communities and raising awareness of bamboo's benefits can further enhance restoration efforts. While the current understanding of bamboo's ecological and economic potential is promising, continued research and long-term monitoring are essential to unlock its full capabilities in addressing land degradation and promoting sustainable development. Bamboo stands as a beacon of hope for restoring degraded lands, protecting ecosystems, and improving livelihoods worldwide.

References

1. Arunachalam A, Arunachalam K. Evaluation of bamboos in eco-restoration of 'jhum' fallows in Arunachal Pradesh: ground vegetation, soil and microbial biomass. Forest Ecol Manag. 2002; 159: 231- 239. http://dx.doi.org/10.1016/S0378-1127(01)00435-2
2. Ohrnberger D. 1999. The bamboos of the world: annotated nomenclature and literature of the species and the higher and lower taxa. Amsterdam: Elsevier.

3. Lessard G, Chouinard A. 1980. Bamboo research in Asia. Proceedings of a workshop held in Singapore. IDRC, Ottawa, Canada
4. Zhihua T, Lihua C, Xinxiao Y, Yushan Z. Effect of bamboo plantation on rhizosphere soil enzyme and microbial activities in coastal ecosystem. J Food Agric Environ. 2013; 11(3&4): 2333-2338.
5. Desh R. Experience in waste land development: a case study. In: Renewable energy and environment. Proceedings of the International Solar Energy Convention. Udaipur, India, 1 -3 December 1989 (Mathur AN, Rathore NS, Eds.), pp. 139-143. Himanshu Publications, Udaipur, India.
6. Venkatesh MS, Bhatt BP, Kumar K, Majumdar B, Singh K. Soil properties influenced by some important edible bamboo species in the North Eastern Himalayan region, India. J Bamboo Rattan. 2005; 4(3): 221-230.
7. Zhang M, Zheng YS, Chen LG. A preliminary report on introduction experiment of bamboo into coastal sandy area. J Southwest Forestry College. 2007; 27: 48-50.
8. Singh PV, Bhardwaj P, Kumar A. Effect of mango, bamboo and haldu plants on physico-chemical properties of soil in tarai region. Progressive Hortic. 2012; 44(1): 130-136.
9. Tiwari SP, Patel AP, Singh HB. 1998. Soil health as affected by conservation measures in ravine lands of Gujarat. In: Soil and water conservation, challenges and opportunities. Eds: Bhushan LS, Abrol IP, Rama Mohan Rao MS. Indian Association of Soil & Water Conservationists, Dehradun.
10. Mishra Gaurav, Giri Krishna, Panday Shalish, Rajesh Kumar, Bisht N. S. Bamboo: potential resource for eco- restoration of degraded lands. Journal of Biology and Earth Sciences 2014; 4(2): B130-B136
11. Singh A. K., Kala S., Dubey S. K., Mahopatra K.P., Rao B.K. and M.L. Gaur. Impact of Resource Conservation Treatments on Runoff, Soil Loss and Growth Performance of Bamboo for Reclamation of Yamuna Ravine systems of India (2013). In: Natural Resource Conservation: Emerging Issues and Future Challenges, 361-369.
12. Kaushal Rajesh, Kumar Ambrish, Patra S, Islam S, Tomar JMS, Singh DV, Mandal D, Mehta H, Chaturvedi OP, Durai J (2021). In-situ soil moisture conservation in bamboos for rehabilitation of degraded lands in the Himalayan foothills. In: Ecological Engineering 173, 106437.
13. Kale Sangram D, Gaikwad Aniket S, Ghadge Swapnil T. Effect of different bamboo species on soil properties grown on Entisol of semi -arid climate (2022). In: Pharma Innov 11, 829-835.
14. Nath Arun Jyoti, Lal Rattan, Das, Ashesh Kumar. Ethnopedology and Soil Properties in Bamboo (Bambusa sp.) based agroforestry system in North East India (2015). In: Catena 135, 92-99.
15. Kala S., Singh Ak, Rao BK, Meena HR, Rashmi I, Singh RK (2020). Bamboo-based technology for resource conservation and management of Gillied Lands in Central India. In: Gully Erosion Studies from India and surrounding Regions, 307-319.