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Vetiver in Environment

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Abstract

Vetiver grass (*Chrysopogon zizanioides* L.) being a commercial perennial crop plant acquires numerous properties for the environmental protection as well as creates marketing avenues for the benefit of the farming community. This crop can grow in tropical and sub-tropical conditions. It has its native in India, grows up to 2 m height and the depth of roots may reaches upto 3 m. It possesses the fibrous root system and can hold plenty of soils, also grows even in water deficit or limited water conditions. This crop is used for various medicinal and aromatic purposes. The marketing potential of the plant includes Oils, Biomass, Briquettes, Roofing and Handicrafts. The environmental prospective includes Soil Stabilization, Groundwater recharge, Tolerant to heavy metals, Salinity and Stress tolerant, and Carbon Sequestration.

Introduction

Vetiver grass (*Vetiveria zizanioides*) is a potential tropical grass, very tolerant to some extreme soil and climatic conditions. It is an excellent hyper-accumulator of heavy metals and other salts in soil ecosystem. Vetiver grass was first used for soil and water conservation purpose in all countries. Due to its unique morphological, physiological characteristics, the tolerance to high levels of heavy metals and adverse conditions, its role has been successfully extended to environmental protection, particularly in the field of wastewater treatment and soil remediation. Research studies confirmed the potential of Vetiver in removal of heavy metals especially chromium and other salts from the contaminated sites.

Numerous studies found that it is utilized for soil stabilization, groundwater recharge, and carbon sequestration. High biomass producing nature of vetiver makes it appropriate for carbon sequestration. Vetiver Network (2013) estimated that vetiver sequesters around 15.24 Mg Carbon ha⁻¹ year⁻¹ in shoot and roots which is equivalent to carbon sequestration of 150 Tg per year in India, which is nearly 46% of C emissions in India.

Vetiver in Agriculture

Vetiver crop is highly useful for the controlling soil erosion because of its root cover which can grow upto the depth of 2 m high and with strong dense with vertical root system. It is propagated vegetative and is non-invasive. It is highly extremely resistant to incidence of pests and diseases and is used worldwide for soil and moisture conservation and soil restoration. It is suitable crop for severe floods, and other natural hazards viz., fires, and other hazards. Vetiver grass is regarded as an important crop of the third millennium because of its multipurpose and flexible nature.

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The crop has both a xerophytic and hydrophytic properties, and it can withstand worst conditions like droughts or floods, once after establishment of the crop because of its deep roots system. Highly adaptable to a wide range of soil conditions viz., saline soils, saline sodic, sodic, alkaline and acidic soils. They can able to tolerant extreme heat (50 °C) and frost (-10 °C). By tradition, these roots were woven for fans, fragrant screens and mats preparations.

Medicinal Properties of Vetiver

Besides the environmental benefits, vetiver also possesses a very good medicinal value and it is used in medicinal field's viz., Ayurveda, Homeopathy and Siddha. Vetiver oil extracted from its roots through distillation process can be used as anti inflammatory especially in nervous and circulatory system. It is also used as antiseptic thereby

Table 1: Environmental perspective of growing Vetiver crop

S. No	Advantages	
1	Phyto-extraction	It is used for removal of high concentrations of heavy metals and therefore results in reducing severe pollution problems and land degradation issues.
2	Phyto-stabilization and Mine Site Rehabilitation	Used in metalliferous mining activities such as tailings and wastewater. It helps to reduce the spreading of contaminants and it's useful for barren mining land, where it can tolerate harsh soil conditions.
3	Landfill Rehabilitation and Leachate Treatment	Most of the landfill rehabilitation and industrial sites especially in Australia and China, started to explore the potentials of vetiver for removing the contaminants (heavy metals) viz., Arsenic, Cadmium, Chromium, Nickel, Copper, Lead, and Mercury, which are highly toxic to both plants and humans. Heavy metals and other toxic leachate movement from landfills can be restricted by a Vetiver system.
4	Wastewater Treatment	It is low cost, simple, effective, and an environmentally friendly solution for treating wastewater discharged by the various sources both in developed and developing countries. Here, the wasted nutrients are recycled and are converted into biomass as well as organic mulch. Being a biological process, it overcome the disadvantages arises due to the chemical methods of wastewater treatment. As a result, phytoremediation using Vetiver seems to be much admired technology in both industrialized and developing countries.
5	Carbon sequestration	Most of the aromatic crops have high biomass production and serves as suitable candidates for carbon sequestration (Seshu lavania, 2019) in both biomass and in soil. Sequestration of carbon using land biomass is a potential method for controlling and reducing GHG. Changes in agricultural management can potentially increase the accumulation rate of soil organic C (SOC), thereby sequestering CO ₂ from the atmosphere. Numerous studies provide field estimates of biomass production and C- sequestration by vetiver.

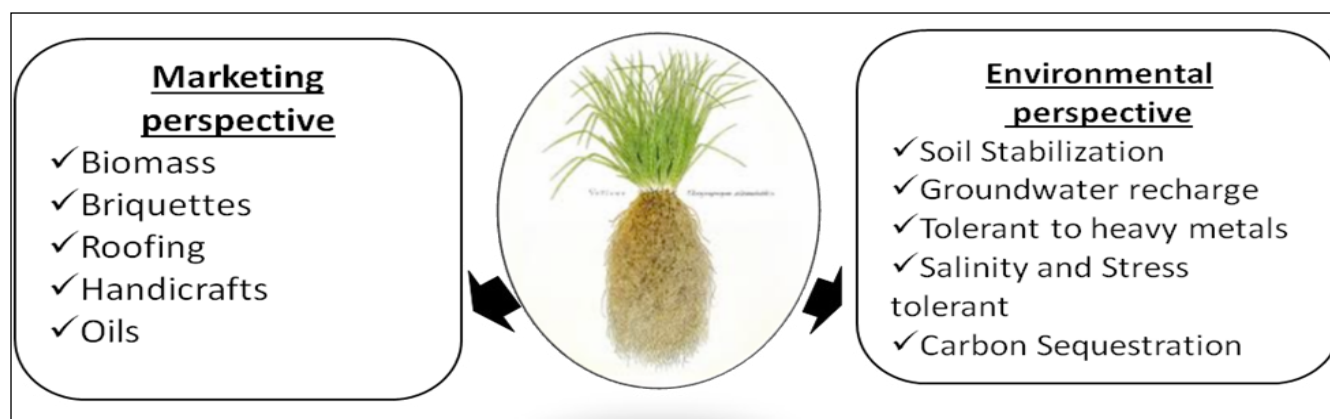


Figure 1: Environmental and Marketing Perspective of Vetiver

cures any wounds and ailments caused due to bacteria, virus etc. Vetiver is also used as aphrodisiac, cicatrisant and Sedative. Essential oil obtained from vetiver is also used for bone strengthening, muscle aches, dryness, cramps, treating arthritis, rheumatism and gout (Balasankar *et al.*, 2013).

Global Impact of Vetiver in Environmental Clean Up

Globally many countries exploit the potential of vetiver for removal of various pollutants and contaminants in the affected areas as *In-situ* and *Ex-situ* remediation (Table 2).

Table 2: Environmental Clean Up by vetiver at Global level (Truong, P.N, 2000)

S. No	Place/ Country	Role of Vetiver	
1	Queensland, Australia	Erosion and sediment control on floodplain	Vetiver hedges grown at 90m interval provide an everlasting protection against flooded water. Studies conducted for five consecutive years, have proven that VGT is very successful in reducing flood swiftness and limiting soil movement, with very little erosion in fallow strips.
2	Australia, Asia, and South America	Soil erosion and sediment control on sloping farmlands	Studies revealed that in comparing to the conventional cultivation practices, surface runoff and soil loss from fields treated with vetiver were significantly lower and crop yield was much improved.
3	Africa, Asia Thailand and Vietnam	Rehabilitation Saline and Acid Sulfate Soils	Acid Sulfate Soils (ASS) was found in major arable lands of many tropical countries. These soils are complex to stabilise and rehabilitate. Leachate collected from ASS is extremely acidic. Vetiver is found to be best suited for this type of arable lands.
4	Thailand	Bioremediation	Vetiver crop has the capacity to decontaminate the agrochemicals and pesticides as monocrotophos, carbofuran, and anachlor which was confirmed by a research study conducted at Thailand in cabbage crops grown on steep slope (60%). This study concluded that vetiver helps in preventing soils and crops contamination.
5	Madagascar	Landslides	Vetiver prove to be best suited for the controlling of landslides.
6	Vietnam Australia, Malaysia, Philippines	Flooding	Vetiver Grass Technology helps to stabilize the extensive Red River dyke system, which was built over centuries to protect the Red River delta in North Vietnam from annual flooding.

Conclusion

Industrialization caused a serious pollution problem due to the disposal of sewage and industrial effluents to water bodies and agriculture lands. Vetiver being a commercial perennial crop, farmers in the polluted and contaminated areas will have the dual benefit of removing pollutants in the soil as well as gaining income in growing this crop. Vetiver can be used for carbon sequestration for combating the climate change. Vetiver crop can be grown at large scale for restoration of any degraded lands and wastelands for improving the soil fertility and agricultural sustainability.

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