

Vetiver: An Amazing Plant for the Green City*

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Abstract

The Vetiver System promises a natural solution to mitigate the effects of climate change due to global warming caused by the release of greenhouse gases into the atmosphere. With its automobiles, factories, concrete and asphalt, air conditioners, people dumping their garbage, etc., the city is a major contributor to the greenhouse gas emissions. One low-cost solution is to employ the Green City philosophy, which is based on the concept that plants can bring social, economic and environmental benefits to the city dwellers. Plants are keys to our sense of well-being and belonging to a place that is called 'home'. The new concept of the Green City is to improve the liveable conditions of urban surroundings and benefit the well-being of citizens living there. The ideal Green City is more than just being green, i.e. it has to be clean, cool, safe and beautiful. Among the most unique plants other than trees that can make a city green is the vetiver, an amazing grass with exceptional properties.

*Vetiver can make a city **greener** as a road boundary, at roundabouts and in landscaping parks and resorts. It can make a city **cleaner** through: (i) its pond embankment filtration, various techniques in domestic, industrial and agricultural wastewater treatments, and water purification; (ii) rehabilitation of contaminated or polluted water with the treatment of eutrophicated water, removal of effluents, heavy metals and toxic substances; (iii) treatments of landfills and garbage dumps with the removal of agrochemicals and pesticides, and absorption of heavy metals – a new approach of phytoremediation; and (4) dust reduction. It can make a city **cooler** using its evapo-transpiration function, heat reduction and the cooling and refreshing effects of its dried massive roots. It can make a city **safer** serving as a windbreak and utilizing its ability to stabilize slopes of the road, riverbanks, ponds, and shorelines. And finally, being a grass with a beautiful form and aesthetic value, it can make a city **more beautiful** when used as an ornamental plant in landscaping, or as a decorative potted plant. Vetiver-based Green City employs simple and low-cost technology, which is sustainable and has low maintenance costs.*

Keywords: Green, clean, cool, safe, beautiful, sustainable, low maintenance costs.

1. Introduction

1.1 Vetiver and Climate Change

The Vetiver System promises a natural solution to mitigate the effects of climate

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change due to global warming, which was mainly initiated by human activities, especially those that increase the concentration of greenhouse gases in the atmosphere, such as deforestation and burning of fossil fuels. Scientific evidence indicates that the concentration of greenhouse gases is increasing at a rapid rate. This has resulted in the apparent strengthening of the greenhouse effect that has played a critical role in global warming. The end result is a climate change being attributed to the current rise in the average temperature of the Earth's atmosphere.

Humans are considered as one of the major causes of said climate change. We normally blame it on deforestation, while burning of fossil fuels, especially in the city, receives little attention.

1.2 The City - the Cause of Global Warming

The city is a major contributor to the greenhouse gas emissions. Automobiles, especially during traffic jam, release a large amount of carbon dioxide (CO₂). A large portion of the factories in the city do the same. Garbage apparently contributes not only CO₂ but also methane (CH₄) and numerous compounds from the methyl group (-CH₃). Concrete on the building and road surfaces, as well as asphalt, absorb more heat than the forest and water body, possibly causing the so-called 'heat island effect'. Air conditioners release a lot of heat into the surrounding atmosphere. People and their pets also release a large amount of CO₂ into the atmosphere.

1.3 The Green City Philosophy

The Green City Philosophy is based on the concept that plants can bring social, economic and environmental benefits. Plants are keys to our sense of well-being and belonging to a place that is called 'home'. They are an antidote to our increasingly disjointed and rootless lives (Anon. 2005).

1.4 An Ideal Green City is More Than Just Green

The function of the Green City is to improve the liveable conditions of urban surroundings and benefit the well-being of citizens living there. An ideal green city is more than just being green, i.e. it has to be clean, cool, safe, and beautiful.

1.5 Not Only Trees Can Make a City Green

Whenever an idea related to the Green City emerges, most people always think of trees as the only group of plants that could make a city green. In fact, every group of plants is being able to absorb CO₂ and

consequently release oxygen (O₂), as well as to transpire water into the air, which can relieve the city of the heat generated as a result of various urban activities. Among the most unique plants other than trees that can make a city green is the vetiver, a grass with exceptional properties.

2. Vetiver: An Amazing Plant

Vetiver is truly an amazing plant due to its numerous beneficial properties, namely:

2.1 Physical Properties

Vetiver roots grow vertically to a depth of about 2-3 m, developing into a root system that is massive, can hold soil particles together, and is able to absorb ground water at such a great depth. It also has erect and stiff stem that resists a high velocity of runoff.

2.2 Physiological Properties

Vetiver is tolerant to adverse edaphic conditions and a high concentration of heavy metals. It also withstands a submerged condition as well as eutrophicated and polluted water and is able to use more water than other plants. It has a very high carbon sequestration rate (Lavania and Lavania 2009).

3. Vetiver Makes a City Greener

Vetiver can make a city greener by using the following approaches:

3.1 Road and Pond Boundary

Vetiver hedges along roads and ponds make a nice boundary, much more pleasing to the eyes than concrete panels and other artificial objects.

3.2 Landscaping Park and Resort

Parks and resorts artistically planted with vetiver usually attract the visitors more than decorations with other natural or artificial objects.

4. Vetiver Makes a City Cleaner

Vetiver can make a city cleaner by using the following approaches:

4.1 Pond Embankment Filtration

Acting as a living soil barrier and a soil nail, vetiver can filter soil particles and debris, leaving only the clean water to pass through into the pond.

4.2 Wastewater Treatment/Purification

Domestic, industrial and agricultural wastewaters can all be treated and purified with the use of vetiver.

4.3 Polluted Water Purification

Heavy metals and toxic substances in polluted water can also be purified with the use of vetiver.

4.4 Rehabilitation of Contaminated or Polluted Water

Vetiver can rehabilitate contaminated or polluted water with the treatment of eutrophicated water, the removal of effluents, heavy metals and toxic substances.

4.5 Treatment of Landfills and Garbage Dumps

Vetiver can remove agro-chemicals and pesticide residues as well as absorb heavy metals from landfills and garbage dumps.

4.6 Dust Reduction

A thick and permanent hedge of vetiver can act as an excellent barrier to prevent dust from coming into the properties. Numerous research studies have shown the abilities of greenery with the use of vetiver to cope with problems caused by fine dust, especially in cities located near the edge of the desert regions.

5. Vetiver Makes a City Cooler

Vetiver can make a city cooler by using the following approaches:

5.1 Utilizing Its Carbon Sequestration Capability

Vetiver has a very effective way of sequestering carbon emissions and encountering the effects of global climate change. According to Grimshaw (2011), four mature vetiver plants would sequester the same amount of atmospheric carbon as one fast-growing poplar tree, the best of all trees for carbon sequestration. As an example, one 'carbon footprint' would be negated by planting 50 to 60 vetiver plants, or approximately 8 m of vetiver hedgerow.

5.2 Applying Its Evapo-Transpiration Function

Through its massive roots that penetrate 2-3 m deep down in the subsoil where plenty of water is available, coupled with an equally massive leaves that evapo-transpire large amount of water into the atmosphere, vetiver is substantially contributing with its cooling effect to the environmental cause.

5.3 Using Its Harvested Massive Roots

The cooling property of vetiver roots could be simply judged from the observation that even birds make use of vetiver roots to partly prepare their nests during summer. Other uses of dried roots to cool the atmosphere include:

5.3.1 A Hut Made with Vetiver Roots: In India, vetiver roots are used as a cover to prepare make-shift cabins or environmental chambers in achieving the desired cooling effect (Lavania 2003). Such cabins are frequently visible during summer in zoological gardens, the countryside, courtyards, parks, lawns, etc., and are used to suit specific needs and situations. When vetiver is sprinkled with water onto the root-screens or 'tatti', the air passing through it is cooler than the air outside, which may reach over 45°C. The air also has a

nice aroma of vetiver oil which is quite refreshing.

5.3.2 Dried Roots in Household Usage:

Dried roots are employed to scent linen and clothes, to make sachets, and to be burned as incense.

5.3.3 As Ventilating Panels in Electric Coolers: Vetiver dried roots are used as a stuffing material in ventilating panels used in electric coolers.

5.3.4 As Car Rooftops: Dried vetiver roots are used on car rooftops to achieve a cooling effect during summer. In India, the vetiver roots have been used since ancient times for making woven screens, mats, blinds, hand fans, broom hangers and baskets. When sprinkled with water and hung at proper ventilated spaces, such materials provide both cooling effect and pleasant aromatic air (Lavania 2003). In outer Delhi, India, poultry farmers kept their large poultry houses cool using desert coolers and heat exchange by forcing air through 'wet mats' made from woven vetiver roots (Greenfield 2003).

5.4 Heat Reduction: A thick and permanent hedge of vetiver can act as an excellent barrier to prevent heat from coming into the properties.

6. Vetiver Makes a City Safer

Vetiver can make a city safer by using the following approaches:

6.1 Removal of Toxic Substances

Vetiver is an excellent means of removing toxic substances from the soil and the water through a new process known as 'phytoremediation'.

6.2 Disaster Mitigation

With its deep, massive root system, vetiver can stabilize slopes of various structures (Grimshaw 2000a, 2000b) such as highways, river banks, shorelines, reservoirs, lakes, etc. For example, river banks of the MeKong Delta areas are stabilized with vetiver planted along the banks to mitigate the effect of waves caused by motor boats. In Brazil,

vetiver is grown on almost pure beach sands to stabilize the beach front; it will stop a lot of rubbish, effluent and runoff entering the beach and the sea.

6.3 Disaster Prevention

6.3.1 Wind Break: In addition to preventing dust and heat from coming into the properties, thick vetiver hedges can also act as a windbreak to slow down strong wind. This has been applied to a field of jojoba crop in Daping Village, Zhonglou Township, Pingtan County, Fujian Province, China (Xu 2003). Vetiver hedgerows at 6-8 m intervals were interspersed with the jojoba rows being perpendicular to the direction of the strong wind coming from South China Sea. By the end of the second year, vetiver hedges were over 2 m high and could act as an effective windbreak to arrest the shifting sand and protect the jojoba field.

6.3.2 Slow Down Runoff: Vetiver hedges planted across a slope can slow down the damaging runoff. In fact, most of the water penetrates deep down and retains as aquifer in the subsoil, thus reducing the amount of water running off down the slope.

6.3.3 Traffic Safety: Greenery can play a large role in working on road safety. Vetiver planted in a lane accentuates the course of the road, and the tunnel effect ensures that the road users are going to slow down. Vetiver hedgerows at the end of a straight, bare road warn the drivers to push on the breaks earlier and handle a bend or an intersection at low speed. Roundabouts have the same decelerating function.

6.3.4 Improve Air Quality: Pollutants are everywhere in the city. Greenery can make a great contribution to the improvement of air quality. Vetiver plants contribute to a higher air quality in the following ways: (i) by absorption of gaseous pollution like ozone (O₃), and sulphur dioxide (SO₂) through the surface of the leaves; (ii) by catching fine dust, ashes, pollens and smoke on the surface of the leaves; (iii) by giving up moisture to lower the temperature; (iv) by giving up O₂ through photosynthesis; and (v) by reducing hydrocarbon emissions from parked cars.

6.3.5 Stop Moving Sand Dunes: Vetiver hedgerows can stop moving sand dunes that approach the city as in the case of a city in Southwestern China.

7. Vetiver Makes a City More Beautiful

Being a grass with both beautiful form and aesthetic values, vetiver is sometimes used as an ornamental plant in landscaping, or as a decorative potted plant (Pease 2000, 2002). These are discussed below:

7.1 Landscaping

Vetiver is a beautiful ornamental plant for gardens, patios, decks, etc. The bush of the vetiver plant is so large that it hides unsightly structures. Grown as a hedge, i.e. planted close together in line, it forms a dense, uniform, and attractive hedge under tropical and subtropical climates. It also forms an aesthetically beautiful barrier for an unsightly view. Examples of the various uses of vetiver in landscaping are the following:

7.1.1 As a Decorative Hedge: Vetiver is used as a decorative hedge on roadsides, roundabouts, riversides, ponds, resorts, hillsides, etc. It looks good and seems to serve a good purpose. For example, when used in the roundabouts, these hedges make them look beautiful and also serve a useful function by hiding from view the traffic that is passing on the opposite side of the roundabouts.

7.1.2 As a Decorative Plot: A resort in Samui Island in the Gulf of Thailand grows vetiver in plots of various shapes in the area of the resort. The main purpose is to beautify the area.

7.1.3 For Dual Purpose in Beautifying the Landscape and the Environmental Protection: Vetiver hedges have been used to stabilize soils and control erosion in amenity sites such as golf courses and water park recreational areas. In many countries such as Australia, China, South Africa, etc., the use of vetiver hedgerows as a combined landscaping and land stabilization tool also produces an aesthetically pleasing hedgerow system

(Truong and Pease 2001). In Thailand, vetiver hedgerows are used very effectively as borders to vegetable plots and flowerbeds, for filtering runoff water to farm ponds and for stabilizing their banks. Along the winding road uphill leading to the Doi Tung Development Project, Chiang Rai, Thailand, vetiver was planted for decorative and ornamental purposes in addition to its main objective of stabilizing the roadside. A golf course in Mauritius (Anon. 2009) has been partially landscaped and protected using vetiver grass. The lakes on the course look particularly clean because the vetiver plots planted on the upstream drainage areas have removed most of the agricultural chemicals used on the course. Vetiver plots themselves look beautiful.

7.1.4 For Reservoir Landscaping: A common problem found around reservoirs is the barren strip on the shore caused by the fluctuation of the water level in the reservoir. The height of this level sometimes exceeds 10 m. Since reservoirs have become popular recreational sites and efforts to vegetate the banks have been unsuccessful in the past, vetiver, by virtue of its resistance to surviving in the water for a long period of time, has been grown on the bare banks of a reservoir in Guangzhou, China, which, after four months, were greened up completely. In Thailand, vetiver was planted on a reservoir bank of Kasetsart University Chalerm Prakiat Sakon Nakhon Campus (Anon. 2000). The result was beautiful scenery along the reservoir with no erosion of the lateritic soil.

7.2 Decorative Potted Plant

Grown in large pots, vetiver forms a nice bush with green foliages, some are upright while the others are drooping. They can be used to decorate platforms, stages, etc., as seen in the following:

❖ Potted vetiver plants were used to decorate the stage at ICV-2 held at Dusit Resort in Cha-am, Phetchaburi, Thailand, during 18-22 January 2000.

❖ In Senegal, small growers and nurseries grow vetiver in large clay pots and sell it in nearby towns and cities for use as ornamental plants (Juliard 2000, 2002).

❖ In Vietnam, vetiver is also grown in pots to be used as decorative potted plant outside an office. Thien Sinh Co., an ornamental plant firm, has a plan to promote the use of vetiver for home decoration during the 'Tết' (Vietnamese Lunar New Year) festival (Truong 2002).

7.3 Vetiver Bouquet

Bundle of cut vetiver leaves, together with the culms bearing inflorescences, can be used as a material for a bouquet, or a decorative plant for display in containers such as vase, pot, etc. Examples were seen in the decoration on the stage at ICV-3 in Guangzhou, China.

8. Discussion

8.1 Simple and Low Cost Technology

Whenever the cost of making greenery is concerned, people always think that it costs a lot of money. Planting vetiver is relatively cheap as compared to other plants such as trees and ornamental plants. It is one of the most simple plants and employs a low-cost technology.

8.2 Low Maintenance Costs

To make a city green with trees and other plants, particularly ornamental plants, is rather costly, especially in maintenance. Vetiver requires low maintenance costs - it is only required to cut the leaves down every three months, to leave the cut leaves to cover the soil to reduce evaporation, and to add nutrients to the soil after decay.

8.3 Sustainability

Most other plants grown for greenery in the city are difficult to sustain. Trees, for example, require pruning, spraying with fungicides and insecticides, and sometimes, after heavy storms, can topple down and destroy houses and other structures.

8.4 Economical and Social Importance of Greenery

Although making green areas with vetiver costs money, it can yield enormous economic and social benefits. For example, green spots of vetiver hedges in residential areas, nursing homes, shop floors, etc., can have a positive influence on health. Many studies have shown that green spots in the offices can reduce the absenteeism costs and make the employees enjoy their work so much more that an increase in productivity is recorded (Chomchalow 2001).

8.5 Value Increase

Vetiver plants add value to the property as they are good for the health of the residents, thus increasing the value of real estate that is surrounded by vetiver hedges, improving the air quality and much more.

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