For a plant to be useful for agriculture and biological engineering, and be accepted as safe, it should have:

- **THE PLANT -- VETIVER GRASS --**

    - Malaysia - highway stabilization
    - Australia - wastewater treatment

**Vetiver Grass**

*Vetiveria zizanioides L (Nash)*

- It should be capable of growing in a wide range of climates -- from 300 mm of rainfall to over 6,000 mm.
- It should not be a host (or intermediate host) for undesirable pests or diseases of any other plants.
- It should not compete with the crop plants it is protecting.
- It should be capable of developing new roots from nodes when buried by trapped sediment, and have a deep penetrating root system, capable of withstanding tunnelling and cracking characteristics of soils, and should the potential to penetrate vertically below the plant to at least three meters.
- It should be capable of growing in extreme soil types, regardless of nutrient status, pH, sodicity, acid sulphate or salinity, and toxic minerals. This includes sands, shales, gravels, mine tailings, and even more toxic soils.
- It should be capable of developing new roots from nodes when buried by trapped sediment, and continue to grow upward with the rising surface level, forming natural terraces.
- It should not compete with the crop plants it is protecting.
- It should not be a host or intermediate host for undesirable pests or diseases of any other plants.
- It should be capable of growing in a wide range of climates -- from 300 mm of rainfall to over 6,000 mm -- from air temperatures of -19°C (where the soil does not freeze) to more than 50°C. It should be able to withstand long and sustained droughts (>6 months).
- It should be cheap and easy to establish as a hedge and easily maintained by the user at little cost.
- It should be easily removed when no longer required.

WHY VETIVER GRASS

For a plant to be useful for agriculture and biological engineering, and be accepted as safe, it should have as many as possible of the following characteristics:

- Its seed should be sterile, and the plant should not spread by stolons or rhizomes, and therefore not escape and become a weed.
- Its crown should be below the surface so it can resist fire, over grazing, and trampling by livestock.
- It should be capable of forming a dense, ground level, permanent hedge, as an effective filter, preventing soil loss from runoff. Apparently only clones will grow into each other to form such a hedge.
- It should be perennial and permanent, capable of surviving as a dense hedge for decades, but only growing where we plant it.
- It should have stiff erect stems that can, at minimum, withstand flowing water of 1 foot (30 cm) depth that is moving at 1 foot per second (0.3 meters/second).
- It should exhibit xerophytic and hydrophytic characteristics if it is to survive the extremes of nature. Vetiver grass, once established, is little affected and highly tolerant of droughts or floods.
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Vetiver Grass cultivars used around the world for essential oil production, rehabilitation of misused land.

Vetiver for centuries to reduce soil loss, conserve soil water.

Vegetative propagation by rootstocks. Once established, it is not weedy or invasive. In some cases vetiver never flowers, but when it does, it produces rather beautiful non-fertile flowers.

CS LC SL VS LC SC VS

Malaysia - highway stabilization

Australia - wastewater treatment

Vetiver System (VS)

- Consists of a simple vegetative barrier (a hedge) comprising upright, rigid, dense, and deeply-rooted clump grass, that slows runoff, allowing sediments to stay on site, eventually forming natural terraces.
- Vetiver grass is already found in more than 100 countries throughout the tropics and sub-tropics.
- It has been used for more than a century in many Asian, African, and Caribbean countries as a traditional "soil binding" technology.
- Today, the VS is used for soil and moisture conservation, bioengineering, and for bioremediation.

It is not weedy or invasive:

- Hedges are propagated and established vegetatively. Analyses show that recommended cultivars of *Chrysopogon zizanioides* (South India type) are sterile and are not invasive.

Deep, tough roots:

- Vetiver’s deep, massive fibrous root system can reach down to two to three meters in the first year.
- This massive root system is likened to “living nails”, binding the soil together.
- The measured maximum resistance of vetiver roots in soils is equivalent to one-sixth that of mild steel (75 Mpa); stronger than most tree roots; improves soil shear strength by as much as 39%.
- The fibrous mat of roots strengthens earthen structures and removes many contaminants from soil and soil water.
- Closed planted slips grow into dense hedgerows with a deep, tough root system. They can withstand inundation and effectively reduce flow velocities, forming excellent filters that prevent soil loss.

THE VETIVER SYSTEM

- Closely planted slips grow into dense hedgerows with a deep, tough root system. They can withstand inundation and effectively reduce flow velocities, forming excellent filters that prevent soil loss.
- The fibrous mat of roots strengthens earthen structures and removes many contaminants from soil and soil water.
- Closely spaced (15 cm between plants at planting) hedgerow

**VS FOR AGRICULTURE**

- **On-farm** - in modern and traditional agriculture
- **Off-farm** - in non-farm activities

**On-farm**

- **Vetiver System (VS)** can be used to trap sediments, control runoff, increase soil moisture recharge, and stabilize soils during intense rainfall and floods. There is only minimal competition with adjacent perennial and annual crops for moisture or nutrients. VS is used for wind erosion control, forage, and pest control.
- **On-farm - Vetiver System (VS)** protects rural structures such as roads, ponds, drains, canals and building sites. Also used for land and gully rehabilitation.
- **On-farm - Vetiver System (VS)** is used to trap sediment, enlarge stream channels, and enhance fish production.
- **On-farm - Vetiver System (VS)** is used to trap sediments, improve water quality, and prevent erosion.

**OFF-FARM**

- **Vetiver System (VS)** plays a vital role in watershed protection at large scales - slowing down and spreading rainfall runoff, recharging groundwater supplies, reducing siltation of drainage systems, lakes and ponds, reducing agrochemical loadings into groundwater and watercourses, and for rehabilitation of misused land.

**THE PLANT -- VETIVER GRASS --**

*Vetiveria zizanioides L (Nash) recently reclassified Chrysopogon zizanioides L (Roberty)*

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Vetiver Grass cultivars used around the world for essential oil production, originating from south India, have all these characteristics.

VS for agriculture

- **On-farm** - in modern and traditional agriculture
- **Off-farm** - in non-farm activities

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On-farm - Vetiver System (VS)

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Off-farm - Vetiver System (VS)

- Plays a vital role in watershed protection at large scales - slowing down and spreading rainfall runoff, recharging groundwater supplies, reducing siltation of drainage systems, lakes and ponds, reducing agrochemical loadings into groundwater and watercourses, and for rehabilitation of misused land.
The Vetiver System
A PROVEN SOLUTION
The Vetiver Network International - www.vetiver.org

VS FOR BIO-ENGINEERING

- For the stabilization and protection of infrastructure (roads, railroads, and building sites) VS is proven effective, efficient, and cost effective when compared to other hard engineering alternatives using cement, rock, and steel. Vetiver grass roots have an Mpa of 75 (1/6 the strength of mild steel) and will improve soil shear strength at a depth of 0.5 meters by as much as 39%. VS costs from 55% to 85% less than traditional engineering systems.

For successful applications cultivars of Chrysopogon zizanioides originally from south India should be used. These cultivars are of the same genotype as Monito and Sunshine, and are non-invasive. They have a more massive root system structure than non sterile C.zizanioides accessions from north India, Africa (C.nigrata) and Thailand (C.nemoralis)

VS FOR WATER RELATED APPLICATIONS

- VS protects ponds, reservoirs, and rivers banks from erosion caused by wave action, it strengthens earthen dams against collapse, and it reduces maintenance costs and ensures the integrity of dam walls, canal and river banks, and drains.

- VS improves groundwater recharge through improved infiltration and reduced runoff, and the quality of water by removing sediments and chemicals.

- Venezuela: the Ho Chi Minh Highway has been stabilized with vetiver grass. The batters and fills are stable and withstand cyclonic rainfall events. 

- China - expressway stabilization. This cut was prone to massive slip. Stabilization with VS has given complete protection

- Vietnam - Ho Chi Minh Highway - with and without vetiver stabilization

- Thailand - a gas pipeline was laid through tropical forest. On steep slopes the right of way was stabilized with vetiver - native plants regenerated

- Cambodia - This very large bank on the Mekong River has been under continuous erosion. The land owner with assistance from TVNI is stabilizing using vetiver hedges.

- Vietnam - Vetiver withstands flooding for long periods. This grass was flooded for 8 months. Vetiver one month after flood receded

- China - partially submerged vetiver grass used to stabilize the drain-down slopes of a reservoir in Guangdong Province

- Australia - VS protects the right hand bank of a drain cut through acid sulphate soils of Queensland. Note left hand bank is devoid of any vegetation

- China - same fill less than a year later. After another two years this fill became fully forested. Unstabilized cut in background

- Vietnam - Vetiver is increasingly used to stabilize the banks of fishponds and to purify pond water

- Spain - unstable and eroding highway fill treated with VS. Unstabilized eroded fill on right. VS grows well under low rainfall Mediterranean climate

- Zambia - a last flowing stream protected from stream bank erosion using VS application

VS FOR BIO-REMEDIATION

- Onsite and offsite pollution control from wastes and contaminants is a breakthrough application of VS for environmental protection. Vetiver is being used to rehabilitate a large copper mine in China, coal mines in Indonesia, diamond mine spoils in South Africa, to control erosion and leachate from municipal landfills in China.... and more.

- Research has clearly established vetiver’s tolerance to extremely high levels of Al, Mn, As, Cd, Cr, Ni, Pb, Hg, Se, and Zn.

- Vetiver has been used to reclaim soils and increase site productivity in places that were previously believed to be totally unproductive.

VS FOR OTHER USES

- In disaster mitigation and vulnerability reduction, VS has a crucial role to play....

"The storms were terrible. [Afterward there were] landslides, roads destroyed, agricultural lands washed away; but, where there were vetiver barriers, everything seemed normal." - Doi, C. (2001) South Asian Natural Disasters: How Vetiver Grass Works.

- For handicrafts, perfumes, and medicinal purposes.

- For paper making, mulch, thatch, reinforcing bricks, biofuel, pest control, carbon sequestering, and many other uses.

ACT NOW! Contact TVNI for additional technical information.

The Vetiver Network International
709 Brier Rd., Bellingham, WA 98225 USA
Tel/Fax: (001) 360-671-5985
E-mail: coordinator@vetiver.org

The Vetiver Network (TVNI) is a nonprofit foundation under United States code 501 (c) (3). It is a volunteer organization that promotes the use of the Vetiver System through dissemination of information and networking worldwide. TVNI has helped established over 25 regional and country-based affiliated networks.

Contact your local vetiver network at:

Home Page: http://www.vetiver.org
Vetiver Clients Gallery: http://picasaweb.google.com/VetiverClients
Vetiver Picture Gallery: http://picasaweb.google.com/VetiverNetwork

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