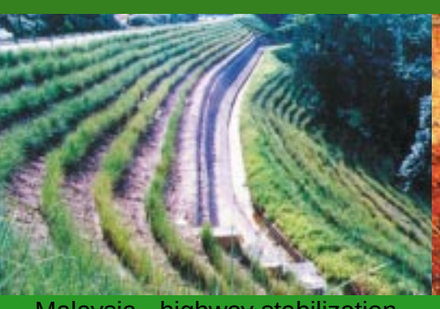
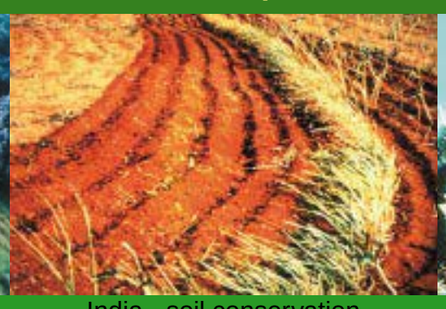
THE VETIVER SYSTEM

A PROVEN SOLUTION

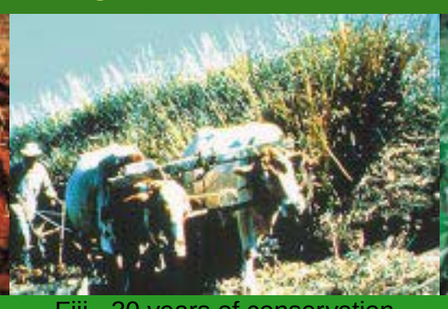
The Vetiver Network http://www.vetiver.org



Malaysia - highway stabilization



India - soil conservation



Fiji - 30 years of conservation

The problems we face are growing at a pace that challenges our ability to solve them

- Soil loss results in physical, chemical, and biological degradation and loss of ability to produce food.
- Land slides, unstable slopes and flooding destroy agricultural land and valuable infrastructure.
- Siltation of drains, lakes, reservoirs, and rivers reduce storage capacity and can result in flooding.
- Overuse and misuse of large areas of land, and contamination by toxic runoff from mine dumps, landfills, feedlots, salinization, etc., require extensive reclamation programs.
- Water polluted by mineral or organic sediments as well as the pollutants mentioned above detrimentally affect drinking water supplies, fresh and saltwater fisheries, and coral reefs.
- Decreased groundwater recharge in watersheds results in local water shortages.
- Inattention to site stabilization and maintenance results in infrastructure failure and losses.

Solutions are often too complex or costly given existing resources and capacity

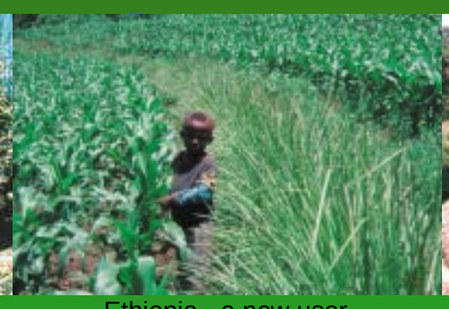
- The complexity and high cost of engineering and structural designs; ambitious and impracticable environmental protection and remedial practices - often due to over demanding design engineers and supervisors - and unnecessary high-end quality control measures; as well as, amongst others, bureaucratic accounting and bidding procedures.
- Low potential for sustainability due to lack of funds for maintenance, unsuitability to local conditions/ capacity, or need for continuous subsidies to maintain effectiveness.

Many of these problems share a common solution in THE VETIVER SYSTEM

VETIVER GRASS

A HEDGE AGAINST EROSION

The Vetiver Network http://www.vetiver.org



Ethiopia - a new user

Panama - steep land protection

Australia - prevents flood erosion

The 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 120 countries throughout the tropics and subtropics.
- 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. DNA tests show that recommended varieties are nonfertile. The plant stays where planted; as for example the decades old hedges In Gundalpet, India.
- Closely planted slips grow into dense hedgerows with a deep, tough root systems. They can withstand inundation, and effectively reduce flow velocities, forming excellent filters that prevent soil loss.

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.
- The fibrous mat of roots strengthens earthen structures and removes many contaminants from soil and soil water.

THE PLANT -- VETIVER GRASS -- *Vetiveria zizanioides*

Vetiveria zizanioides

Planting slip

Tissue cultivation of vetiver grass

Two year old, two meter root system - Mpa 75 - equivalent to 1/6 of the strength of mild steel

Cross section through a two year old hedgerow. Note sediment build up over original top soil (brown line)

Longitudinal section through hedgerow

Newly planted vetiver hedgerow

3 years old, extreme drought conditions

Vetiver nursery of containerized plants

6 year old vetiver, Pomona California

Planting containerised vetiver on steep highway fill slope in Malaysia

Vetiver inflorescence. In many cases vetiver never flowers, but when it does it produces rather beautiful sterile seeded flowers

WHY VETIVER GRASS

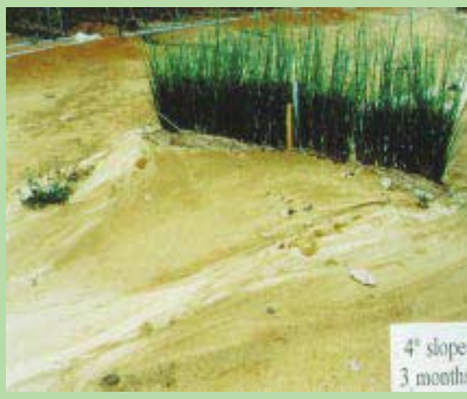
For a plant to be useful for agriculture and biological engineering, and be accepted as safe, it should have as many as possible of the following characteristics:

- Its seed should be sterile, and the plant should not produce 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 withstand a water flows of at least 1 cusec (.028 cumecs) 12 inches (0.3m) deep.
- It should exhibit xerophytic and hydrophytic characteristics if it is to survive the forces of nature.
- It should have a deep penetrating root system, capable of withstanding tunnelling and cracking characteristics of soils. The roots should 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 with the new ground level, to eventually forming natural terraces.
- It should not compete with the crop plants it is protecting.
- It should be totally free of pests and diseases, and should not be an intermediate host for 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 temperatures of -15º C to more than 55º 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.

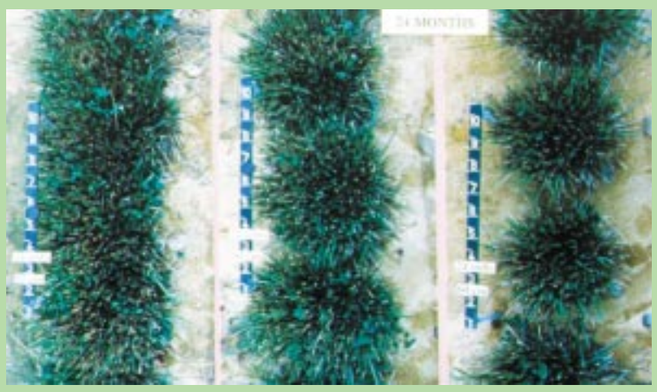
Vetiver grass has all these characteristics.

Dense crown of a vetiver grass clump

After a fire vetiver hedge remains vertical and quickly recovers



This research hegerow shows how vetiver will trap sediment



Closely spaced (15 cm between plants) row at left assures a dense hedgerow

Very dense and very effective vetiver hedgerow

VS FOR AGRICULTURE

- On-farm - in modern and traditional agriculture VS is 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 also used for wind erosion control.
- On-farm - VS protects structures such as roads, ponds, drains, canals and building sites. Also used for land and gully rehabilitation.
- Off-farm - VS plays a vital role in watershed protection - slowing down and spreading rainfall runoff, recharging groundwater, reducing siltation of drainage systems and water bodies, and reducing agrochemical loading into groundwater and watercourses and for rehabilitation of misused land.

Top Left: Vetiver hedgerow on a farm in upland Nigeria (Mambila Plateau - 1500 meters a.s.l.)

Top center: Vetiver hedgerow on Darling Downs, Australia, used to reduce erosive power of flooding on flat land -- as a result more land can be cropped each year

Top right: Farmers from Gudalpet, India, have used vetiver for centuries to reduce soil loss, conserve moisture, and increase groundwater recharge

Bottom left: Vetiver hedgerow used to protect crops from high winds as well as reducing wind erosion in Pintang Island, China

Bottom center: Vetiver used to stabilize a farm road in Malaysia

Bottom right: A drainage line/gully in Zimbabwe stabilized by vetiver hedgerow