GLOBAL AND REGIONAL APPLICATIONS OF THE VETIVER SYSTEM

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THE VETIVER NETWORK

CONTENTS

Introduction - History of Application Use

–Aromatic oils, handicrafts, agricultural bi-products

–Soil and Water Conservation

–Slope Stabilization

–Flood Control - water flows

–Pollution Control - tolerance to toxic materials

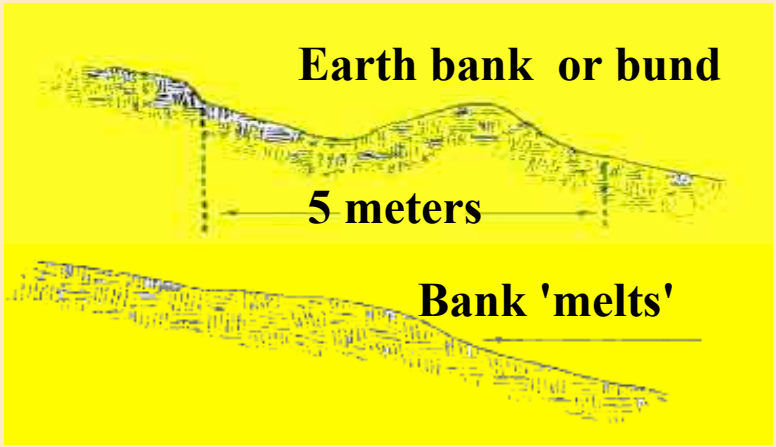
VETIVER SYSTEMS APPLICATIONS

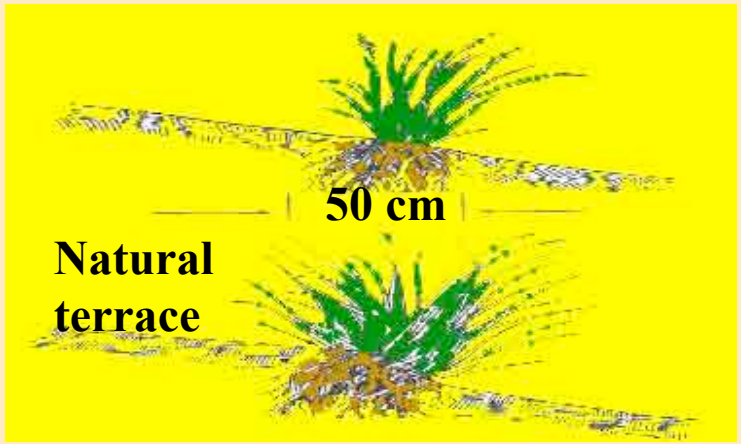
- Soil and Water Conservation
- Land Reclamation
- Slope Stabilization
- Disaster Mitigation
- Interface between Water and Structures
- Improved Water Quality and Remediation of Polluted Sites
- Agricultural Uses
- Other Uses
- Potential uses of VS in Kuwait

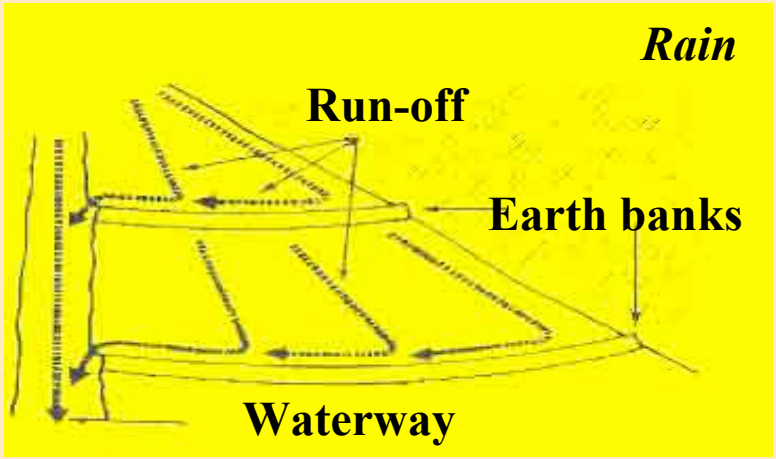
Soil and Water Conservation

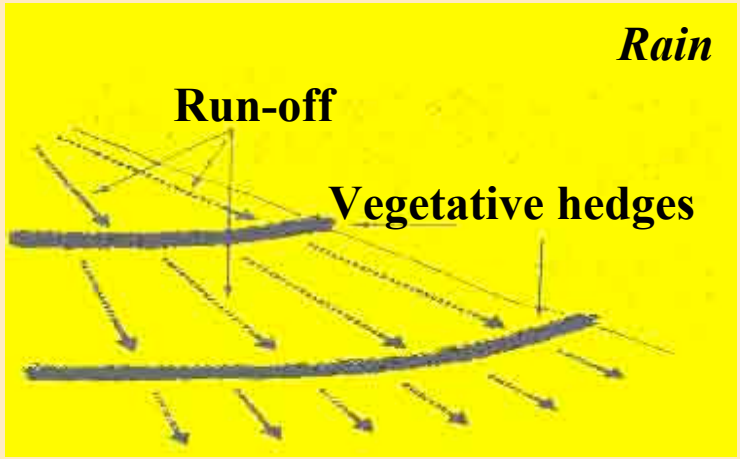
The Vetiver Grass Hedge and its function

CONSTRUCTED ***VEGETATIVE***









The Vetiver Grass Hedge

Soil and Water Conservation
The Vetiver Grass Hedge and its function

Upper image shows a cross section through a 2 year old vetiver hedgerow. Note the dark humus band above the lower white line was the original soil surface, above 60 cm of soil has been trapped.

Lower image shows the huge root system of vetiver grass compared to the minimum root growth of "local: grasses

Soil and Water Conservation
The Vetiver Grass Hedge - St. Lucia. West Indies

Photo of Vetiver hedgerows in St Lucia taken in the 1940s. Vetiver grass was used for soil conservation in many ex British Caribbean Islands during the colonial era. Note this slope is fully stabilized.

Soil and Water Conservation
The Vetiver Grass Hedge - Thailand

Vetiver hedgerow protecting an orchard in Thailand

Soil and Water Conservation
The Vetiver Grass Hedge - Jiangxi Province - China

Controlling erosion on a citrus farm on China's red soils. Vetiver grass also provides an excellent source of mulch, improves nutrient availability to adjacent crops

Soil and Water Conservation
The Vetiver Grass Hedge - Wind breaks

Fujian Province, China

Land Rehabilitation
Reclaiming the “Red Desert” in south China

Before and after images

Land Rehabilitation
Sand dune reclamation in Central Coastal Vietnam

Land Rehabilitation
Gully control in the Congo

Before. This gully is eroding back into a nearby village

After - Gully shaped band planted with vetiver

Land Rehabilitation
Gully control in Fiji (30 years after establishment)

Land Rehabilitation
Gully control in South Africa

Land Rehabilitation
Rehabilitating a quarry in Australia

Before

After

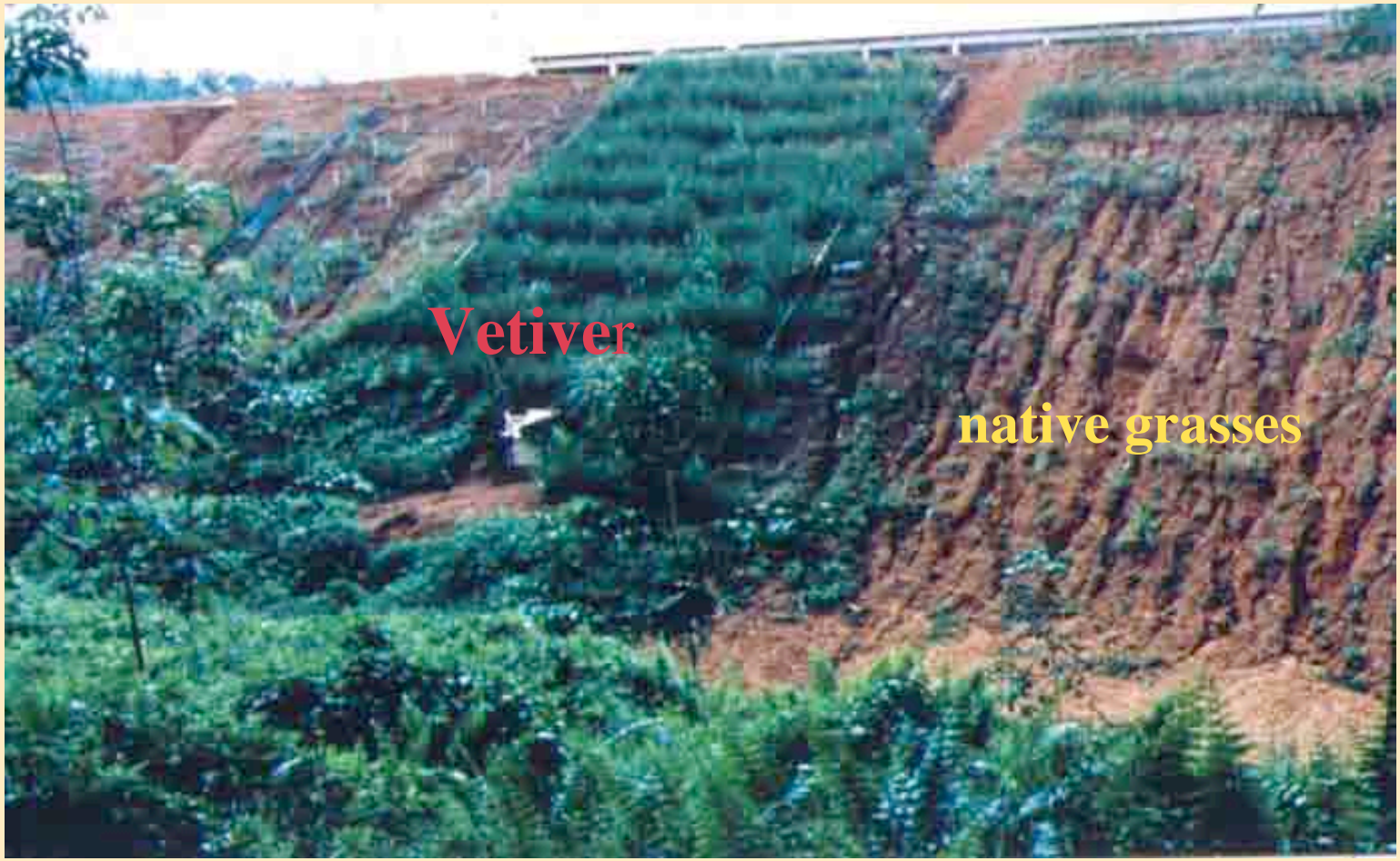
Slope Stabilization

Table 1: Tensile Strength of Roots of Some Plants

Botanical name	**Common name**	**Tensile strength (MPa)**
Salix	Willow	9-36*
Populus	Poplars	5-38*
Alnus	Alders	4-74*
Pseudotsuga	Douglas fir	19-61*
Acer sacharinum	Silver maple	15-30*
Tsuga heterophylia	Western hemlock	27*
Vaccinum	Huckleberry	16*
Hordeum vulgare	Barley Grass, forbs Moss	15-31* 2-20* 2-7kPa*
Vetiveria zizanioides	Vetiver grass	40-120 (Average 75**)

Slope Stabilization

Testing site: vetiver grass versus native grasses



Slope Stabilization
Stabilization of a highway embankment in Malaysia

Before treatment

After treatment with Vetiver

Slope Stabilization
Stabilization of a railroad embankment in Madagascar

Slope Stabilization
Stabilization of a building site in South Africa

Slope Stabilization

Stabilization of a gas pipeline in tropical Thailand

Pipeline routes are often not easy to stabilize. These two images from Thailand show the before (above) and after (below) situation. Vetiver was used very successfully for the stabilization of extreme sections of this important pipeline that traversed very sensitive forest areas.

Disaster Mitigation

Over the past ten years we have come to realize that Vetiver Systems could have an important role in preventing many disaster related problems resulting from extreme high rainfall events.

Vetiver Systems for Erosion and Flood Control
Landslide stabilization in Honduras

The **top** of the slide shown on the previous page is heavily eroded, gullied and devoid of top soil.

Bottom. The slope is reshaped and with a combination of vetiver hedgerows and some "hard" structures has been rehabilitated.

Since Hurricane Mitch there are wide reports that Vetiver Systems are being increasingly used in Central American countries for land slide prevention

Vetiver Systems for Disaster Mitigation
Railway Rehab in Madagascar - 1

Typical damage from cyclones

Vetiver Systems for Disaster Mitigation
Railway Rehab in Madagascar - 2

After VGT treatment there have been no closures to railroad even after intense cyclones.

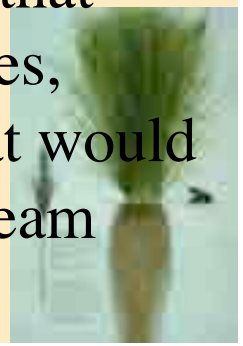
Vetiver Systems for Flood Control
Flood control on the plains

The Darling Downs of Queensland, Australia are subject to occasional massive flooding. Vetiver hedgerows have proven to be very effective in reducing water velocity flows and erosion on these nearly flat lands. These images show young hedgerows.

Vetiver Systems for Flood Control

Flood control on the plains

These two images show the impact of mature vetiver hedgerows on the black soils of the Darling Downs. The **top** image indicates no erosion from the flooding that has occurred. The **bottom** image shows the extraordinary controlled growth of vetiver and the standing crop adjacent to it. Such a system could be applicable to flood plain areas. Subsequently to this application in Queensland we have learned that vetiver removes excess nitrates, phosphates and pesticides that would otherwise impact on downstream communities

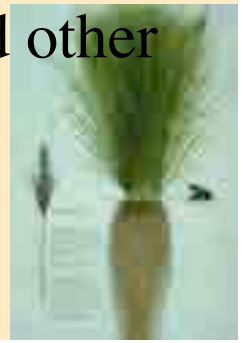


Vetiver Systems for Flood Control
Flood protection in drainage areas

On this Australian farm flash flooding frequently destroyed a concrete crossing (bottom image).

Vetiver Systems for Flood Control
Flood protection in drainage areas

To solve the problem shown on the previous slide two lines of vetiver were planted above the crossing. The subsequent flash floods were unable to uproot the vetiver and as a result the high velocity flow of water was unable to undermine the concrete crossing. Subsequently this technique has been used frequently in Madagascar and other countries.



Vetiver Systems for Erosion and Flood Control

Flood control on the plains

Vetiver Systems for Flood Control
Flood protection of Sea Walls - salt water fish ponds - China

This sea wall protecting a salt water fish pond at a coastal China site was overtopped by sea water during a typhoon. It did not breach. Unprotected walls were completely destroyed

Vetiver Systems for Flood Control
Flood protection of sand dunes on beach property in Senegal

Vetiver Systems for Flood Control
Flood protection of Sea Walls - Vietnam 2005

In 2005 Vietnam experienced its worst typhoons in 60 years. Trial plantings of vetiver proved very effective in preventing breaching of sea walls.

Vetiver Systems for Flood Control

Flood and river bank protection of waterway in the Mekong Delta

Vetiver Systems - The Interface between Water and Structures

Vetiver hedgerows protecting reservoir spillway and stream in Zimbabwe

Vetiver Systems - The Interface between Water and Structures

Vetiver hedgerows protecting the interface of a bridge abutment in Madagascar

Vetiver Systems - The Interface between Water and Structures

Vetiver hedgerows protecting the inside curve of a highway in Malaysia from river water damage

Vetiver Systems - The Interface between Water and Structures

Vetiver hedgerows protecting the river bank of a major river in south China

Vetiver Systems for Improved Water Quality and Pollution Control

- **Reduction of sediment flows.**
- **Containment of leachates from mine tailings, landfills, and industrial sites.**
- **Sewage treatment - urban and rural.**
- **Livestock effluent pond clean up.**
- **Reduction of pestcide residues and excess nitrates and phosphates from agricultural lands.**

Vetiver Systems for Improved Water Quality and Pollution Control

Reduction of Sediment Flows

Sediment trapping and retention on the upside of vetiver hedgerows in Zimbabwe (above) and Australia (right)

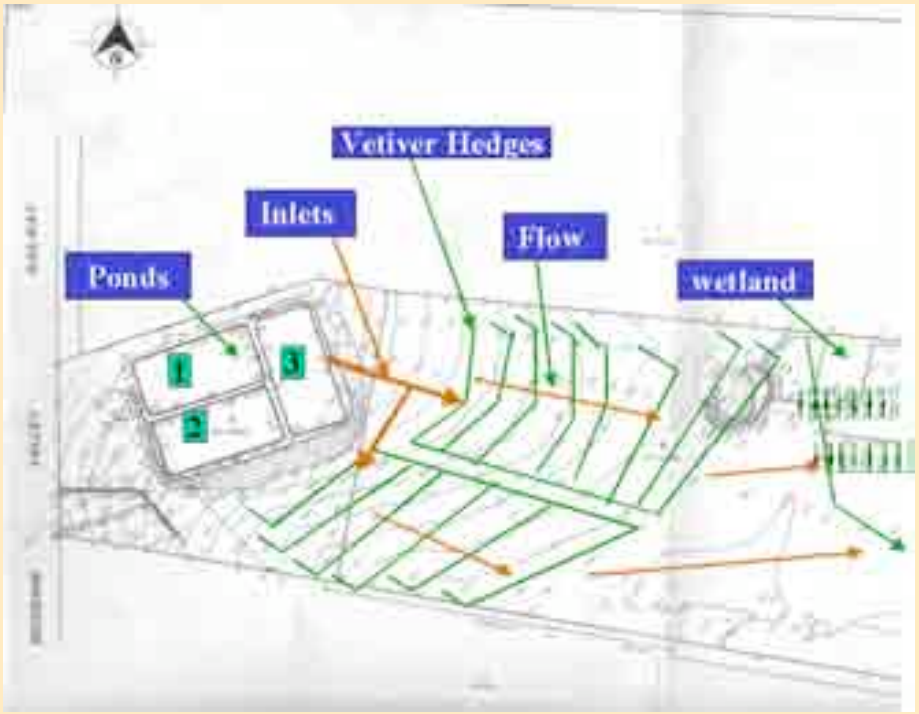
Vetiver Systems for Improved Water Quality and Pollution Control

Leachate containment from landfills and industrial sites

Treating landfill Leachate in Australia

Vetiver Systems for Improved Water Quality and Pollution Control

Urban and Rural Sewage Treatment



Layout for tertiary sewage Australia treatment in Australia.

Effluent clean up for small houses in rural Australia. As few as 50 plants will mitigate seepage

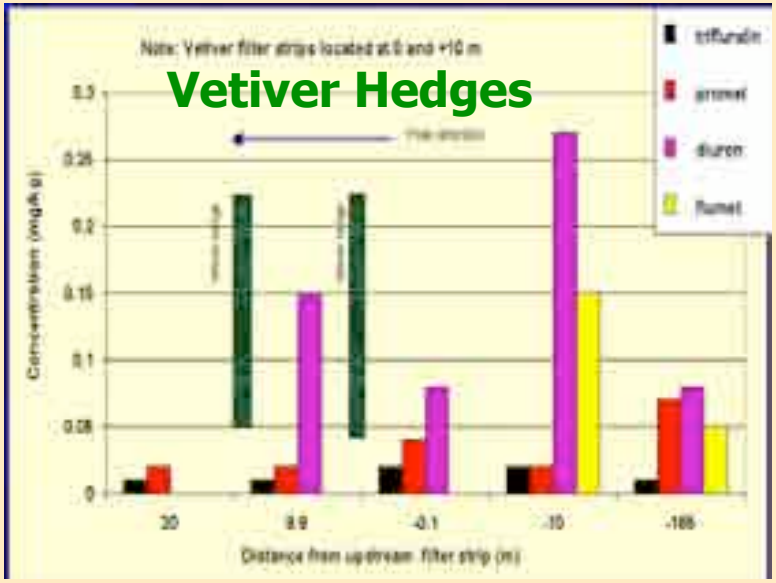
Vetiver Systems for Improved Water Quality and Pollution Control

Livestock effluent pond treatment

Treating piggery effluent

Vetiver Systems for Improved Water Quality and Pollution Control

Reduction of pesticide residues and excess nitrates and phosphates from agricultural lands.



Trapping herbicides on cotton farms in Australia to prevent downstream fish kill

Vetiver Systems for Agricultural Production

Soil and Water Conservation.

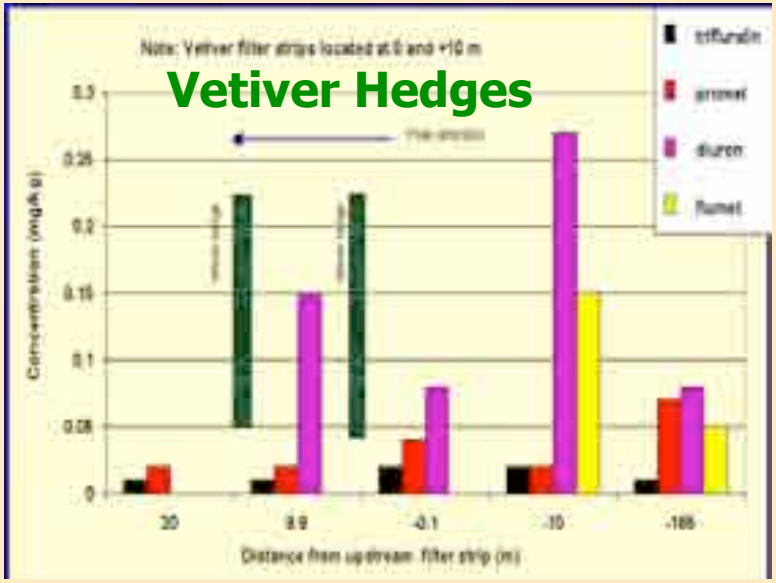
Forage

Mulch and Soil improvement

Crop protection

Vetiver Systems for Improved Water Quality and Pollution Control

Reduction of pesticide residues and excess nitrates and phosphates from agricultural lands.



Trapping herbicides on cotton farms in Australia to prevent downstream fish kill

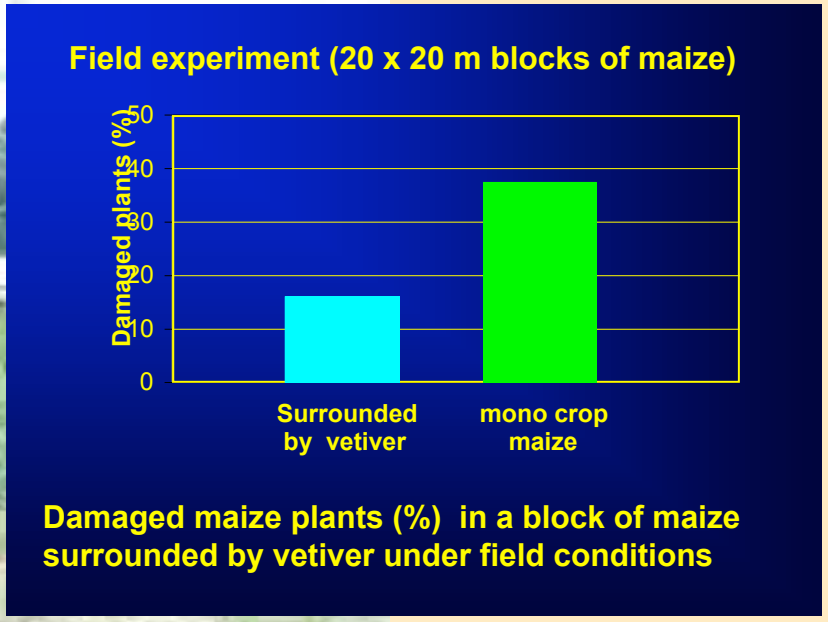
Vetiver Systems for Agricultural Production
Forage for livestock

When vetiver is cut or grazed frequently is has good digestibility and a crude protein level of about 13

Vetiver Systems for Agricultural Production
Mulch and Soil Improvement

Used as a mulch for coffee and tea in Ethiopia and Sri Lanka

Vetiver Systems for Agricultural Production
Crop Protection



Damaged maize plants (%) in a block of maize surrounded by vetiver under field conditions

Vetiver Systems for Other Uses

Construction materials

Handicrafts

Medicinal

Fragrance

Flavoring

Vetiver Systems for Other Uses
Thatching material

Vetiver Systems for Other Uses
Thatching material

Cement Replacement Material

- **Low-cost, environmental-friendly, energy-saving construction material can be made from vetiver grass ash as a mortar especially for the rural areas**

Vetiver clay tiles

Thailand

Rice storage silo

Vetiver Systems for Other Uses
Handicrafts

From shoots

From roots for insect repellant use

Vetiver Systems for Other Uses
Medicinal

Traditional Medicines

Dissolve **gallstones;** ***reduce*** **fever;** ***heal*** **stomach discomfort;** ***relief*** **rheumatism, lumbago, headache, sprain, prostrate cancer, diabetes;** ***improve*** **skin conditions.**

Aromatherapy

- ***balance the activity of sebaceous oil gland***
- ***normalize oily skin and clear acne***
- ***prevent stretch marks of pregnant women***
- ***strengthen central nervous system***
- ***overcome depression, insomnia, anxiety, stress, tension and nervousness, etc.***

Herbal Drinks

In India: **Refreshing drinking water is made from vetiver roots**

In Thailand: **Root and leaves in equal proportions are boiled in water until the liquid is concentrated; it is taken as herbal drink**

Vetiver Systems for Other Uses
Fragrance

Fragrance

- Vetiver roots contain essential oil, thus can be used to produce various aromatic products
- Natives of many countries where vetiver grows produce traditional fragrant products from vetiver such as potpourri, soap, hair pomade, volatile oil for skin treatment, etc.

Flavor

- In India, vetiver essence is used to flavor a soft drink *(Sharbat),* syrup, and ice cream

The Vetiver System
Applications for Kuwait

With supplementary irrigation or shallow ground water (brackish water?)

Infrastructure stabilization
Rehabilitation of degraded land including oil well heads
Windbreaks
Forage and mulch
Coastal stabilization
Municipal waste clean up

Without supplementary irrigation

Sewage treatment (urban and rural)
Wildlife habitat improvement in wetland areas

Acknowledgements

The Vetiver Network thanks in particular Paul Truong for providing many of the images, and the many other users of vetiver grass around the world.