
LAKE NAIVASHA
A Lake in Trouble
A Possible Solution?
Naivasha
A 104
Old Naivasha Rd
Kongoni
© 2009 Google
Image © 2009 DigitalGlobe
Image © 2009 TerraMetrics
Image © 2009 GeoEye
2009 Google

THE PROBLEM

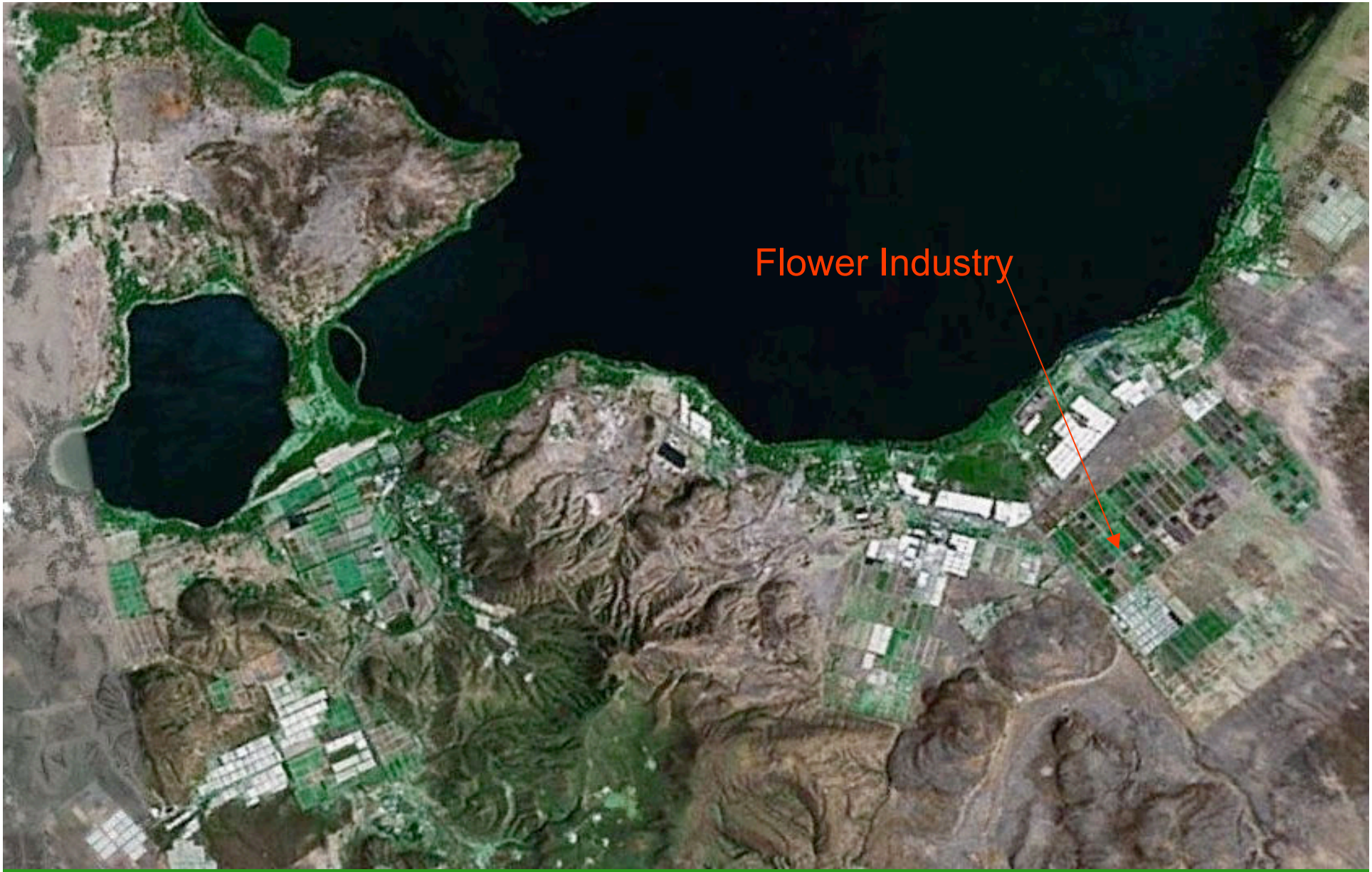
Significant and dangerous reduction in the size of the Lake Naivasha water body and serious degradation of water quality caused by:

1. Large quantities of sediment inflow from Malewa and Gilgil Rivers.
2. Reduced water inflows in low rainfall years.
3. Polluting inflows from Naivasha town and intensive flower enterprises adjacent to Lake. These pollutants include high levels of phosphates, nitrates, and pesticide residues, and other agro-chemicals.
4. Increased water extraction through uncontrolled licensing.

This presentation focuses on items 1, 2 and 3

Northern shore of Lake Naivasha. From Left to right: Vetiver hedgerows on Loldia farm, Gilgil river flood plain, Malewa Flood plain and delta. Serious sediment inflows to Lake Naivasha derive from catchments of the Malewa and Gilgil Rivers

Approximate farmed catchment area of Malewa (160,000 ha) and Gilgil (60,000 ha) rivers that drain the western Aberdare mountains. The upper catchments comprise some of the most intensive and high density small farms in Kenya.



South west Lake Naivasha - intensive flower industry. These businesses discharge agrochemical effluent into the Lake either through drainage water or through storm water discharge.

East end of Lake Naivasha near Crescent Island showing eutrophic bloom and silt effect on lake water. Crescent Island Lake is clean. On-land effluent discharge to lake is from intensive high input farms and nearby Lake Naivasha township.

THE VETIVER SYSTEM COULD BE AN IMPORTANT COMPONENT OF THE TECHNICAL SOLUTION

1. The Vetiver System (VS) would:
2. Reduce flooding by slowing down rainfall runoff in Malewa and Gilgil river catchment area
3. Reduce erosion in the catchment area
4. Trap sediment on lakeshore floodplains
5. Reduce chemical pollutant inflow from flower industry, high input agriculture, and Naivasha town
6. Improve groundwater and related ground water inflows to rivers and streams

WHAT IS THE VETIVER SYSTEM?

The Vetiver System:

1. Vetiver grass (*Chrysopogon zizanioides*), planted as a dense long-living hedgerow across the land slope.
2. The grass has deep (4m) roots that have a tensile strength of mild steel (75 MPa).
3. The hedge row will trap as much as 90% of the silt in rainfall runoff and will reduce run off by as much as 70%.
4. Because of its deep and penetrating roots this saved runoff recharges groundwater. The latter will be released to improve the flow of streams and rivers throughout the year.
5. The grass is drought proof and is NON invasive.
6. The plant will remain in place for decades
7. The plant is already growing in the Naivasha area and has been in Kenya for at least 80 years. Some growers are multiplying it in nurseries. Multiplication is quick and easy.

Right: 6 year old Vetiver grass on Loldia farm, north shore, Lake Naivasha. This Vetiver was not planted correctly (too far apart) - no hedge formation and on existing contour bunds, and is consequently far less effective, as it does not create a filtration barrier

Left: Vetiver grass in Ethiopia - same genotype as Kenya Vetiver - grown at 1700m asl

SILT INFLOW REDUCTION TO LAKE
River catchment areas

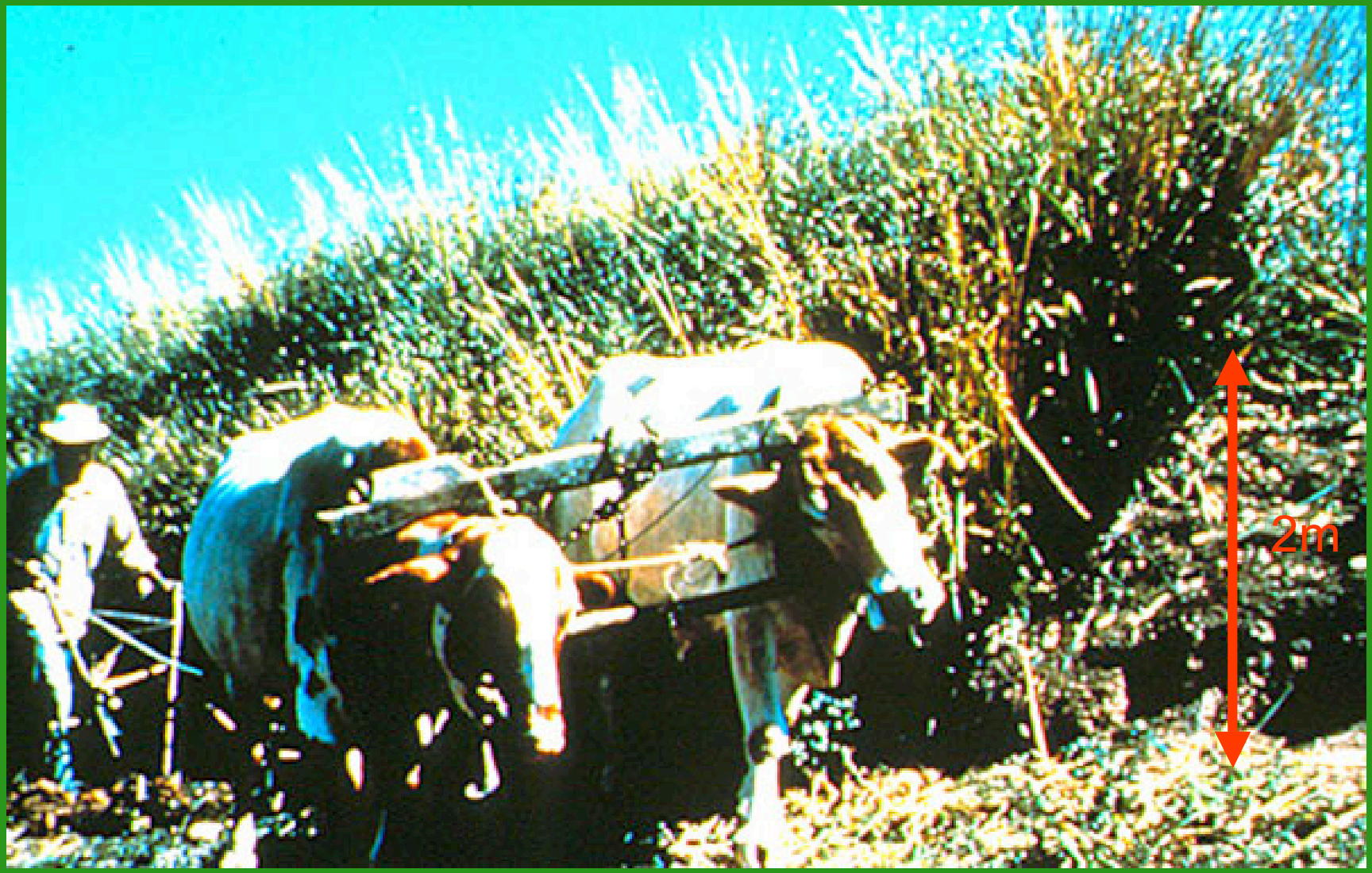
VS would be used to systematically:

Stabilize upstream eroding catchment areas of Malewa and Gilgil rivers (applied to farm land and to point source high sediment producing areas such as river banks, gullies, and road sides).

Note: Vetiver hedgerows are a total substitute for farm contour bunds (fanya-ju). In Ethiopia farmers using VS have increased crop yields by 30-50%. Initially Vetiver was used to stabilize existing terraces. However the preferred and most method is to create hedgerows directly on farm land without initial terracing. Saves labor, reduces rat problems and is much more effective.

Upper catchment on farm erosion control

5 to 6 year old Vetiver hedgerows in Ethiopia. Some were planted on old terraces; the cut hedge on the left was planted on unterraced land and over the period has created, through trapping erosion sediment, a natural terrace that is 30 cm high (James Owino from Edgerton bottom left). The leaf of the grass is cut for forage, thatch, mulch, fuel, and for handicraft material. Vetiver reduces stem borer in maize. In Mettu district (western Ethiopia, 1700 m asl) more than 20,000 farmers are using the technology.



This 30 year old Vetiver hedgerow in Fiji has trapped enough sediment to create a natural terrace riser that is 2 meter high. The balance of the rainwater runoff that passed through the hedgerow was sediment free.

Vetiver hedgerows from space - western Ethiopia - 8° 7.930'N 35° 32.380'E. Altitude 1,700 m asl. Some of these have been in place for more than 20 years.

Vetiver hedgerows protecting farm land in western Ethiopia. The dissemination of the technology started with an NGO, and then driven by farmer to farmer advice and plant material supply. Note: very little evidence of erosion.. 8° 19.869'N 35° 38.424'E

Catchment flood and gully control

Intensive rainfall runoff can result in serious erosion and gullying. The images to the left show how Vetiver will prevent erosion in upper catchments in Australia, and can repair gullies (above) in Fiji (dark green grass + Vetiver hedgerow.

Catchment point source erosion control

River bank stabilization using Vetiver grass at highly erodible locations - left: Zimbabwe; center: Australia. Road cut and fill are major sources of erosion; right top: Vetiver stabilizing a road cut at Jimma, Ethiopia; right bottom stabilizing fill in China.

Flood-plain erosion control

- In the wet season water from the Malewa and Gilgil rivers flood the “delta” area in the north eastern part Lake Naivasha. This is flat land. The Malewa has a defined river course, but the Gilgil is less well defined.
- One solution would be to establish Vetiver hedgerows across the delta area at about 100 m intervals. If the the hedgerow lines were first established with a bulldozer to flatten the line and then planted (possible by machine) with Vetiver, very effective barriers could be established. Wildlife could move through the hedge rows but would not destroy them. Considerable silt deposits could be expected behind the hedgerows.
- This is demonstrated through the following slides of Vetiver hedges on the black soils of the Queensland’s Darling Downs that can be subjected to major flooding

VS for Flood Plains

Left: Gilgil River Flood plain adjoining “Loldia Farm”. Right: a part of the Darling Downs laid out with Vetiver hedgerows

Top left: Vetiver Hedgerow on black cracking soils of the Darling Downs. Bottom left: 50 cm water flooded this area, depositing large amounts of sediment behind hedgerows. The Vetiver did not collapse from the pressure of water, and will continue to grow under flooded conditions. Top right: planting Vetiver with vegetable planter. It also recovers very quickly after fire.

Upper Catchment Ground Water Recharge

In Ethiopia it has been well demonstrated that Vetiver hedgerows will increase the recharge of ground water and will provide the means for the restoration of wetlands. Restored wetlands act as a sponge for the slow release of water downstream thus improving stream flow.

Ground water recharge

1. Improved Spring Flow

This 500 ha farm in Ethiopia was fully protected with Vetiver hedgerows (left), resulting in much higher crop yields and (above right) an annual permanent flow of potable spring water where there was none before the Vetiver application

Ground water recharge 2. Wetland Restoration

In Ethiopia, under a similar climate as the Mau forest area, extensive areas of farm land have been protected with Vetiver hedgerows (top left). These hedgerows, in some cases halted erosion and runoff entirely, resulting in substantial crop yields due to improved soil moisture, better soil fertility (the latter - reduced loss of fertilizer, and improved soil structure, organic matter, and nutrients though mulching with Vetiver. An unintended benefit was the restoration of adjacent wetlands (top right). Before VS was used this area was dry and used for football games. Now it has been restored by groundwater. You can see bodies of water. Wild life (migrating birds) have returned, and substantial forage sources are now available. Today the Ethiopian Wetland Society is a major promoter of the Vetiver System

Pollution Control

Research and full scale applications of VS for pollution control has been demonstrated in Australia, China, and Thailand. When correctly designed and applied VS can be used to stabilize and prevent pollutant flows from landfills, sewage works, and from industrial and agricultural effluent discharge

Pollution Control

Vetiver hedgerows if planted as constructed wetlands will:

1. Reduce phosphate and nitrates in effluent by over 90% meeting environmental code and standards.
2. Remove most agrichemicals such as herbicides and pesticides.
3. Remove high levels of heavy metals such as lead, arsenic, copper etc, and will hold the metal in its root system (except for lead that is translocated to the leaves.

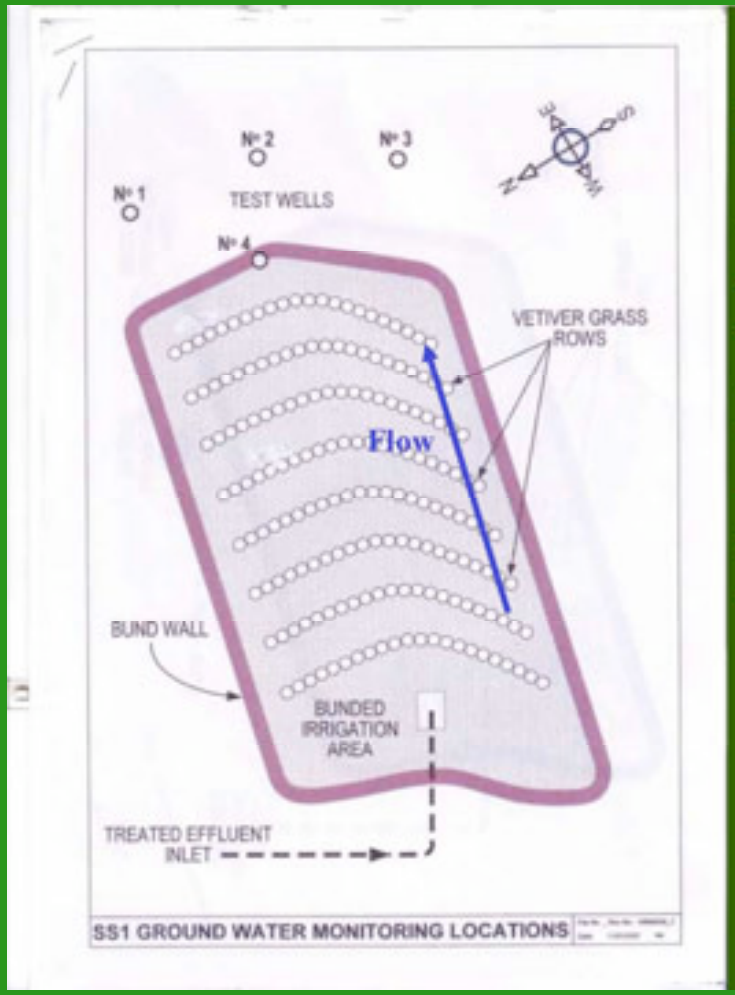
Pollution Control

In the Lake Naivasha area VS could be used to:

1. Stabilize and prevent seepage from Naivasha town landfill
2. Remove nitrates, phosphates and heavy metals from Naivasha town sewage plant effluent, effluent and seepage from private sewage and effluent disposal sites that are normally wet, smelly and act as a health hazard.
3. Remove surplus agrochemicals discharged from flower enterprises.

If applied to the above the discharge of pollutants into the Lake would be greatly reduced.

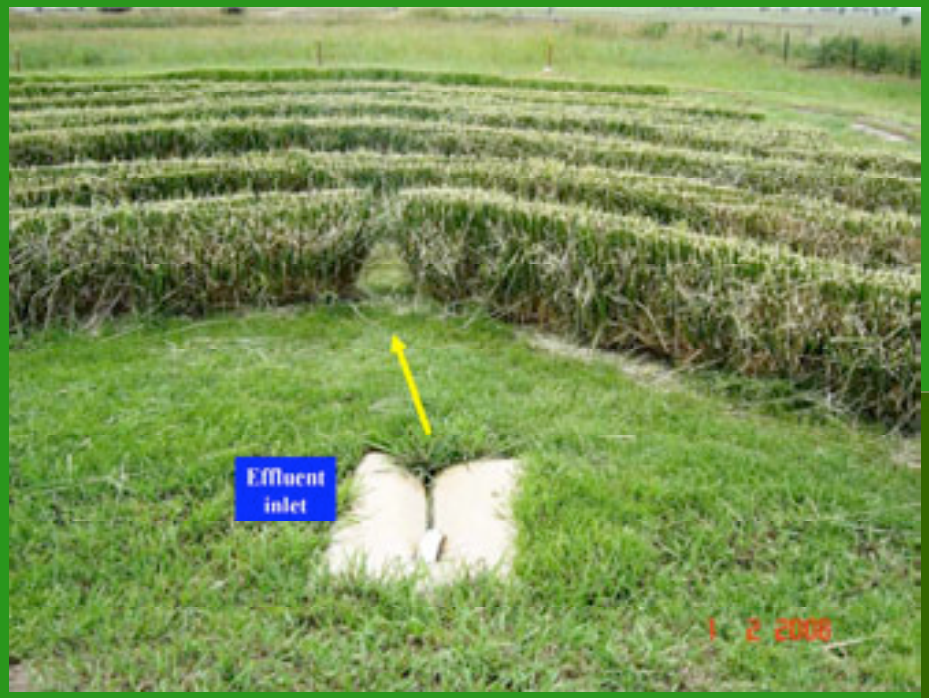
Design for a small Vetiver wetland to process 1,600 liters per day, can be scaled up for 1 million liters per day



Planting Design

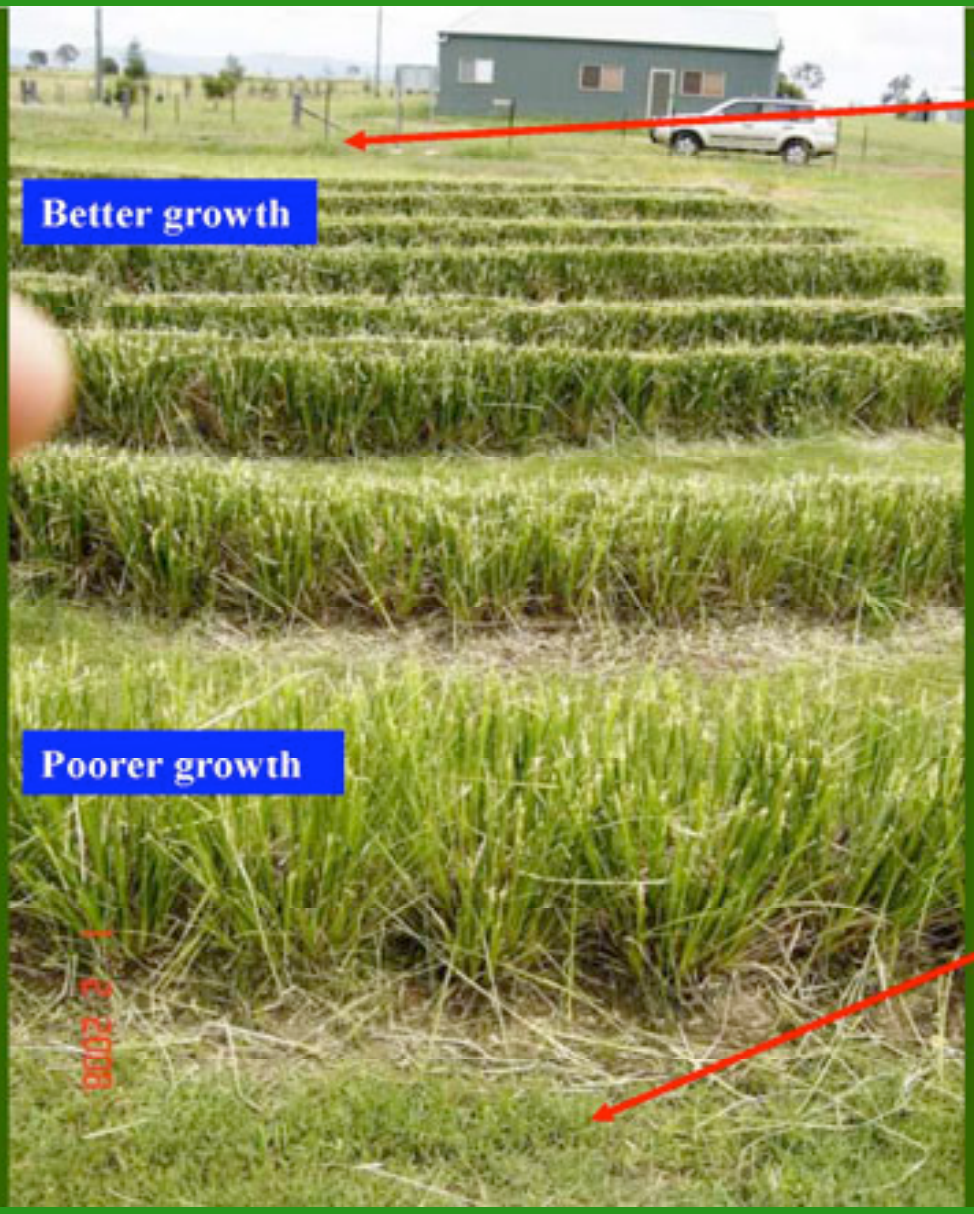
- 8 rows of vetiver
- 10m long each
- Inter-row spacing 1m
- Plant spacing 5 plants/ m
- Total plants 400
- Gravel trench 60cm deep
- Land area 100 sqm
- Bund wall W54 X H30cm

Actual establishment of wetland using VS



Properly maintained, note no weed in or between hedges

Pollution control - Results



INPUT

Average daily flow: 1 670L

Average total N: 68mg/L

Average total P: 10.6mg/L

Average Faecal Coliform:>8 000

SUMMARY

OUTPUT

Average daily flow: Almost Nil*

Average total N: 0.095mg/L

Average total P: 0.138mg/L

Average Faecal Coliform:<10

* Only flow after heavy rain

Control of agricultural chemicals

This Vetiver hedgerow established on the bank of a drain (Queensland, Australia) on acid sulphate soils (1) protected the bank from erosion (compare with unprotected left side of drain) and (2) reduced significantly the movement of agrochemicals from the adjacent sugar cane field. Note the sediment (that carries the agrochemicals) trapped behind the hedgerow. This is a young hedgerow less than 1 year old. This system could be applied to Naivasha flower farms (and also sugar cane farms in Nyanza). All farms bordering or in the vicinity of the lake should plant Vetiver hedgerows across their farms, particularly along the lower boundary.

Is this solution possible? YES

It is possible if:

1. Government, NGOs, Private Sector, and farmers, together with their associated communities, can commit to an effective policy and strategy.
2. Effective training of technical staff and users is undertaken.
3. The economic incentive to use the technology is properly identified.
4. Vetiver plant material is created by area farmers.
5. The technology is correctly applied.

FURTHER INFORMATION

Additional information including technical and research papers and images are available free at: http://www.Vetiver.org

Specific information about the Ethiopian experience is at:

http://www.Vetiver.org/ETH_WORKSHOP_09/ETH-OO%20Proceedings.htm

This PowerPoint was prepared by the Vetiver Network International as an example of how Lake Naivasha problems might dealt with. The proposed solutions have a much wider impact and implication for many other parts of Kenya.

December 20 2009