

EMBEDDING VETIVER GRASS TECHNOLOGY INTO FARM SYSTEMS AT VARIOUS SCALES UNDER “TROPICAL” and “SEMI-ARID” CONDITIONS

Over 20,000 farmers planted vetiver hedgerows in the Mettu area of western Ethiopia resulting in significant reduction in soil loss, increased and sustainable crop yields, and reduced conservation maintenance costs

- Yield increase 30-50%
- Soil Loss reduction 18T/ha to 3T/ha/yr
- Rainfall runoff reduction 70%
- Adjacent wetlands recharged
- Pest control
- Forage
- Thatch

6,000 plants/linear km

2020



Debela Dinka

THE BEST SMALL FARM VETIVER SWC PROJECT THAT I KNOW OF.



Some of these hedgerows were planted in 1990 – organized by an NGO with support of a \$10,000 grant from the Vetiver Network. At least 30,000 ha protected. Expansion - Farmer to Farmer and continues.

DICK GRIMSHAW & JIM SMYLE -- TVNI



WHY EMBED VETIVER??

#1 -- INCREASE SOIL MOISTURE

- REDUCE SOIL LOSS
- INCREASE SOIL ORGANIC MATTER
- IMPROVE SOIL HEALTH
- INCREASE NET FARM INCOME

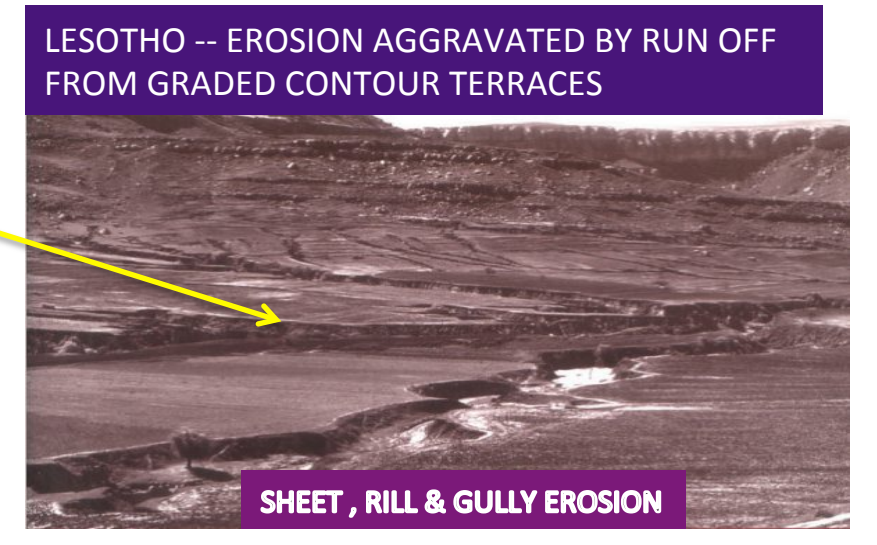
GET IT RIGHT ON THE FARM -- THEN

DOWN STREAM --- ALL SPECIES (INCLUDING HUMANS)
WILL BENEFIT FROM REDUCED SEDIMENT, REDUCED
CHEMICALS, CLEANER AND MORE WATER



LOSS OF SOIL AND WATER ON **SLOPING** LANDS

A FARM THAT LOSES SOIL IS LOSING WATER!!



EXTREME SOIL EROSION ON FARMS AND RAINFALL CAUSED BY COMMUNITY/PUBLIC INFRASTRUCTURE



OFTEN CAUSED BY
RAINFALL RUNOFF
FROM ADJACENT
ROADS



LOSS OF SOIL AND RAINFALL OCCURS ON **FLAT** LANDS



FAILED CONVENTIONAL UNMAINTAINED GRADED BUNDS



FAILED CONVENTIONAL UNMAINTAINED GRADED BUNDS

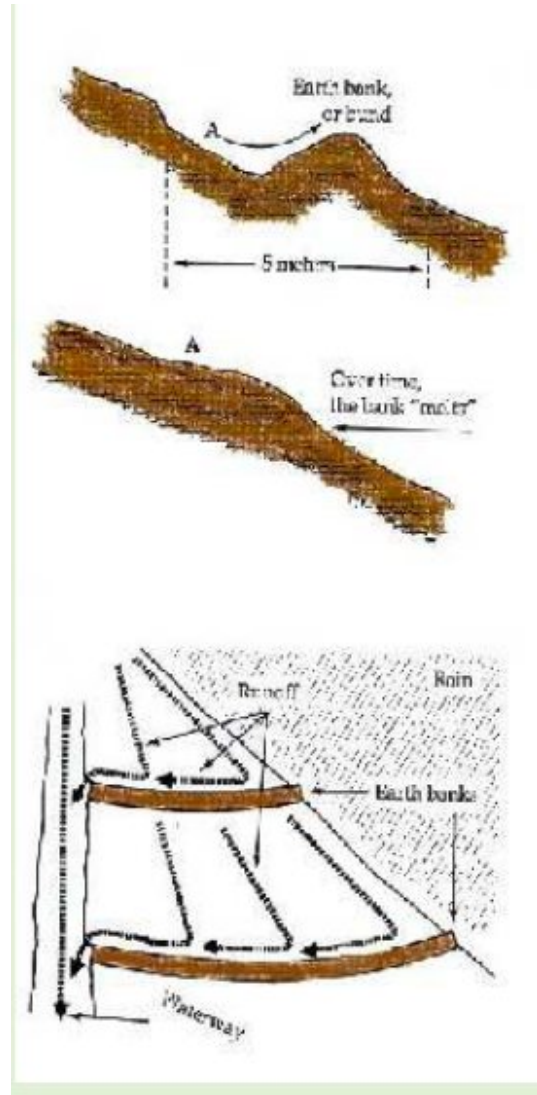


GRADED TERRACES AND SMALL WATERWAYS CAN RESULT IN GULLYING

HARD ENGINEERED SWC TECHNOLOGIES



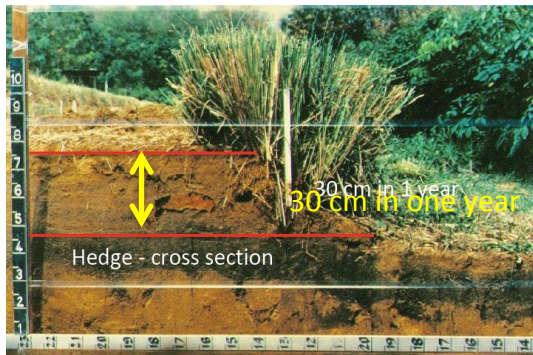
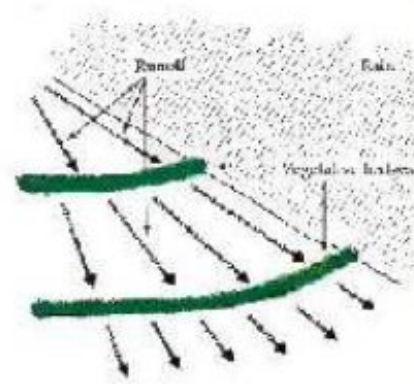
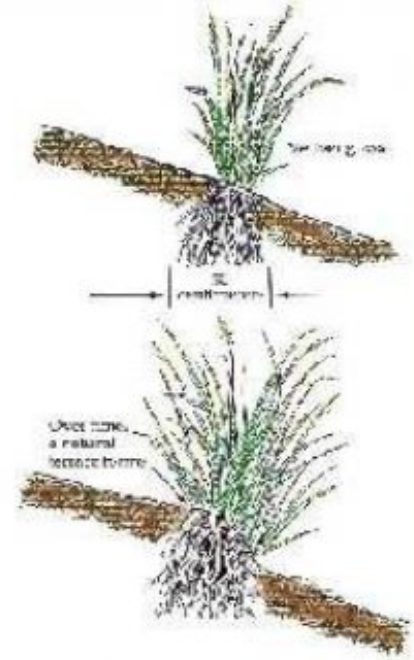
- ARE EXPENSIVE TO CONSTRUCT
- ARE EXPENSIVE TO MAINTAIN
- OFTEN FAIL, ESPECIALLY IN EXTREME RAINFALL EVENTS
- TAKE UP SPACE
- DIVERT PRECIOUS RAINFALL OFF CROP FIELDS
- CREATE GULLIES DUE TO LACK OF WATERWAY AREA
- HAVE NO ADD ON BENEFITS



VETIVER GRASS - SOFT – SMART SWC – A NATURE BASED SOLUTION



- LOW MAINTENANCE AND CONSTRUCTION COSTS
- RARELY EXHIBIT FAILURE
- MINIMUM SPACE REQUIREMENT
- DO NOT DIVERT RAINFALL RUNOFF
- HEAL GULLIES
- HAVE MANY ADD ON BENEFITS



ERODED SEDIMENT & WATER IS SPREAD
EVENLY BEHIND HEDGEROW – RUNOFF
VELOCITY REDUCED TO NEAR ZERO AT
HEDGEROW



CLIMATE SMART FARMING USING NATURE BASED SOLUTIONS

VETIVER GRASS TECHNOLOGY **SIX BASIC MODES** OF APPLICATION

1. AS A SWC SYSTEM FOR **TOTAL FARM PROTECTION** WITHIN WHICH OTHER CULTURAL/MANAGEMENT PRACTICES CAN BE APPLIED.
2. AS AN **ADHOC HEDGE INSERTION** TO EXISTING CROP MANAGEMENT PRACTICES FOR SWC
3. **VETIVER PLANT(S) INSERTIONS** IN VARIOUS CONFIGURATIONS TO ENHANCE CROP PERFORMANCE BASED ON A SPECIFIC VETIVER CHARACTERISTIC
4. **BIOENGINEERING APPLICATIONS** TO SUPPORT FARM INFRASTRUCTURE AND GENERAL ENHANCEMENT OF FARM ECOSYSTEM
5. **MITIGATE NON CROP POLLUTION** ASSOCIATED WITH FARM ACTIVITIES
6. **SPECIFIC NON CROP** RELATED VETIVER BUSINESS ACTIVITIES



1. A SWC SYSTEM FOR THE **TOTAL FARM PROTECTION** WITHIN WHICH OTHER CULTURAL/MANAGEMENT PRACTICES CAN BE APPLIED.

A LONG LIVING * VETIVER HEDGE CAN:

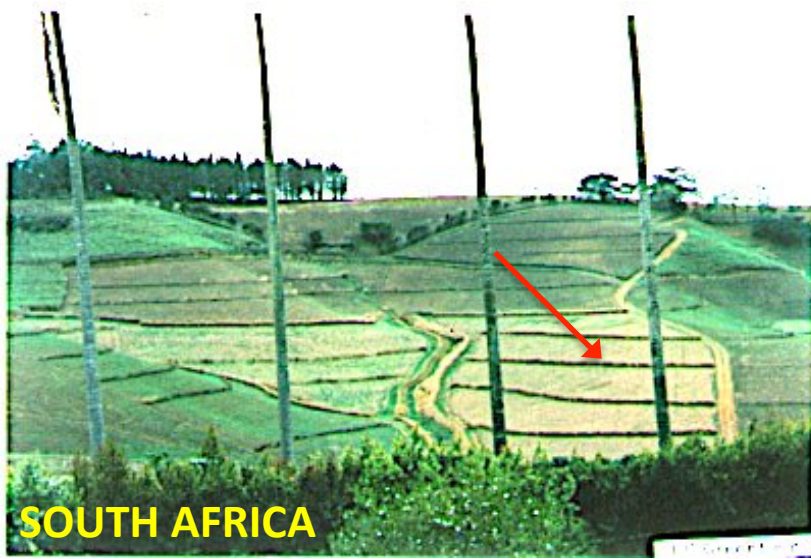
1. **REDUCE RAINFALL LOSSES** (RUNOFF REDUCTION UP TO 70%)
2. **SPREADS WATER RUNOFF** BEHIND THE HEDGE
3. INCREASE **SOIL MOISTURE** TO ENHANCE PLANT GROWTH AND IN TIMES OF **DROUGHT** INCREASES CROP TIME TO WILTING
4. IMPROVE **INFILTRATION** AT AND BETWEEN HEDGEROWS
5. INCREASE **GROUND WATER RECHARGE** , ENHANCE WATER TABLES AND REHABILITATE FARM RELATED WETLANDS
6. REDUCE **EROSION** AND SOIL (BY UP TO 90%).
7. CREATE **NATURAL TERRACES** > SLOPE DECREASES > EROSION DECREASES
8. **PROVIDE A PERMANENT KEY LINE** FOR CONTOUR CULTIVATION AND CROP MANAGEMENT PRACTICES
9. **REHABILITATE DEGRADED** FARM LAND
10. **UNDER EXTREME RAINFALL EVENTS PERFORM SIGNIFICANTLY BETTER THAN ALTERNATIVE TECHNOLOGIES**



*Minimum of 20 + years if maintained



VGT APPLICATION – TOTAL FARM PROTECTION – SWC – SLOPING LANDS



VGT APPLICATION - TOTAL FARM PROTECTION - SWC – SLOPING LANDS – FLAT LANDS

BLACK CRACKING AND ERODIBLE VERTISOLS



FOR LARGE SCALE PLANTINGS – MECHANICAL DEVICES



Left: machine planting; below:
machine digging of nursery
propagated plants.
AUSTRALIA

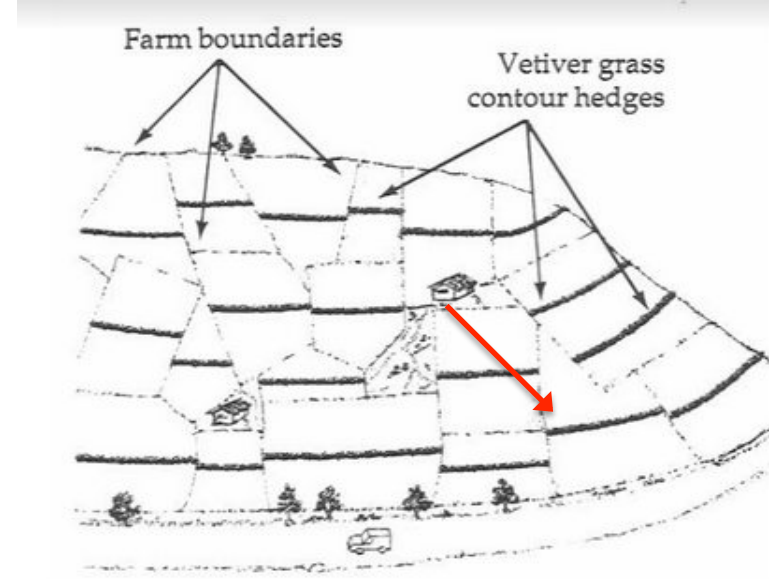




2. AS AN **ADHOC HEDGE INSERTION** TO EXISTING CROP
MANAGEMENT PRACTICES FOR SWC



ADHOC HEDGE INSERTION FOR FARM PROTECTION



VETIVER HEDGES CAN FIT ANYWHERE WITH NO NEGATIVE EFFECT DOWN SLOPE



VGT -- ADHOC HEDGE INSERTION FOR FARM PROTECTION



INCREASES SOIL MOISTURE



Dune invasion of banana plantation (Les Niayes, Senegal)



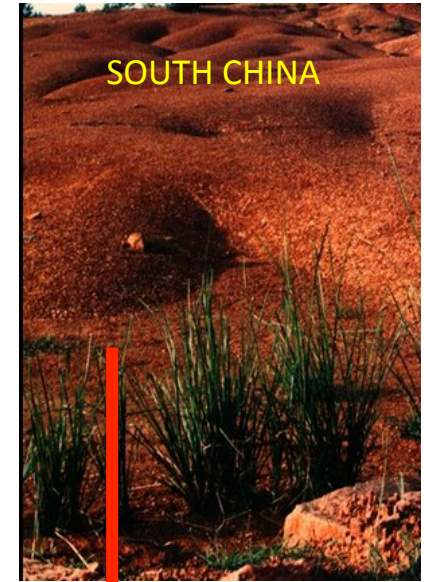
Left: Before. Note condition of banana



Dune stabilized with one vetiver hedge



MANY FARMS HAVE DEGRADED LAND – CAN BE REHABBED WITH VETIVER



LAND REHAB – BEFORE AND AFTER (ABOUT 6-8 years)



3. VETIVER PLANT(S) **INSERTIONS** IN VARIOUS CONFIGURATIONS TO ENHANCE CROP PERFORMANCE BASED ON A **SPECIFIC** VETIVER CHARACTERISTIC(S) AND FARM **NEEDS**

- **MULCH: SOM – SOC - SOIL MOISTURE – SOIL TEMPERATURE**
- **SOIL NUTRIENT RECYCLING - - SOIL HEALTH – ARBUSCULAR MYCORRIZA**
- **IMPROVED SOIL MICRO FLORA/FAUNA**
- **SYMBIOTIC PLANTING WITH INDIVIDUAL PLANT**
- **HABITAT FOR BENEFICIAL INSECTS & FAUNA**
- **PEST CONTROL – STEM BORER RICE and MAIZE +++**
- **TOXIC CHEM REMOVAL - ARBUSCULAR MYCORRIZA - 90% STORED IN ROOTS**
- **BARRIER TO EXTERNAL TOXIC SOIL CHEMICALS (++ ORGANIC FARMING CERT?)**
- **ENHANCES BIODIVERSITY – PARTICULARLY IN “WINTER MONTHS” WHEN LAND IS BARE**
- **FORAGE**



WITH AND WITH OUT VETIVER – NUTRIENT and MOISTURE ENHANCEMENT



!4 month with Vetiver



14m. Mene 80
14 month without vetiver



without vetiver – no banana fruit



with vetiver – planted at the same time as above – fruited two months earlier – improved soil moisture



A TAMARIND TREE

Below: Tree of the same age, without help from vetiver.

Above: One year old Tamarind, circled with vetiver (Chiang Rai Research Station, Thailand). Arbuscular mycorrhizal activity, associated with vetiver roots, results in better soil nutrient translocation at depth. The latter combined with improved soil moisture and more soil micro-fauna activity results in better tree growth



Planted in association with vetiver:

- Arbuscular mycorrhiza cycles NPK
- Improved soil moisture
- Greater micro fauna activity
- Possible reduced pests (nematodes)
- Soil temperature reduction



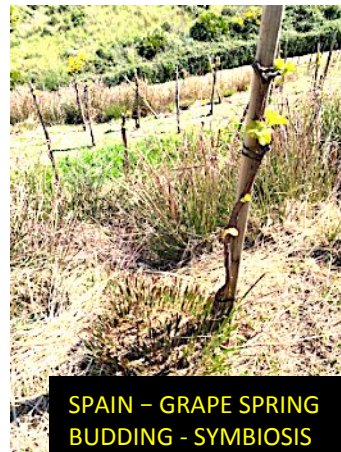
IN-SITU MULCH – INCREASED: SOIL ORGANIC MATTER & SOIL MOISTURE.

- REDUCED: SOIL EROSION, SOIL TEMPERATURES, PEST DAMAGE

NOTE: THE STEEPER THE SLOPE - THE CLOSER THE HEDGES - THE GREATER AMOUNT OF MULCH MASS



VGT – IMPROVED SOIL MOISTURE, PEST CONTROL



CUT AND DROP MULCH



VETIVER CAN BE THE PRIMARY LAYER AND INITIAL "DRIVER" OF FOOD FORESTS



INSITU MULCH



VANYA FARMS INDIA

FOOD FOREST _ VETIVER CRITICAL ELEMENT



IMPROVED SOIL ORGANIC MATTER



VETIVER SYMBIOSIS



BIRD'S NEST



START OF A FOOD FOREST



VETIVER CAN CONTROL SOME PESTS

DEAD END TRAP CROP:

- STEM BORER OF MAIZE AND SORGHUM (*Chilo partellus*)
- STEM BORER OF RICE – Pink (*Sesamia inferens*) and Striped stem borer (*Chilo suppressalis*)
- STEM BORER OF SUGAR CANE? Anecdotal
- FALL ARMYWORM – attracts but not preferential over maize



CHINA RICE STEM BORER CONTROL

HOSTS BENEFICIAL INSECTS:

- PARASITIC WASPS
- LADY BIRDS
- SPIDERS

OTHER PESTS

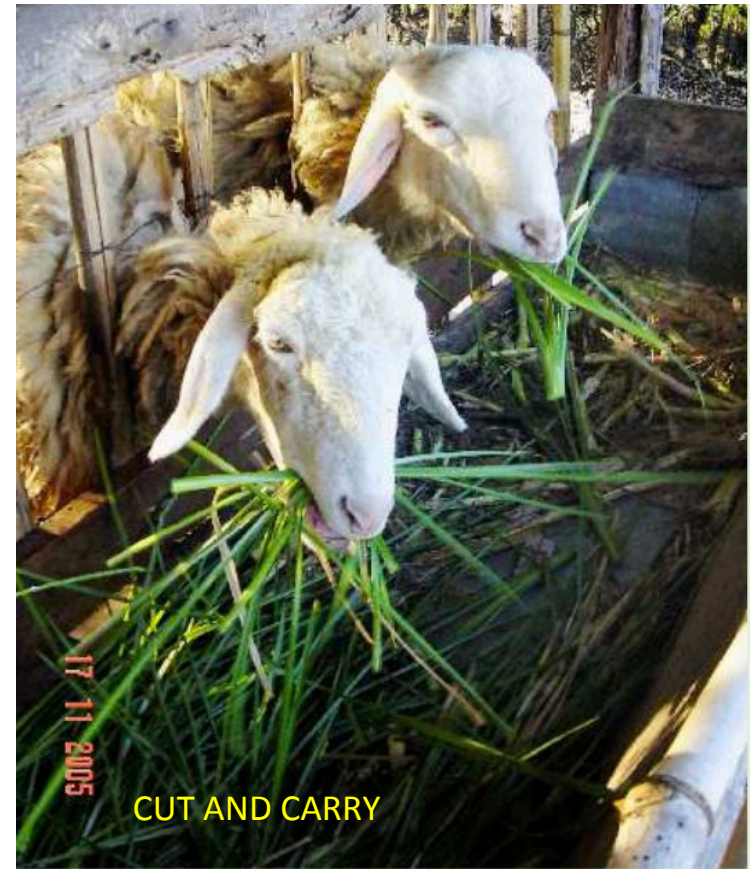
- VETIVER DETERS APPEARS TO DETER NEMATODES AND TERMITES
- WHITE FLY ON BRASSICAS



SOUTH AFRICA/ETHIOPIA STEM BORER CONTROL

GENERAL OBSERVATION – CROPS / VEGETABLES IN THE VICINITY OF VETIVER NEARLY ALWAYS LOOK “CLEAN” DO NOT NEED A CONTINUOUS HEDGE (3x25 m)





Vetiver feed values compared to other forage grasses

Analytes	Units	Vetiver grass			Rhodes	Kikuyu
		Young	Mature	Old	Mature	Mature
Energy (Ruminant)	kCal/kg	522	706	969	563	391
Digestibility	%	51	50	-	44	47
Protein	%	13.1	7.93	6.66	9.89	17.9
Fat	%	3.05	1.30	1.40	1.11	2.56
Calcium	%	0.33	0.24	0.31	0.35	0.33
Magnesium	%	0.19	0.13	0.16	0.13	0.19
Sodium	%	0.12	0.16	0.14	0.16	0.11
Potassium	%	1.51	1.36	1.48	1.61	2.84
Phosphorus	%	0.12	0.06	0.10	0.11	0.43
Iron	mg/kg	186	99	81.40	110	109
Copper	mg/kg	16.5	4.0	10.90	7.23	4.51
Manganese	mg/kg	637	532	348	326	52.4
Zinc	mg/kg	26.5	17.5	27.80	40.3	34.1

VETIVER AS FORAGE

NEEDS TO BE PROPERLY MANAGED THROUGH
REGULAR CUTTING OR GRAZING

DROUGHT TOLERANT MAINTENANCE FODDER



STREAM BANK BUFFERS REDUCES POLLUTANTS MOVING DOWN STREAM



FARM/FIELD VETIVER BOUNDARY HEDGES ALSO STOPS POLLUTION FROM NEIGHBORS ENTERING LAND



VETIVER REMOVES TOXIC AGRO CHEMICALS FROM WATER MOVING OFF FARM FIELDS

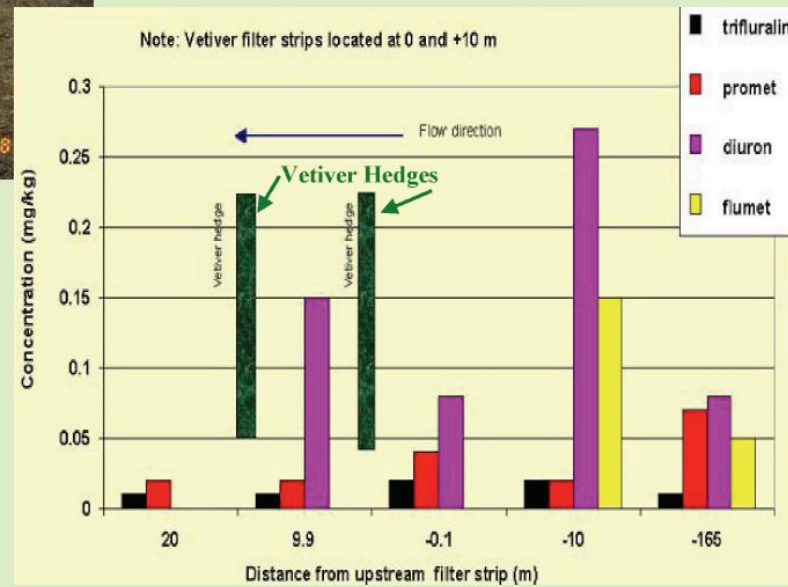
EVERY VETIVER PLANT CAN TAKE UP EXCESS N&P, PESTICIDES, & HEAVY METALS

PLANTING VETIVER HEDGEROWS ON FIELD BOUNDARIES, DRAIN BANKS, AND STREAM BANKS, WILL HELP MAINTAIN
“ORGANIC” CERTIFICATION



Above: Drain associated hedgerows are effective in trapping sediment. **Right:** reduction in herbicide concentration when drainage water passes through vetiver filter hedges.

Vetiver hedges will trap and reduce toxic agric chemicals from runoff – sediment.



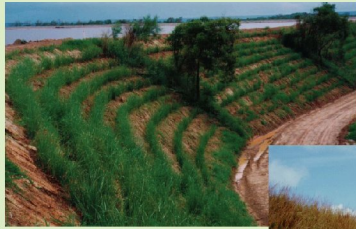
MULCHING WITH VETIVER IMPROVES SOIL ORGANIC MATTER AND SOIL HEALTH



4 - BIOENGINEERING APPLICATIONS TO SUPPORT FARM INFRASTRUCTURE AND GENERAL ENHANCEMENT OF FARM ECOSYSTEM



Farm dam stabilization and protection



Left: 6 months after planting with vetiver.



Right: 1 year after planting with vetiver.



- FARM PONDS
- BUILDING SITES
- DAM WALLS & SPILLWAYS
- ROAD SIDE
- GULLY REHAB
- CANAL BANKS
- RIVER BANKS
- DRAINS

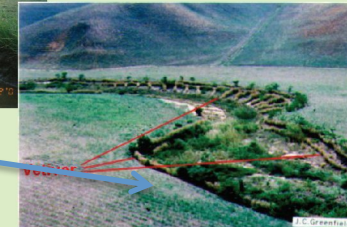
Gully remediation



Top left: typical gully problem on a farm. Above: The fix using vetiver. Bottom left: the result - a stabilized gully



Australia - Queensland



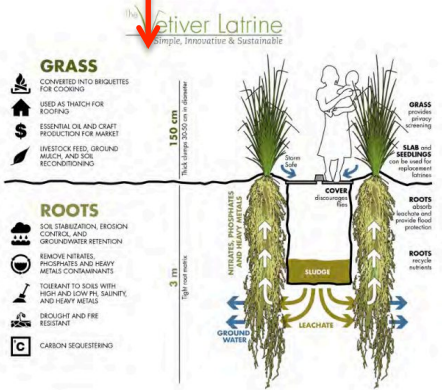
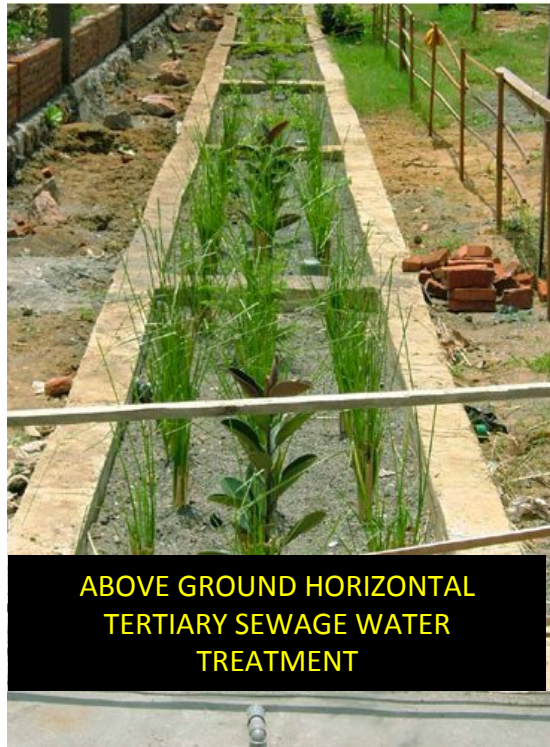
South Africa - Natal



Zimbabwe - Hippo Valley



5 - MITIGATE **NON CROP POLLUTION** ASSOCIATED WITH FARM/DOMESTIC ACTIVITIES



6 - SPECIFIC NON CROP RELATED **VETIVER BUSINESS ACTIVITIES**

- **OFF FARM SALES** OF VETIVER PLANTS
- **BIOENGINEERING APPLICATIONS**
- **CONTRACTOR** FOR OFF FARM APPLICATIONS
- **VETIVER DESIGN** CONSULTANT
- **THATCH** and **THATCHING CONTRACTS**
- **FORAGE**
- **BIOMASS FOR ENERGY**
- **VETIVER OIL** PRODUCTION AND SALES
- **HANDICRAFTS** FROM VETIVER LEAVES AND ROOTS



The Antahova family in the Mangarivotra Village proudly displayed their Vetiver nursery where they reached their target of 110,000 plants.



Getting the Message Out



- Community Driven
- Comprehensive Messaging About VS As A Whole
- Publications/Pamphlets/Social Media
- Training Of Trainers
- Training Of Farmers
- Key “Mother” Nursery (*The Medium Is The Message*)

zoom



Minimum Support Required



- Start up nurseries: Small localized household/community nurseries....central supply opportunity?
- Networks (e.g., WhatsApp-type that allow connection of “champions” with farmers)
- NGOs — to facilitate access to financing, link across communities, integrate into their ongoing NRM initiatives, support capacity development (TOT, training, F2F extension, learning visits, central nursery), organization at higher scales.
- Productive relationship with existing extension services....however good or bad they are

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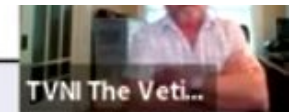
Minimum Support Required



- National platform (e.g., Sustainable Land Use Forum in Ethiopia) to provide support & linkages between institutions and policy makers and communities/end user support systems.
- Technical competency is a **must**. All technical or promotional staff must know what they are talking about.
- Involve Universities/Research Inst. to validate technology (esp., benefit/cost, impacts, systematize experiences, develop technical standards), fine tune & advance innovations developed by users.
- Supportive government policy – at minimum for “soft” solutions, then specifically for VGT in public procurement (requires standards to be fully integrated)



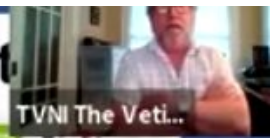
IMPLEMENTING VGT ACROSS SCALES



Unit	Primary Stakeholders / Target Groups	VGT Objectives & Focus
Field <i>Micro-watershed</i>	Farmer (-s)	<ul style="list-style-type: none"> → Soil/water cons., nat. disaster mitigation, climate risk, productivity, mulch, pests, fodder; micro-nursery → Participatory planning; BMPs; site design; demonstration; people's science
Farm <i>Micro-watershed</i>	Farming Household (HH)	<ul style="list-style-type: none"> → All above + infra. protection, H₂O quality, sanitation, handicrafts → Same as above
Farmer Group (FG) <i>Micro-watershed</i>	Farming HH Community-Based Organizations (CBO) C/V Leaders	<ul style="list-style-type: none"> → Lead farmers & demonstrations → Training (F2F) → Group nursery propagation plan
Community / Village (C/V) <i>Micro-watershed or Sub-watershed</i>	Farming HH CBO C/V Leaders M/D Tech Staff	<ul style="list-style-type: none"> → Training of Trainers (TOT) → Community/Village nursery propagation strategy → Promote business opportunities
Municipality / District (M/D) <i>Sub-watershed or Watershed</i>	Farmer & CBO & C/V Leaders M/D & R/P Tech Staff Local Authorities Micro-Credit Inst	<ul style="list-style-type: none"> → Technical guides – manuals, pamphlets, etc. in local languages → Micro-hub – knowledge, networking, planting material, outreach, promotion
Region / Province (R/P) <i>Watershed or Sub-basin</i>	Farmer & CBO & C/V Reps M/D & R/P Tech Staff R/P Authorities Academics, Researchers, NGOs Micro-Credit Inst	<ul style="list-style-type: none"> → Social media (e.g., FB groups, INaturalist) → Enabling/supportive policy (e.g., inclusion in public and NGO/ODA programs, eligible for incentive payments) → Organized field visits for target groups → Focal point (links micro-hubs, facilitates coordination between key stakeholders)
Country <i>River basin, multiple watersheds</i>	Farmer Orgs NGOs Nat'l Authorities Univ. & Research Inst. ODA	<ul style="list-style-type: none"> → Workshops & training events; outreach & promotion → Enabling/supportive policy (participate in policy formulation to incorporate VGT) → Organized field visits for national decision-makers & delegations from outside



https://www.inaturalist.org/projects/vetiver-systems



iNaturalist Search Filter Your Observations Community Identify More

Vetiver Systems

About [View](#) [11](#)

Vetiver is a unique subtropical/tropical bunch grass that is highly tolerant to environmental conditions and used for erosion control, slope stabilization, disaster mitigation, wastewater disposal, and phytoremediation. The most common vetiver species used in bioengineering is the sterile *Chrysopogon zosterifolius*, which has

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Overview **193** OBSERVATIONS **3** SPECIES **26** IDENTIFIERS **83** OBSERVERS **9** Stats

Recent Observations [View All](#)

Vetiver <i>Chrysopogon zosterifolius</i> All	Vetiver <i>Chrysopogon zosterifolius</i> 1 Tag	Vetiver <i>Chrysopogon zosterifolius</i> 1 Tag	Vetiver <i>Chrysopogon zosterifolius</i>

Most Observations	Most Species	Most Observed Species
 thongp 32	 wlvordd 2	 Vetiver 182
 dckgrishaw 32	 dckgrishaw 2	 <i>Chrysopogon zosterifolius</i> 9
 wlvordd 16	 rousling 1	 Australian Vetiver 2



Embedding VGT Under Tropical & Arid Conditions



- Adaptability: 500 mm/yr upwards
- Higher cost to propagate in lower rainfall (ETB 0.17 vs ETB 0.10 per seedling)
- Drier conditions: Recommend containerized seedlings & closer spacing (8 cm) to get hedge closure in 1 year
- Wetter conditions: Bare rooted, 4 tillers/slip at 10 cm spacing to get hedge closure in 1 year
- Drier conditions demand good organization & timing...wetter, too, but more forgiving

zoom

