Poverty Alleviation Using the Vetiver System In Tropical Developing Countries.

Using Vetiver Hedges to Control Runoff and Conserve Moisture, Nutrients and Soil In-situ, will Produce Crops like this in Countries like Ethiopia.

ALLEVIATING POVERTY IN THE THIRD WORLD

THIS IS ALL IT TAKES

There is only one way to make rainfed subsistence farmers capable of producing food and cash crops on a sustainable basis, and that is by controlling runoff, no matter how little or how much, but by controlling runoff using dense vetiver hedges planted across the slope, as seen below. This is all it takes.

A simple vetiver hedge planted across the slope, as shown here, is anchored in to the ground by its massive 3+ m vertical root system. This is all the rainfed farmer needs to control runoff, slow it down, spread it out and prevent the loss of soil and nutrients, at the same time store essential soil moisture under rainfed conditions, for sustainable crop production. This non-invasive hedge of vetiver grass once established will last for decades without any special maintenance. Vetiver grass (*Chrysopogon zizanioides*) is a non-invasive clonal clump grass.

In rice growing areas this hedge planted along the top of the paddy bunds, has several advantages, it takes the power out of floodwater thus preventing lodging of the crop. Once a viable hedge is formed it repels rats and mice due

to the repellent vetiver oil in its roots. On windy days, the hedge prevents "Lap erosion" from breaking down the paddy 'bunds' and losing the essential stored water.

Preparing the Ground:

If we want to alleviate poverty in the developing world, then we must stop measuring the problem and do something about addressing it.

For the past 80 years we have been measuring the problem of erosion, the largest factor in the rural poverty equation. We have even developed an equation for soil loss: "*.....As additional research, experiments, data, and resources become available, research scientists continue to improve USLE, which led to the development of Revised Universal Soil Loss Equation (RUSLE). RUSLE has the same formula as USLE, but has several improvements in determining factors".*

This is an absolute nonsense. A man on a galloping horse can see we have a problem with erosion. We do not need to spend even more money on measuring it, nor on writing an equation for it.

Historically, global development policy and its associated funding has been controlled by well-intentioned men and women, experts in their own field – philanthropists, accountants, lawyers, business people, economists, engineers, medical doctors, and even soldiers. When it comes to allocating money to alleviate poverty, obviously, being professional and business-oriented, they want to do' due diligence' – and measure the problem first!

Over several decades, I have noted that the politicians, the planners and quite often the Heads of the aid agencies, like to have development reports written in long academic prose with lots of formulae, bar charts and scientific data that they can present at yet another conference. The resulting academic papers from these conferences will be filed away, and the scientists will return to their bases with even more new ways to measure poverty, ready for the next conference.

Whatever their expertise, I have yet to work with one who has any useful field experience in agriculture. Years ago, I had a first-hand experience of this working in Viet Nam when the Planning Chief asked me "What is a contour? I am a medical doctor by training and don't understand any of these terms. You people use these terms and you lose my staff completely to the point they

are too embarrassed to even ask questions at the conference".

Yet these same people will go home, and if they want to grow vegetables in their home gardens, know that if they don't water their garden the vegetables will die, no matter what high yielding varieties they planted; no matter how much fertiliser they applied; no matter how much pest control they used or how well they weeded their garden. Without the necessary water plants will die. If they have easy access to a 'hose' at home, to be able water their garden is so commonplace that they are quite convinced it was the fertiliser and seed that gave them a good crop.

Poverty in the developing world is the plight of the rainfed farmers and their extended families throughout the tropics. Get these farmers producing food and cash crops on a sustainable basis and we will be addressing poverty alleviation properly. It is easy to measure a problem, what is difficult is 'fixing' it. After 80 years, we have surely measured enough.

Let's get one thing straight here. There is no such thing as a drought resistant crop. Even drought tolerant is stretching it. We need to control rainfall runoff - simply, economically, sustainably and effectively.

Rain is the only water the rainfed farmer gets, and if he cannot control the runoff from that rainfall he not only loses his only source of water but also faces severe erosion problems, loss of inputs, ultimate loss of his crop which the rain germinated initially but there was insufficient soil moisture to carry the young crop through to the next rains - or the first heavy rains washed his seed and fertiliser down the drainage network.

Efforts have been made to control runoff - with conservation banks; water harvesting; alley cropping; 'keyline' farming on the contour etc., but all these systems require some form of construction, earth moving and costly maintenance, way out of the rainfed farmers' means, and no matter how well constructed these works are, they will eventually break down and be lost as they are all unnatural systems, prone to destruction by natural processes.

With the sole exception of 'keyline' farming, none of these solutions help the rainfed farmer as they divert runoff away from the farm to "prevent erosion". Even 'keyline' farming, which endeavours to control runoff through deep contour cultivation, is a temporary solution, as the keylines will eventually break down over time and fill-in.

This report will describe the Vetiver System; a proven method of alleviating poverty in the developing world through a simple biological system to control

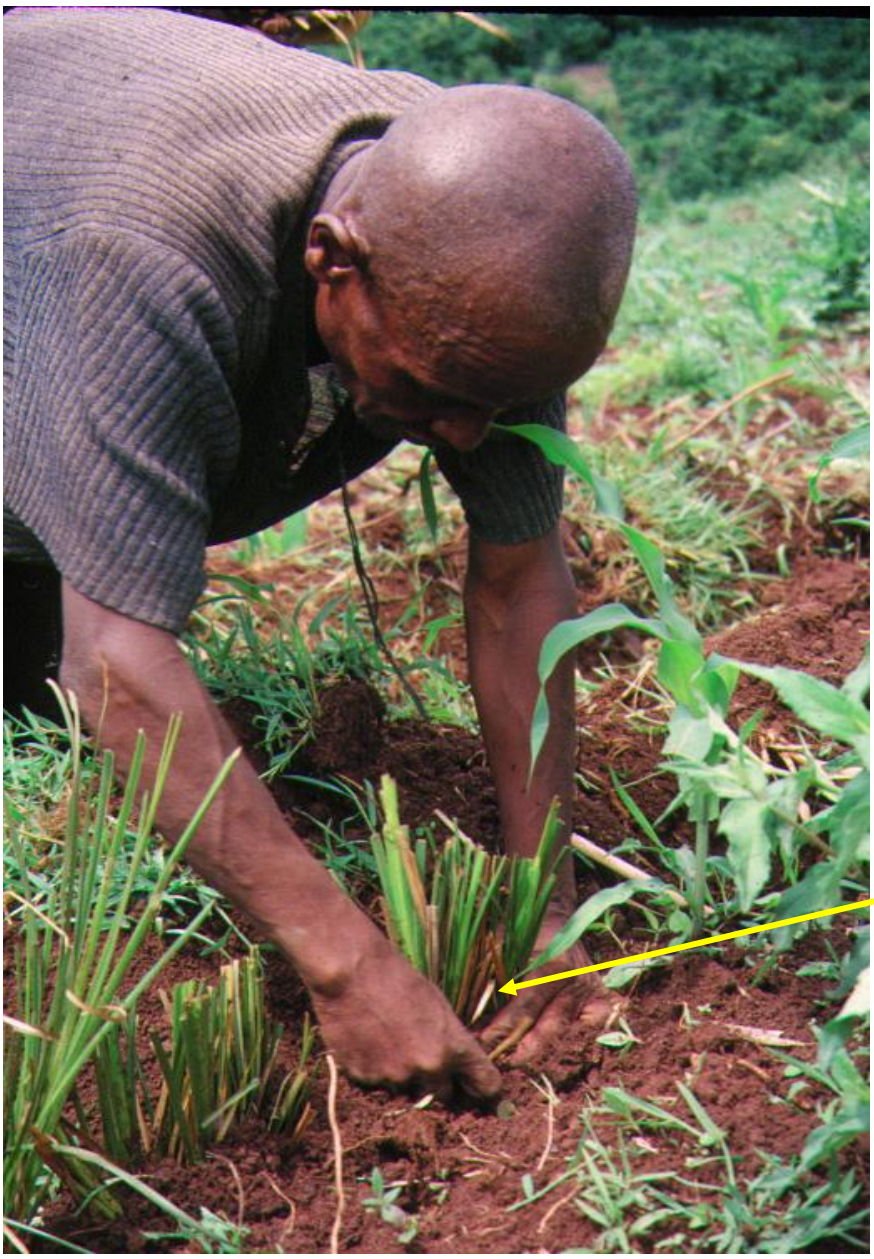
runoff. It is a method every rainfed farmer can afford, which once established needs no maintenance; will last for decades (even centuries as in India), will control runoff, slow it down, spread it out and allow it time to soak into the ground providing the essential soil moisture and retaining the fertilisers for sustainable cropping, at the same time preventing erosion and ultimately building natural stable terraces.

The Vetiver System will also resolve the serious problem facing all rainfed farmers, especially in the tropics, of year-round access to their markets. Often, extreme weather events can lead to roads being blocked by slips or washouts, bridges and culverts being left inaccessible by floods washing out the abutments. These problems can take weeks, even months, to fix, leaving the farmers isolated. Governments are notorious for building infrastructure but not maintaining it. This report will give a link to the Vetiver System for stabilising road cuts and fills, protect bridge abutments from erosion, stabilise all farm tracks to town and offer protection against landslides, even during major hurricanes. Access to markets and the sale of cash crops is the start of a 'virtuous circle' of sustainable progress out of poverty for rainfed farmers and their families.

I have deliberately kept the tone of this report short and simple, hopefully without being patronising, but appreciating that the busy reader who isn't a trained agriculturalist hasn't time to look up the terms we would use in a more scientific approach.

The system we are describing is itself so simple there is absolutely no need to muddy the waters with unnecessary formulae or scientific prose or bar charts. Extensive use is made of photographs, and for those who would like to delve more deeply into the science of the system checkout the vetiver website for hundreds of pages of international scientific research into the merits, benefits and myriad uses of the Vetiver System. www.vetiver.org .

If we can show the subsistence farmers that there is a way both to feed their families and to grow cash crops on a sustainable basis, there may be less of them wanting to leave their land and seek employment in the towns.



THIS IS ALL IT TAKES

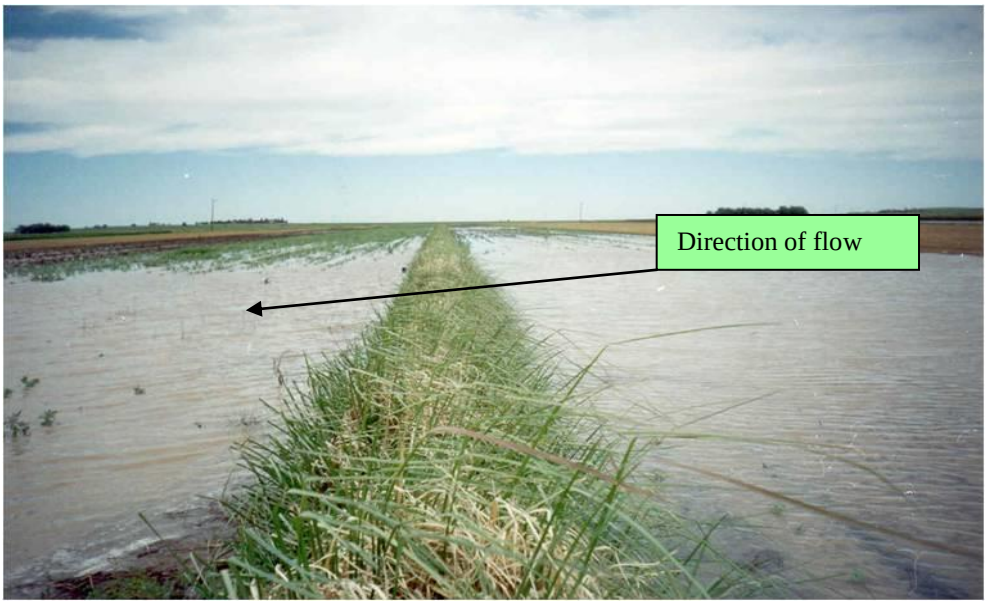
This is all it takes to plant a permanent vetiver hedge across the slope like the one in the second photo above. All that is needed are some planting slips; just the farmer's hands, his machete to cut the slips to size and plant a single line of these slips across the obvious rills in his field, to control runoff.

Any farmer can see the sense of this even if he is a tenant farmer, he is controlling moisture and his fertility to give him a greater yield and more money in his pocket (he couldn't care less about soil conservation, which he

is actually doing subconsciously using this system). No matter which direction a vetiver hedge is planted, with the exception of 'up-and-down' the slope, it controls the speed of runoff.

There is virtually no cost in this system of soil and moisture conservation, you can pull out about 40+ vetiver slips from a single vetiver clump, plant them 20cm apart, straight away or within a week's time and they will survive, especially if planted at the beginning of the wet season.

There is no simpler more 'cost-effective' method of controlling erosion, conserving moisture and nutrients on a sustainable basis than this system.



Severe flooding of a sorghum crop under rainfed conditions in the Darling Downs, Queensland, Australia, was protected by vetiver hedges planted across the slope by Dr. Paul Truong.

Normally this level of flood-flow caused the unprotected crop to ‘lodge’ (collapse) and rot, but this dense vetiver hedge prevented that from happening by withstanding the flood pressure. The vetiver plant can also withstand two months submergence without any ill effects.

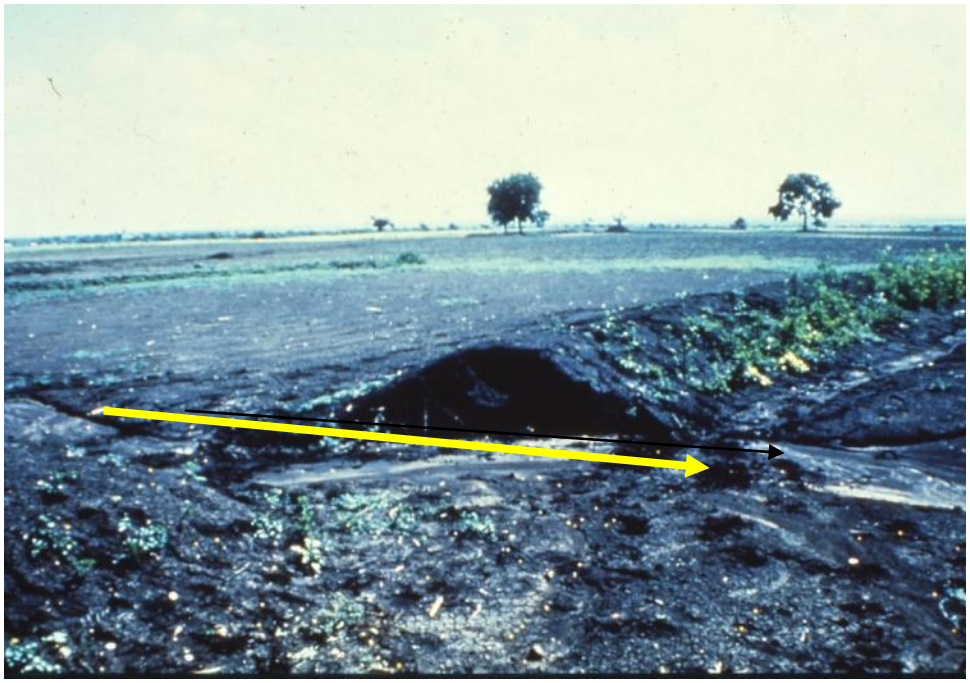
After the flood you can see the silt and nutrient deposition in the low spots of the field behind the hedge, but the young Sorghum plants have not been flattened as the vetiver hedge resisted the flow of the flooding and prevented

lodging. This protection and “self-levelling” is impossible with the African “Fanya Juu” system of terraces, or constructed contour banks. Here the controlled runoff has soaked in to the ground and will support the crop to fruition.

An excellent crop of sorghum was the result, where previously such a flood would have destroyed the entire crop.

Prior to using vetiver hedges to prevent erosion, this farmer had left a 20m wide strip of grass uncultivated, hoping it would reduce the speed of flood flow or prevent erosion leading to lodging and loss of the crop. These 20 m grass strips didn’t work and have now been replaced by a 2 m wide vetiver hedge giving the farmer 20% more land to plant, total protection from erosion and better moisture conservation leading to much higher yields

Fanya Juu terraces in Africa or hand- constructed contour banks are extremely labour intensive, nonsustainable and totally inappropriate for rainfed farming in the tropics. Below, a bank has burst under the pressure of slight flooding. These constructed banks are not anchored to the ground they are constructed on to protect. The Vetiver plant has extremely strong roots that penetrate the soil to a depth of over 3 m + making a breach virtually impossible.



Fanya Juu ("throw the soil up" in Swahili) is a system introduced by the Colonial Government in to East Africa back in the 1930s following the American system of constructed soil conservation, using contour banks; absorption banks; diversion banks and grassed waterways leading to either natural drainage outlets or low dams, to prevent erosion, and hopefully sustain and increase yields , this system is a total failure in the tropics under extreme rainfall conditions, as the banks are easily 'washed out'(breached).

The American system was designed for the Temperate Climate low rainfall areas of the Midwestern States of the USA and Fanya Juu is just a labour intensive copy of that system for East Africa. The construction of contour banks is too labour intensive; they cannot withstand heavy tropical storms or flooding, have high maintenance costs, do not control runoff effectively, conserve very little moisture in the soil eventually break down causing more erosion, and ultimately have to be replaced at great cost at least every five years.

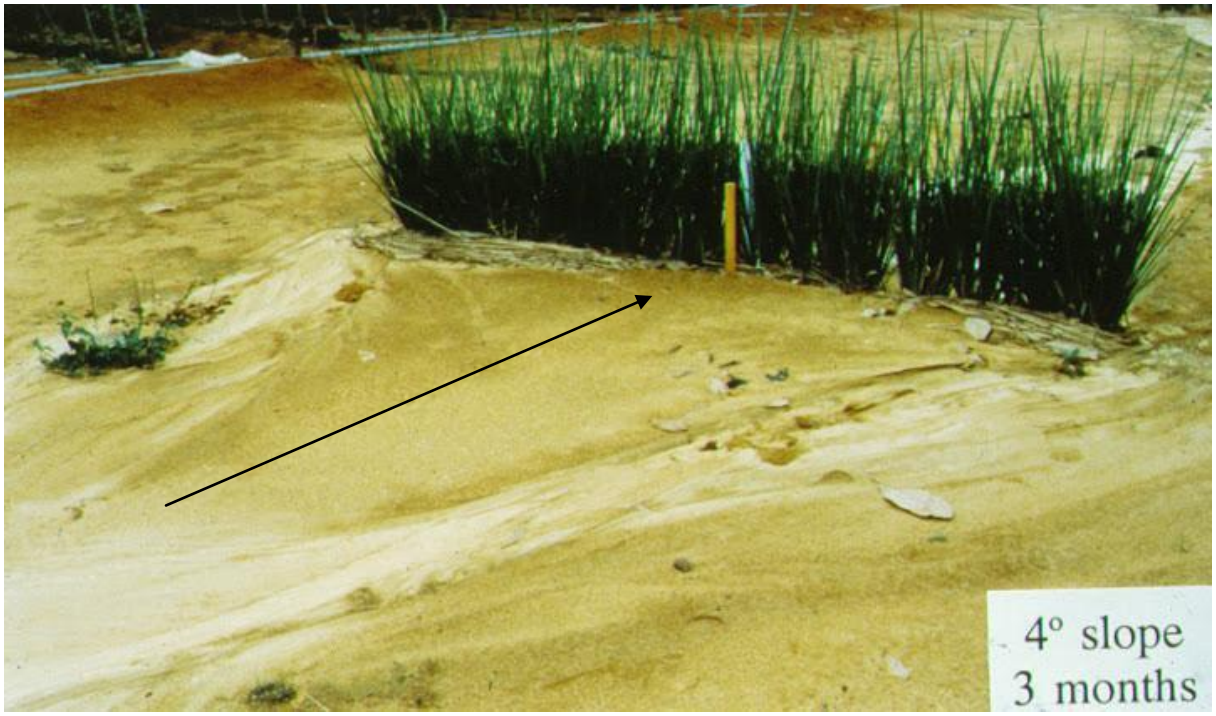
One of the major problems with constructed soil conservation measures is that they are the last thing a rainfed farmer would want on his farm, as they are designed to run the rainfall off the farm to a 'safe' outlet – in other words, the drainage network. The rainfed farmer depends on all the rainfall he can get to grow his crops. Even so called "Absorption banks" in the constructed system, that are designed to hold the runoff, do so in a fashion making it unavailable to the crop.

Soil is the dynamic product of thousands of years of weathering, it is

constantly on the move, swelling and shrinking as it gets wet and dry, Black Cotton soils (Vertisols), can heave up to a metre in height wrecking concrete irrigation structures in the process. The channels of absorption banks, no matter how skilfully constructed will not stay level, runoff collected in them ends up, in deep puddles along the channel, and unavailable to the crop, while on the immediate ‘down-hill side of the absorption bank, the soil has been denied the runoff for a few metres and remains too dry for cropping.

The same problem of soil instability applies to the top of the absorption bank, or any constructed bank for that matter, the soil sinks after construction creating uneven low patches that can ‘breach’ during heavy rainfall and cause gully erosion as the bank breaks down and is destroyed. Constructed banks just ‘sit’ on the ground they are not anchored in to it like vetiver hedges with their 3 m+ vertical root system.

Vetiver hedges, once established across the slope will remain in place no matter what excesses nature exposes them to including high intensity rain storms; floods; hurricanes; tornadoes; even earthquakes – not even Gabions can withstand earthquakes



A good demonstration of how the vetiver hedge system works is shown here. Back in the early 1980s, when the idea was first introduced to the chief plant scientist Dr. P.K.Yoon of the Rubber Research Institute in Malaysia, being very sceptical of our claims, he planted a small vetiver hedge across a rill in the Institute's nursery, within three months the hedge had filled in the erosion rill and collected sediment from the runoff and was starting to build up a little terrace of sediment behind the hedge.

This demonstration was sufficient to convince Dr. Yoon that the vetiver system was really worth looking in to and he wrote our first detailed research report "A Look See at Vetiver".

In this photo you can see a stick that was put up to mark the centre of the rill when he planted the hedge, and you can see the rill has been filled in by sediment, in three months. The 'old' rill can just be seen on the outside of the little hedge, but the hedge has created a small silt terrace and this is what happens behind a large vetiver hedge. Terraces up to three metres high have been created on steep land in Cane fields over a period of years.

On a much larger scale, you can see how a vetiver hedge in Queensland, Australia has taken the power out of the flood, and when flood water slows down or stops moving, the silt is immediately precipitated out of the runoff. If there had been no hedge in this case, the silt and accumulated nutrients and the essential ‘water’, would have been lost to the drainage network. But see how level the hedge has made the land where the silt has been deposited.

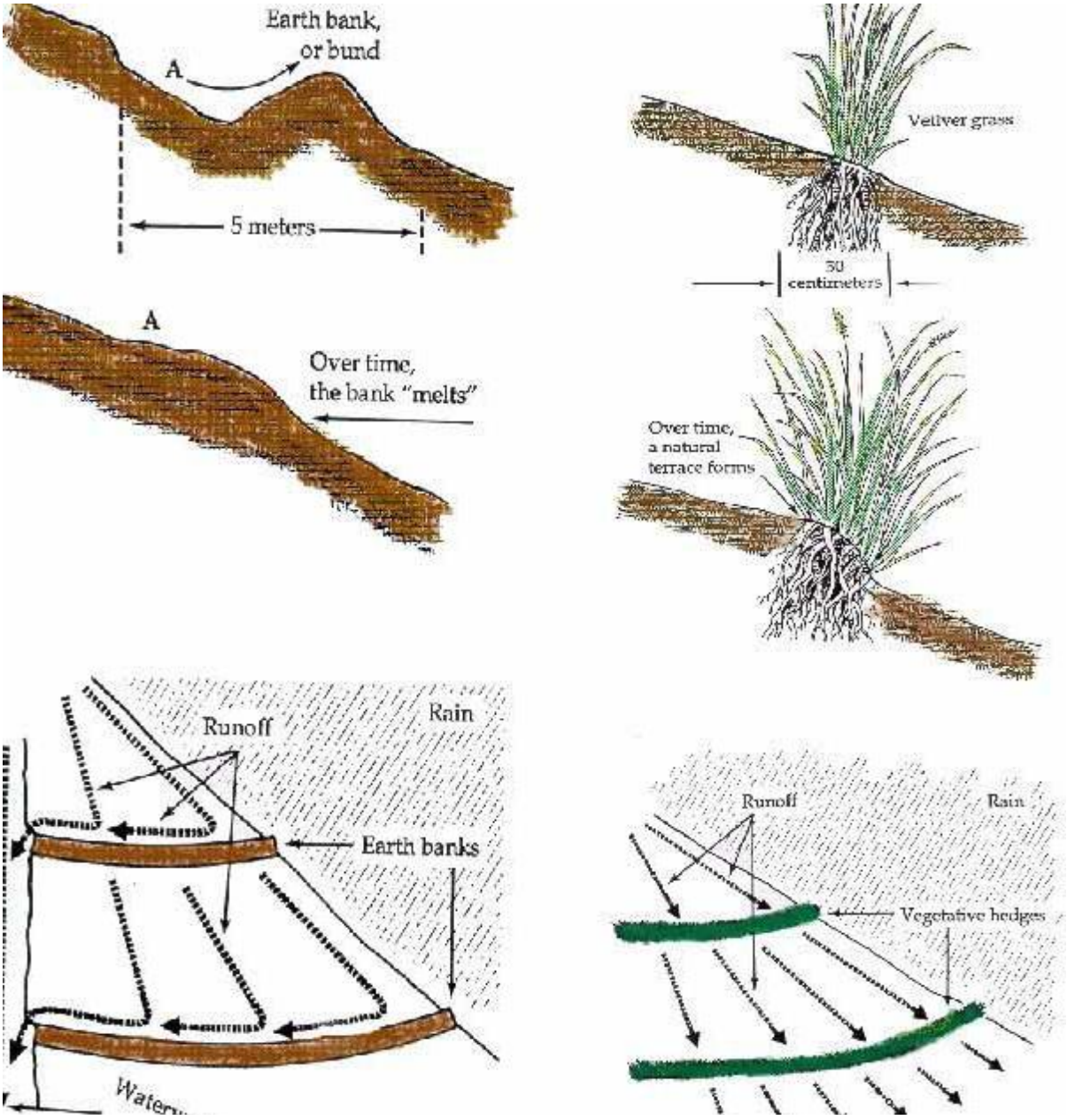
This soil loss and runoff is something the rainfed farmer can’t afford to lose. In the photo above, the flood water has been held back by the hedge, but more important, instead of being drained away, the accumulated water has had a chance to soak in to the ground and will provide the necessary moisture to support a heavy crop. Without this system of controlling runoff, the rainfed farmer would have produced a very poor crop and may have even produced nothing.

Here you can see a 30 year old vetiver hedge planted in Rakiraki, Fiji on a 50% slope. Over the 30 year period this hedge has accumulated 3 metres of sediment forming a natural terrace. (The vetiver grass has been cut back for the photo, to reveal the accumulated soil). Without this hedge this farmer would not be plowing his land now as it would have been washed away, down the slope.

Instead, over the 30 year period this hedge together with the hedge below (out of sight) has built up an almost level terrace between to two hedges reducing the 50% slope on the terrace to almost zero. This is brought about by the “flow through” system unique to the Vetiver System of filtering sediments and not transporting them to the drainage network as in the constructed method of conservation. Instead of having to walk off his ‘degraded’ land this farmer is still producing high yields of sugarcane, thanks to his vetiver hedges retaining his soil and fertility, while storing moisture for the crop , and thirty years later, this hedge is still doing its job of preventing soil erosion..

There is no such thing as <u>flat land</u>, all land needs protection from erosion. In some countries there are no erosion control requirements below a 14% slope. This is not correct – if you spill water on a flat table it will runoff at some point along the table, it doesn't cover the table at an even level no matter how level the table may seem. All water runs down to the flat land and then finds its way to the river or swamp; or the sea. Here a vetiver hedge supplies the necessary protection to runoff in a flat paddock. Crops grown behind this hedge will always have sufficient conserved moisture and nutrients to reach fruition.

Constructed works. **Vetiver System.**



The Diagram above lays out the difference between the two systems of soil and moisture conservation. On the left it shows the constructed system of diversion banks – all banks must be able to 'spill' if they fill up. In this case they spill in to a 'waterway' which usually runs straight to the drainage network or to a Dam. As you can see, the rainfall is run directly off the field conserving little moisture and what rainfall lies in the bank's channel is not available to the crop. This system can create massive 'Herringbone' erosion,

as it has in the little Country of Lesotho, in Southern Africa, where the diversion banks are too deep to cross and the waterways have become minor canyons.

With the Vetiver System on the right, you can see the ‘flow through’ system illustrated, instead of diverting the runoff to the drainage network, it is slowed down, spread out and eventually any surplus flows through the whole length of the hedge, wetting the field in a natural manner, and you will end up with a heavy crop like the one depicted below, between two vetiver hedges which have conserved the necessary moisture from the sporadic rainfall under purely rainfed conditions.

Without these hedges retaining the runoff and nutrients, this high yielding rainfed crop of sorghum below would not have been possible.

But the thing to notice here is how even this crop is, over its entire length. One could be forgiven for thinking it had been irrigated, which in a way, it has been, but under rainfed conditions with the hedges spreading the runoff evenly over the whole area.

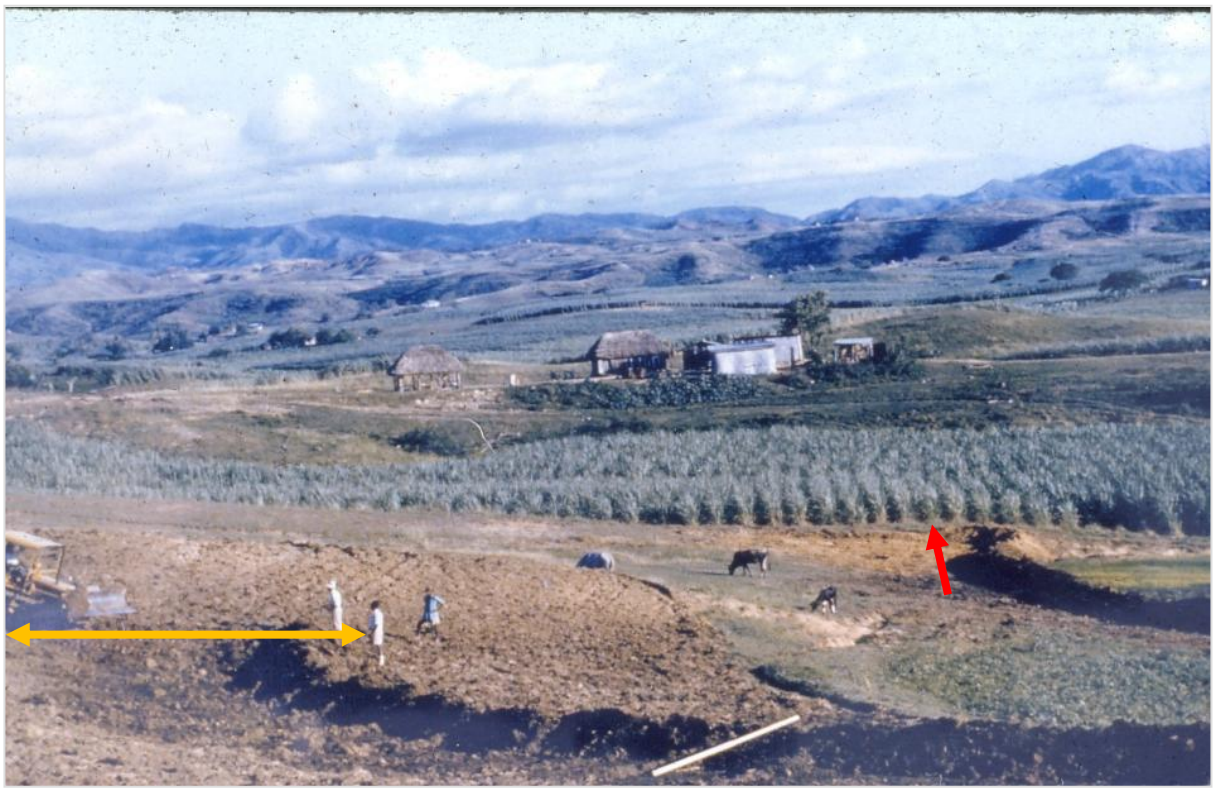
Dense vetiver hedges like these, over the years of ‘pooling’ the sediment runoff in low patches of the field, eventually end up levelling the field, better than man could ever do with equipment. Not only that but every time it rains more low areas in the field are filled with sediment, meaning that the vetiver hedges are continually levelling the field for years .

The constructed system of Soil Conservation.

This is the system we started with in Fiji in the early ‘50s – Bulldozer constructed contour banks as per the USDA/ Soil Conservation Service design, with an 8% slope leading to the natural drainage outlet.(red arrow)

These banks, though well constructed with correct channels and outlets did not survive the first tropical storm, the heaviest of which we measured using an automatic recording Pluviometer, at 500mm in 3 hours,. On the other hand the vetiver hedges have withstood all the high intensity tropical storms and Hurricanes without any damage.

The channel created by the constructed hedge (shown with a yellow arrow) is approximately 5m wide and taking half a hectare of farm land out of production for every kilometre of bank. By comparison the vetiver hedge being only ½ a metre wide only takes only 1/20 of a hectare out of production/1 Km. These contour banks following the USDA system are entirely the wrong concept for the tropics. These banks have to be surveyed in to ensure their gradient is correct and that they spill in the right place, also they cannot be more than 300m long or they are in danger of breaching.



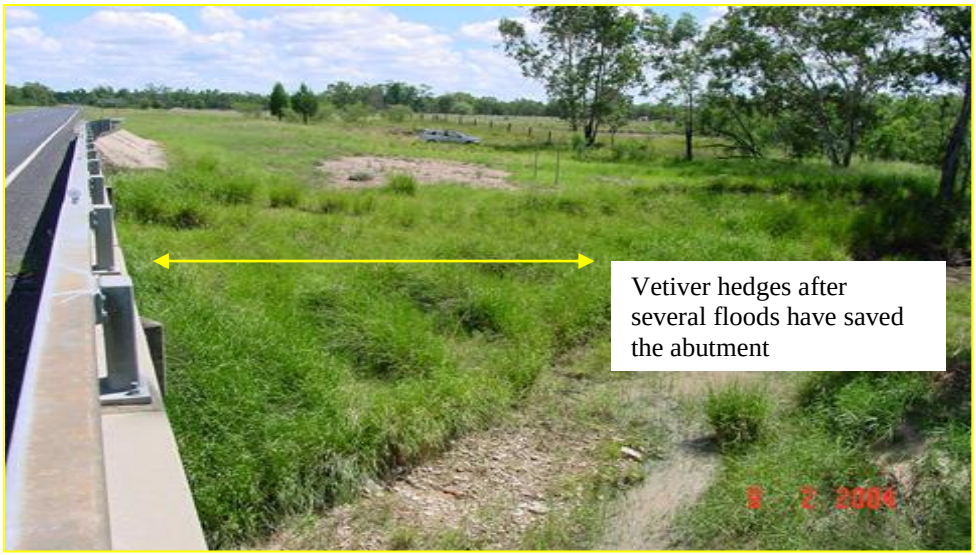
The Waterway: the weakest part of the constructed system

Here you can see the soil; nutrients and "water" washed in to the waterway by a conservation bank, this cannot happen with vetiver hedges as they do not convey the runoff to waterways, instead, they filter the silt out of it in the field, spread it out and let the surplus runoff filter through the hedge in a controlled nonerosive manner. The above photograph is the typical output of the constructed system of conservation in the tropics – the contour banks spill sediment in to a waterway, depriving the crop by taking soil and nutrients to the drainage network.

In a situation like this, the farmer doesn't have the labour or tools to return this sediment in the drain to his field – it is lost permanently

Why would any NGO or Aid Agency support this system when it is so obviously wrong – but they nearly all do through total lack of experience and observation, or is it just 'rent seeking' or because the constructed system is the accepted system, requiring costly earthmoving equipment; trucks; engineers the lot.

This photo shows conservation banks breaking down under the pressure of tropical rainfall. Illustrating those static measures of conservation cannot withstand the dynamic pressure of a tropical storm. Vetiver hedges have no difficulty withstanding such pressure without breaching, as they are anchored in to the ground with an exceptionally strong root system (pictured right). They provide the 'dynamic' solution to soil erosion as a living barrier..



Where a river is prone to repeated flooding, the increased pressure of flowing water against the spandrel or the ‘abutment’ of the bridge may cause the approach to be washed away (top photo), thus totally isolating the bridge from the road. Compacted soil abutments are easily washed away by ‘high-speed’ vortices of water waiting to pass under the bridge during a flood. The vetiver hedges above have already withstood several high volume floods, while protecting the abutment and preventing erosion, and keeping the road open.

These abutments can be protected by strategically placed vetiver hedges, as shown above, saving the bridge and ensuring the populations access to markets and infrastructure remain unhindered.

On this highway in Malaysia a major drainage section has been protected by planting a series of vetiver hedges, thus preventing, slips filling the drain and rendering it useless, these hedges will keep the road open during heavy tropical rain storms of over 5,000 mm annually. and prevent any slipping from the road fill. Thus saving hundreds of thousands of dollars in maintenance and keeping the road open for essential access to markets and infrastructure.

Road cuts and fills have been stabilised all over the world now using vetiver hedges as shown above. This stabilising technology once established, is permanent and requires no maintenance costs, retaining rainfed farmers access to their markets year round

With the Vetiver System illustrated above, all the aspects of Poverty Alleviation can be addressed - moisture and nutrient conservation leading to higher, sustainable yields and the production of cash crops. The stabilisation of tracks, roads and bridges ensuring that these crops can get to the market is essential.

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