



Vetiver

The Proven Soil Conservation Technique

A Training Manual for Communities and Field Workers

Edited by Professor Bill Aalbersberg, USP



Preface

As part of outputs under the COWRIE Project (Towards Coastal and Watershed Restoration for the Integrity of Island Environments), a series of four manuals/ guides on best-practice restoration activities have been developed.

The COWRIE project funded by (Coral Reef Initiatives for the Pacific) CRISP and Conservation International was implemented over fourteen months from August 2009 by the Institute of Applied Sciences of the University of the South Pacific. The main objective of the project was to empower communities to undertake sustainable management decisions in the protection and restoration of their watershed areas. The project takes the “ridge to reef” approach highlighting the connectivity of land-use practices in the upper catchment directly impacting the marine environment.

Lessons learned from demonstration activities of the project in Fiji and Vanuatu have been documented, and resulted in the development of the following four manuals:

- 1.What is a Watershed and Why Look after It?
- 2.A Guide to Planting some Local Tree Species for Restoration Purposes.
- 3.How to Build a Low-Cost Community Nursery.
- 4.The Use of Vetiver Grass in Extremely Degraded Areas.

These manuals provide a simple guide of restoration activities that can be undertaken by communities towards managing their watershed environment from the ridge to reef.

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Acknowledgement

This manual is the result of an extensive effort of a number of people from various organizations who have been part of the COWRIE project (Towards Coastal and Watershed Restoration for the Integrity of Island Environments).

We would like to thank Fiji Department of Forestry for their support in all aspects of our project activities; in particular, we acknowledge Binesh Dayal for his substantial technical input in the on-ground demonstration activities and in the development of the training manuals. We also acknowledge Jone Navuso for his supervision of the replanting demonstration plots at Naroko, Ra and, Peni Cawani and Setareki Qaliduadua who conducted the nursery construction training in Nakorotubu, Ra, Fiji.

We also thank the Ra Provincial Office, Provincial Administrator's office, the Mata ni Tikina and communities of Naroko, Nakorotubu and Rakiraki, Ra, vinaka vakalevu for warmly receiving us and making our work easier to implement over the last year.

We also acknowledge our Vanuatu counterparts from the Foundation of the Peoples of the South Pacific International, the chiefs and community of Epau, the Area Secretary, Mr. Joseph Kalpeau, Mr. Ben Kai, President and staff of the SHEFA Province Council, Mr Tate Hanington , Mr. Philomena Ala and Mr. Russell from the Vanuatu Department of Forestry and Mr. Vatu Molisa and Mrs. Touasi Tiwok from Vanuatu Department of Environment. For the second Vanuatu site of Aneityum Island, we thank Mr. Don Miller from Farm Support Association, the communities of Aneityum in particular, Henry Kathecau , Henry Naumu, and Mr. Nick Lambrechtsen.

To our partners, Conservation International Fiji Office, Secretariat of the Pacific Community, SPC-GTZ Pacific German Regional Programme, Landcare Research and International Union for the Conservation of Nature, we thank you for your support over the project period.

And finally to the IAS family, vinaka vakalevu, this has been a team effort indeed.

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Introduction

In watershed management, there can be a number of objectives:

- Slow down and spread out water flow;
- Minimise soil loss;
- Minimise landslides;
- Minimise sediment entering waterways;
- Provide an environment that supports vegetation growth;
- Stabilise riverbanks to slow bank erosion.

Many of these can be achieved by expensive engineering work. But in the Pacific, we need inexpensive, natural (soft) options. Amazingly, planting vetiver grass can achieve all of the above.

This booklet explains what and also how to plant and grow this material for watershed management.

A. What is Vetiver grass?

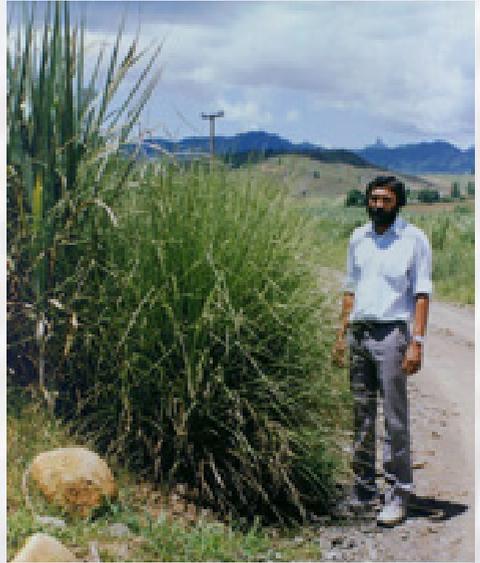
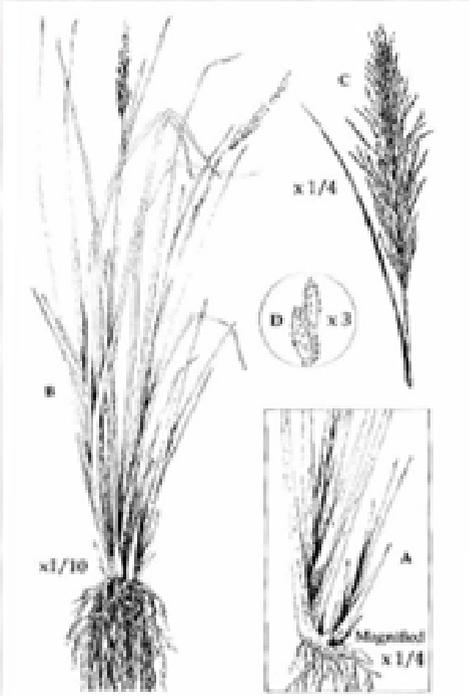


Photo by Don Miller



Vetiver

Ten species of coarse perennial grasses found in the tropics of Europe, Africa and Asia belong to the family Andropogoneae, but only one of these, *Chrysopogon zizanioides* (formerly known as *Vetiveria zizanioides*), has proven to be ideal for soil and moisture conservation.

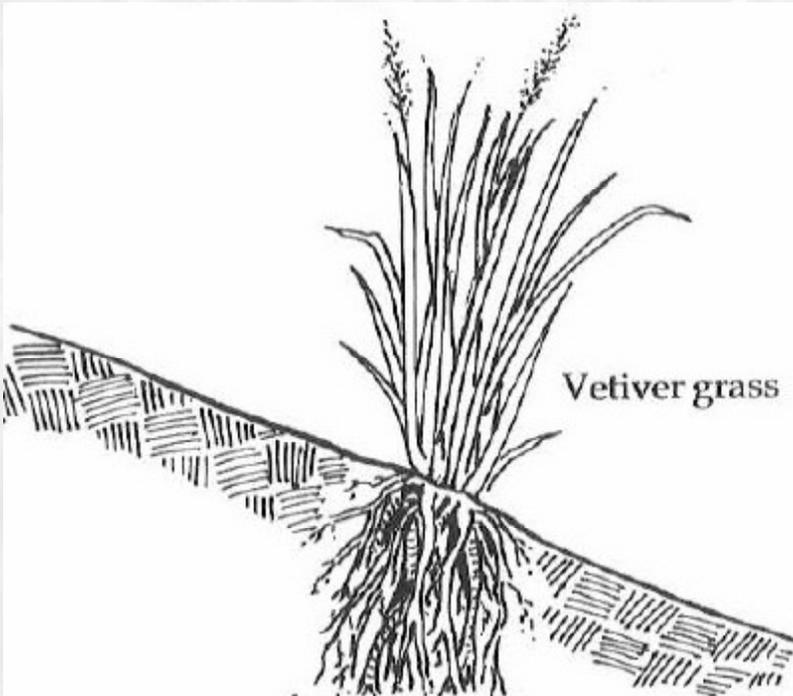
The following are some of its positive properties:

- It has a strong fibrous root system that penetrates and binds the soil to a depth of up to 3 meters and can withstand the effects of tunnelling and cracking. These deep roots also make vetiver grass effective at lessening the occurrence of shallow landslides.

The roots of a one year old Vetiver plant

- It is perennial and requires minimal maintenance.
- It is effectively sterile, and because it produces no stolons or rhizomes it will not become a weed.
- Its crown (growing points) is below the surface, which protects the plant against fire and overgrazing. When all surrounding plants have been destroyed by drought, flood or fire, Vetiver will remain to protect the ground from the onslaught of the next rains.
- Its sharp leaves and aromatic roots repel rodents, snakes, and similar pests.
- Its leaves and roots have demonstrated a resistance to most diseases.
- Once established, it is generally unpalatable to livestock. The young leaves, however, are palatable and can be used for fodder. The older leaves can be used for weaving.
- It is both a xerophyte and a hydrophyte, and once established it can withstand drought, flood, and long periods of waterlogging.
- It will not compete with the crop plants it is used to protect. Vetiver grass hedges have been shown to have no negative effect on—and may in fact boost—the yield of neighbouring food crops. Its roots are a host to beneficial mycorrhiza, which may be of benefit to adjacent crops.
- It is cheap and easy to establish as a hedge and to maintain—as well as to remove if it is no longer wanted.
- It will grow in almost all types of soil, regardless of pH, or salinity. This includes sands, shales, gravels, and even soils of relatively high aluminium toxicity.
- It will grow in a wide range of climates. It is known to grow in areas with average annual rainfall between 200 and 6,000 millimeters and with temperatures ranging from -9° to 45° Centigrade, although hot-season conditions are needed for part of each year to ensure long term survival.

What is Vetiver's value to Agriculture?

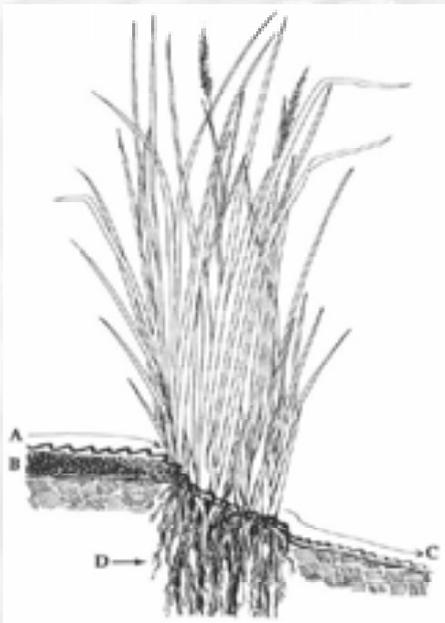


Vetiver is planted as a contour hedge (on a level, although not necessarily straight line) across cultivated slopes. The stems grow so close that run-off water flowing down the slope is slowed and spread evenly.



The dense barrier of Vetiver stems formed by a young hedge. The stems are strong enough to stand up against flowing water 300mm deep. Photo by Don Miller.

When run-off is slowed its ability to carry sediment is reduced, the sediment is deposited and is retained by the vetiver hedge.



- A. Run-off water being slowed and spread
- B. Sediment being dropped from suspension and retained
- C. Slow and even flow of run-off water below the Vetiver hedge.
- D. Thick mat of roots which have beneficial mycorrhizal fungi living in them.



A Vetiver hedge showing sediment being deposited by slowed run-off and then trapped to form a terrace. Photo by Don Miller.

B. Establishing Vetiver Nurseries

Sources of Vetiver plants

The great advantage of the South Indian strain of Vetiver found in the South Pacific (also known as Monto in Australia and Sunshine in the US) is that it does not have fertile seeds and so cannot become a weed. There are other strains of Vetiver in Asia and Australia which may have fertile seeds but these have not been found in the South Pacific and so will not be a problem. No signs of weediness in Vetiver has been observed by the author in the Pacific Island countries in which he has studied it and 100 year old plantings have remained just where they were planted with no spreading.

As it cannot be grown from seed Vetiver is multiplied by vegetative methods and the easiest of these is by splitting up existing large plants and growing these on in a nursery as mother plants, until they are large enough to be split into smaller plants again – either to plant out in the field or back in a nursery.

With a multiplication factor of up to 20 being possible in a well managed nursery per year, a large number of plants can be produced in even two years. One hundred small nursery plants can produce up to 40,000 plants after two years – enough for 4 kilometres of Vetiver hedge on agricultural land and a shorter length on severely eroding infertile soils. Getting a good nursery started early is the key to a soil conservation program based around Vetiver.

It is very important that Vetiver plants for a nursery are sourced from within the country where they are to be used, if they can be found. It is known that the appropriate strain of Vetiver is available in the Cook Islands, New Caledonia, Fiji and Vanuatu. Plentiful supplies should be available from the Rakiraki area of Fiji as there are still remnants of old cane field plantings there. In Vanuatu there are nurseries in Anelghowhat and Port Patrick, established by the two phases of the Aneityum erosion project over the last 16 years, and plants have been observed on other islands.

Preparing Nursery Material

Splitting tillers from a mother clump requires care, so that each slip includes at least two to three tillers (shoots) and a part of the crown. After separation, the slips should be cut back to 20 cm (8") length. For faster growth the slips should be kept in wet and sunny conditions until planting out. In Vanuatu, direct planting of the slip into the nursery has been very successful although being kept in damp sacks for over a week has not harmed the planting material.



A. Vetiver plant ready for splitting

To remove a clump of vetiver grass from the ground dig it out with a spade or fork. The root system is too massive and strong for the grass to be pulled out by hand. Only a short length of root is needed so don't bother digging too deep – 100mm is enough. Next tear a handful of the grass, roots and all, from the clump (B). The resulting piece, the slip, is what gets planted in the nursery or field (C).



B. Splitting the plant and roots



C. Slips of about 3 tillers each after being pulled apart

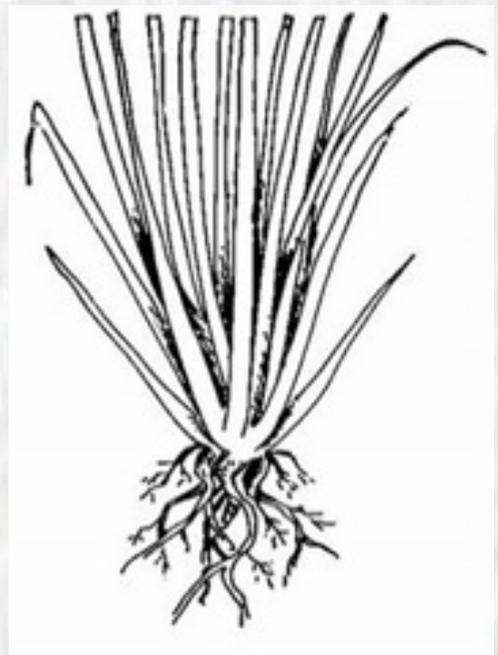
The slips must consist of about three tillers, including the crown and the associated roots. In very old source plants sections of root and crown that do not have shoots or roots may be planted as they will probably grow. If in doubt place such pieces in water for a week and see if they grow roots. If roots grow the piece of crown will survive in the nursery.

It can be difficult to split a large plant. To help break it apart swing the base of the plant down on to the ground while holding the leaves, as this will loosen the intertwined roots and shake out the soil. If this isn't enough to loosen the roots try cutting the plant in halves or quarters with a cane knife or sharp spade. Some slips will be lost but it may be the only option.

If there is a shortage of planting material small pieces of crown and single tillers can be grown on in bowls of soil (about 30 in a plastic washing bowl) until they are large enough to plant in the nursery.



A medium sized Vetiver plant that will yield about 10 slips when split. Photo by Don Miller.



A Vetiver slip with a suitable number of tillers and roots.

There is no point in leaving long roots on each slip as the roots only serve to hold the plant in the soil while new roots grow. Likewise too much leaf will just allow the slip to dry out and reduce its chance of survival.

Nursery size

Nursery size will depend on area available, but for planting on agricultural land a 20 metre by 20 metre area would be able to provide about 24,000 slips suitable for field planting each year, enough for 2,400 metres of contour vetiver hedge. On extremely eroded slopes in infertile soils, as on Aneityum, a higher field planting density is required and so a nursery of that size would allow the planting of only about 500 metres of contour hedge.

A number of smaller nurseries will be just as suitable as long as essential maintenance such as weeding and trimming is carried out on fragmented plots. The nurseries should be in full sunlight as shade slows vetiver growth, although survival may not be affected once plants are well established.

To allow easy tending and digging use a mother-plant spacing in the nursery of 500mm by 500mm. Weeding is important particularly if creeping vines may be a problem. Care must be taken when weeding to avoid damaging new tillers which form just below ground on the outside of the mother plants.

The rate of new tiller production can be increased by trimming the plants to about 200mm height roughly every 3 months, or whenever flower stalks grow. (Note that while flowers may form they do not produce fertile seed.) While the trimming may slow plant growth for a while, the increased rate of tiller production more than compensates with more planting material being available after a year.

It has not been found necessary to fertilise plant nurseries, even on Aneityum, as if they are located on soils that would, for example, grow pineapple without fertiliser, the vetiver will thrive. It is also possible that a better mycorrhizal fungi population will form on the roots of Vetiver grown without artificial fertiliser (soluble phosphate fertilisers inhibit mycorrhizal fungi) and this will allow more immediate beneficial mycorrhizal action when the Vetiver is field planted.



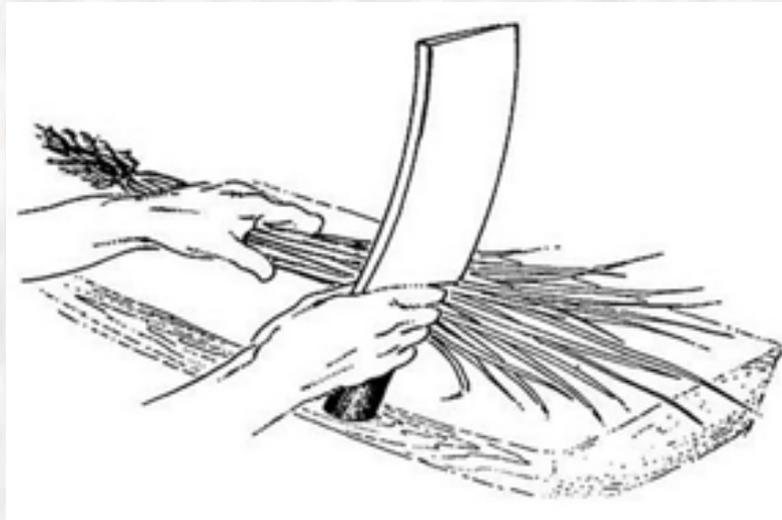
The essential ingredients: a growing nursery (ready for trimming), a good taro spade, sacks to transport plants out to the field site, a pole to sling the sacks from and a very determined and dedicated village leader (who has persisted with vetiver planting in difficult conditions for over 10 years). Photo by Don Miller.

Vetiver plants can be produced in plastic potting bags in the nursery but this is much more expensive and time consuming. It is not necessary for agricultural land as bare rooted slips perform well enough. Potted plants might perform better on severely eroding lands but on Aneityum the additional effort of carrying the bags of soil to the planting site greatly outweighs any advantage (there are no roads or vehicles on Aneityum and no horse in the area affected).

Where roadside slopes are being planted and very rapid growth is required, the use of potted plants may be justified as transport will be available and the additional costs will be minor compared with the cost of the road works being protected.

C. Planting Material

As discussed in the section on nursery establishment it is best to use slips with a minimum of three tillers, which have been cut to a length of no more than about 200mm. This is easiest done with a cane knife and a block of wood.



After a trench has been dug along the previously marked contour line slips can be laid out and planted.

Planting the Vetiver slips



Spacing between slips is approximately 100 mm and they are planted deep as this cannot harm them and improves their soil moisture environment. Photo by Don Miller

A well planted contour hedge can start trapping light plant debris and soil very quickly, as seen in this 5 week old hedge in the next photograph. Note that the slips were planted closely at this point in the contour hedge because it was known to be a waterway during heavy rain.

Locating the contour rows on the slope

Experience from much earlier Vetiver hedge plantings in Fiji, and confirmed later in a number of other tropical countries, has shown that a 2 metre vertical spacing is a good balance between erosion control and possible inconvenience to cultivation.

The following diagram illustrates the relationship between vertical interval and surface run on a 30 degree slope. This slope would be the upper limit of most agricultural activity unless cultivation is by hand and not draft animals. On a more gentle slope of 13 degrees, a recognised upper steepness limit to safe tractor cultivation, there will be a 9 metre surface run.

Vetiver Hedge Maintenance

Once the hedges have been established in the farm field, the only care they will need is annual trimming to a height of about 30-50 centimeters to encourage tillering and prevent shading of the food crops. Plowing along the edges of the hedgerows will remove any tillers that encroach upon the field and will thus prevent the hedges from getting too wide. If this ploughing is done in damp soil conditions any large sections of vetiver can be collected and used for further planting. They should not be left on the ground as they may take root and become a nuisance later.

After the vetiver hedges have properly established, the vetiver grass can be cut down to ground level when the dry season sets in and its leaves used as a mulch at the base of the fruit trees to help retain stored moisture. The advantage of using vetiver for this purpose is that its leaves harbour few insects and last well as a mulch. Vetiver hedges also protect the young trees in the hot summer months by providing some indirect shade and in the colder winter months by acting as windbreaks.