VETIVERIM

A Quarterly Newsletter of the Pacific Rim Vetiver Network

Number 18 **ISSN 0859 – 8878** **October 2001**

Publisher:

Office of the Royal Development Projects Board, 78 Rajdamnern Nok Avenue, Dusit, Bangkok 10300, Thailand
Tel.: (66-2) 280-6193
Fax: (66-2) 280-6206, 629-8915
E-mail: pasiri@mail.rdpb.go.th
Editor's E-mail: journal@au.ac.th
Homepage: http://pvn.rdpb.go.th

Editorial

The Role of Vetiver in Flood Control

During the past few weeks, many parts of the world have suffered from severe floods and other associated catastrophes which, most likely, were the result of the "Global Warming" phenomenon (see Editorial of previous issue of Vetiverim), which in turn, was the direct result of the "Greenhouse Effect" due to the release into the atmosphere of enormous amount of CO_2. This 'greenhouse gas' is the product of burning of carbon-containing compounds like wood, coal and oil. This amount of CO_2 is normally absorbed by the natural forests. Unfortunately, large areas of the forests of the world have now been cleared for development.

In the case of Thailand, recent floods in Phetchabun Province and many other provinces in the North and Northeast resulted in deaths of more than 150 people and incalculable loss of property. This event was not the first, as many such incidences have occurred in recent history. Twelve years ago, a very severe landslide and flood took place in Katun District, Nakhon Si Thammarat Province, resulting in the death of several hundred people. Floods in Khao Phetchakut District of Chanthaburi Province, and Wang Chin District of Phrae Province that followed, claimed lots of death and loss of properties.

Is there any solution to mitigate against such a loss due to landslide and flood? Halting deforestation, reforestation, setting up flood warning system, proper watershed management, etc., were among the proposed campaigns, but unfortunately few were implemented!

Planting vetiver hedges across the slopes in reforestation projects may be a practical alternative since vetiver is the most suitable plant to be grown in such areas. It has an extensive root system, is durable, and can withstand drought, flood, and the force of running water. Moreover, it can fix large amounts of CO_2 (5 kg/ clump/year) and turns it into carbon sink in the soil, thus reducing the amount that causes global warming. In addition, planting vetiver hedges across the slope slows down the running water, thus allowing more water to seep into lower layer of soil instead of adding to the flood water in the low land. In this way more water is added to the depleted aquifers which help to make the soil moist. It also collects debris and other organic matters, making the soil more fertile. With added moisture and fertility, plants of all kinds grow better.

Comparing its cost-benefit, vetiver has more advantages than many other hard engineering practices. Besides it offers more aesthetic value and long-lasting effect to solving the flood problem

Vetiver Glossary: Propagation and Vetiver Parts Used in Propagation

This is the fourth part of the series on Vetiver Glossary. The first part, on "Vetiver and Its Related Terms", was published in Vetiverim 15. The second part, on "The Vetiver System", was published in Vetiverim 16. The third part, on "Species and Related Taxa", was published in Vetiverim 17. The format used includes the definitions from: (i) Webster's New World Dictionary, Third College Edition, (ii) <www.dictionary.com>; and (iii) the Editor's, known as Vetiverim's. Their explanations will also be provided.

Multiplication:

Webster's: *n.* a multiplying or being multiplied. (Multiply is defined as to cause to increase in number, amount, extent, or degree).

www.dictionary.com's: *n.* **1** the act or process of multiplying or of increasing in number, or the condition of being multiplied, **2** propagation of plants and animals, procreation.

Vetiverim's: *n.* any means of reproduction solely to increase the number of individuals.

Explanation: As used for vetiver, multiplication is used solely to increase the number of individuals of vetiver plants, without having the objective of planting them in the field.

Propagation:

Webster's: *n.* a propagating or being propagated; specif. reproduction or multiplication, as of a plant or animal. (propagate is defined as **1** to cause (a plant or animal) to reproduce itself, **2** to reproduce (itself); said of a plant or animal, **3** to reproduce or multiply, as plants or animals.

www.dictionary.com's: *n.* **1** multiplication or increase, as by natural reproduction. **2** the process of spreading to a larger or greater number; dissemination, **3** the act of propagating; continuance or multiplication of the kind by generation or successive production; as, the propagation of animals or plants.

Vetiverim's: *n.* any means of reproduction, either for increasing the number of individuals or for subsequent planting out in the field.

Explanation: Propagation is used as a general term of reproduction of vetiver; it also includes multiplication through various means to increase the number of individuals. The ultimate goal of propagation is to grow individual vetiver planting materials in the field, either through the process of multiplication first, or directly growing the propagated plants in the field.

Micropropagation:

Webster's: (none)

www.dictionary.com's: *n.* **1** a tissue culture technique for plant propagation in which offspring are cloned from tissue taken from a single plant, **2** the use of biotechnological methods to grow large numbers of plants from very small pieces of plants, often from single cells using tissue culture methods.

Vetiverim's: The clonal production of plants through techniques of tissue culture of meristematic tissues of young bud (apical or lateral) or young inflorescence.

Explanation: Vetiver can be multiplied to a large number through the use of tissue culture technique. (See further explanation of Tissue Culture).

***In Vitro* Culture:**

Webster's: (none). *In vitro* means in glass; isolated from the living organism and artificially maintained, as in a test tube.

www.dictionary.com's: (none). *In vitro* means: **1** in an artificial environment outside the living organism, **2** within a glass, observation in a test tube, in an artificial environment

Vetiverim's: A technique for culturing cells, tissues, or organs of plants in a sterile medium

Tissue Culture:

Webster's: *n.* the process or technique of growing tissue artificially in a special, sterile culture medium; the tissue thus grown.

www.dictionary.com's: *n.* the technique or process of keeping tissue alive and growing in a culture medium.

Vetiverim's: **1** a technique for culturing tissue excised from a plant (known also as explant) in a sterile medium, **2** a culture of tissue grown by this techniques or process.

Explanation: Differentiated tiny plants (also known as plantlets) developed from the explants can be used to propagate upon attaining a good size, and after a period of nursing in the nursery.

Vetiver Parts used in Propagation

Vetiver in cultivation rarely produces seeds. Thus, only asexual reproduction is used extensively in vetiver propagation. In the vetiver literature, several terms have been used, sometimes indiscriminately, to designate the parts of the vetiver plant that can be used in propagation. Their definitions and explanations are given below:

Tiller:

Webster's: *n.* A shoot growing from the base of the stem of a plant

www.dictionary.com's: *n.* A shoot, especially one that sprouts from the base of a grass

Vetiverim's: *n.* A shoot sprouts from the base of the stem of a grass.

Explanation: Tiller is the most valid term used to describe the part used in vetiver propagation. It is also the most popular part of the vetiver plant used in propagation since it is available in large quantity, employs simple technique, and gives good result.

Slip:

Webster's: A stem, root, twig, etc. cut or broken off a plant and used for planting or grafting; cutting; scion

www.dictionary.com's: A part of a plant cut or broken off for planting; a cutting

Vetiverim's: A shoot cut off from a vetiver clump used for planting

Explanation: Many authors used this term synonymously with tiller. Some even erroneously called it a 'root division' (in vetiver, the structure from which the slip grows is the base of the stem, not the root!). As it is a rather confusing term, and the fact that the term 'tiller' is more appropriate, it is suggested not to use this term in the future to avoid further confusion.

Culm:

Webster's: A stalk, stem; the jointed stem of various grasses, usually hollow

www.dictionary.com's: The stem of a grass

Vetiverim's: The above-ground part of the stem of a grass, usually hollow

Explanation: The culm of the vetiver grass is strong, hard, and lignified, having prominent nodes with lateral buds that can form roots and shoots upon exposure to moist condition. Laying the cut pieces of culm on moist sand, or better under mist spray, results in the rapid formation of roots and shoots at each node.

Cutting:

Webster's: A slip or shoot cut away from a plant for rooting or grafting

www.dictionary.com's: A part of stem removed from a plant to propagate new plants, as through rooting

Vetiverim's: A part of stem with at least one node each used to propagate new plant

Explanation: Although commonly used as propagating material in horticultural crops, 'cutting' is rarely used in vetiver. This term is synonymous with 'cut culm' or 'culm-cutting'

Culm-branch:

Webster's: (none)

www.dictionary.com's: (none)

Vetiverim's: A branch developed from the lateral bud of a culm

Explanation: It is a term derived from similar structure in bamboo and other ramified grasses. It was Yoon (1991) who used this term in vetiver literature for the first time to mean a branch developed from a lateral bud of a culm of more than three months old whose main culm has been repeatedly cut down to induce tillering.

Clump:

Webster's: A cluster, as of shrubs or trees

www.dictionary.com's: A thick grouping, as of trees or bushes

Vetiverim's: A cluster of tillers developed originally from a mother plant (of the vetiver) in all directions

Explanation: In vetiver, a clump is formed when a plant has been grown for a certain period of time and produces numerous tillers in all directions.

Ratoon:

Webster's: *n.* A shoot growing from the root of a plant (esp. the sugar cane) that has been cut down.

www.dictionary.com's: *n.* A shoot sprouting from a plant base as in the banana, pineapple, or sugar cane.

Vetiverim's: *n.* A shoot (tiller) sprouting from the base of the vetiver plant that has been cut down to induce sprouting.

Explanation: As vetiver (or even the sugar cane!) does not seem to re-sprout from the root when the clump is cut down to the ground, but rather from the base of the stem, thus the re-sprouting structure is actually a 'tiller' which has been induced to sprout by cutting down the top part. This term should not be used in vetiver propagation to avoid further confusion.

Tissue culture plantlet:

Webster's: (none)

www.dictionary.com's: (none) (plantlet is defined as '*n* - a young or small plant', 'a little plant')

Vetiverim's: Differentiated tiny plant developed from the explant through tissue culture technique

Explanation: Unlimited number of plantlets can be produced in aseptic condition from the explants deriving from the shoot tip, lateral bud, young inflorescence, etc. Upon attaining a good size, these 'plantlets' can be transplanted in the containers or in the fields similar to the tillers, although much smaller in size. Tissue culture plantlets can be produced within a relatively short time with reasonable expenses. They also have certain advantages over other planting materials in that they are small in size, easy to transport, and free from pathogen (as they are grown, and still remain, in aseptic condition) which makes them safe for international movement, especially across the countries with strict plant quarantine system.

Of all these parts, only the first (i.e. tiller) and the last (i.e. tissue culture plantlet) are used extensively in most vetiver-growing countries to propagate the vetiver grass, simply because they are the convenient parts to be used in propagation. Besides, the cost of their production is relatively lower than that of the other parts while the success is higher. Of the remaining structures, culm (including cutting and culm-branch) and clump are also used in propagation to some extent while the rest are either not used for practical reason, or do not

Bibliography

Chomchalow, N. 2000. Techniques of Vetiver Propagation with Special Reference to Thailand. Tech. Bull. No. 2000/1, PRVN / ORDPB, Bangkok.

Guralnik, D.B. (Ed.). 1993. Webster's New World Dictionary Third College Edition. Prentice Hall, New York.

http://www.dictionary.com

Yoon, P.K. 1991. Extracts from A Look-See at Vetiver Grass in Malaysia – First Progress Report. Vetiver Newsl. 6:86-96.

Vetiver Hedge – 'The Eyebrow Farms'*

I received the note below from Criss Juliard (of DynEnterprises, Dakar, Senegal – ***Ed***.). I don't agree with the philosophy that is held throughout the world, especially the western world, that land less than 4% slope needs no conservation and, not mentioned in Criss' note, that project areas and farm plots should be squared off - obviously for easier measurement, but you never see squares in nature.

I think in Thailand you could well use vetiver in villages in dry areas as I have described below in my answer to Criss.

A Note from Criss Juliard <cjuliard@DYNAENTERPRISES.com>

Contour Hedging:

I don't see contour hedging (outside of dune stabilization) as a predominant use in Sahelian countries, which are mostly flat. The needs in this region are more in the area of improving soil fertility, increasing soil humidity retention, protection from salt water infiltration, protecting road/railroad infrastructure, and construction (thatch). *V. nigritana* is OK to use in these applications, but *V. zizanioides* is the much better adapted for the prolonged dry spells. In more tropical and coastal West African states (Guinea, Liberia, Ivory Coast, Ghana, Togo, Nigeria, the Cameroon), contour hedging to reduce soil erosion with hedging is more important, but still for these tasks, *V. zizanioides* is a superior performer, and outweighs the arguments to use only the local variety.

The Eyebrow Farms - My Argument

There is no such thing as flat land. Man certainly cannot level land and expect it to stay that way, and is dynamic - it moves, it heaves, it changes after every major rainfall event. The only thing that man can level is a table top, but you spill a cup of coffee over the table and does it cover the whole area? No it runs off.

The only thing I know that can tame the savanna is a good vetiver hedge. By putting vetiver hedges across the slope in the Sahel you will retain moisture, and in the process, improve fertility. Animal dung and organic matter are the only source of fertility in these areas and are the lightest component transported by runoff to the drainage network, unless held back by a good hedge. Just look at the 'Wadis' (or gullies) in the Sahel, they are black montmorillinite clays or their equivalent clay colloid, the product of thousands of years of runoff and weathering - doesn't that tell us something?

I was wallowing in nostalgia the other day as I was wading through some old reports I wrote in Sudan where I was working in the 1960s on savanna development - our project area

was 46,000 sq. miles. Because of its size and isolation, we were the first to use satellite imagery, ERTS 1. At that stage satellite imagery was very primitive, with a resolution of about 40 m. NASA marked the points of interest they could see on the imagery and wanted us to ground truth for them (identify them and say what they consisted of). Large areas of savanna scrub land were quite easy to find and map (Sudan is 1 million sq. miles in area, and at the stage I was living there it only had 184 km of roads in the whole country, so all the driving was by compass transect through mainly uncharted desert).

One feature that stood out on the satellite images was a long and often broken strip of vegetation traversing the otherwise barren savanna. It turned out to be the railway line running across the center of the country. Why it stood out so much was that the railway embankment wherever it ran across the slope, acted as an 'absorption bank' holding back what little rainfall they got in the area (usually only 200 mm+) plus all the products of animals and vegetation and giving them a chance to sink into the ground, resulting in a strip of lush vegetation that would have never survived without this conserved moisture and fertility.

I decided at that stage that we should alter our thinking - get subsistence farmers away from farming little squares of irregular land, but with government aid, construct long absorption bank farms. That is a farm that follows the bank for 1 km and is 10 m wide. That would give the farmer 1 hectare of land that would collect enough moisture, plus camel, goat, sheep, and wildlife dung mixed with other organic matter, to grow his crops of millet and sorghum and a 'farm' that he could have some success on.

At that stage I could not find vetiver in Sudan. Now, if you could get a 'Caterpillar' road patrol grader and make wide 'V' ditches across the slope, then, when the rains came plant vetiver hedges in the bottom of the ditch. It wouldn't matter if they went under water for a month or more, they would survive. This would increase the natural vegetation enormously, with the added positive impact of a vetiver hedge carbon sink. The farmers could harvest the vetiver leaves for organic mulch to control pests and fungi on their crops.

May be today the International Aid community would be prepared to fund these 'barriers' in their effort to control 'Global Warming'. Each barrier would need a 10,000-plant vetiver nursery. This could be taken up by a village, and when successful, the system could be expanded. It would work, believe me. I wish I was out there to do it!

I would call these plots 'eyebrow farms', *the vetiver hedge being the 'eyebrow' that contains the moisture and nutrients for the farmer's crop.*

Introduction of VS to Gansu Province, Northwestern China*

Gansu Province is one of the northwestern provinces of China, which borders Mongolia to its north. It has typical continental climate.

Vetiver planting materials were transported from Anhui Province in April 2000 and were planted in Lanzhou, the capital of the province (N 36', E 104') and Kang County (N33' 20'', E105' 36''). All vetiver grass grew up at the two places with 100-120 cm high and 6-15 tillers/per clump in the same year. The grass grew healthy and all leaves had normal color.

Investigated in May 2001, all planting materials died in Lanzho, while the grass survived in Kang County. Kang County had an elevation of 1220 m, with annual mean temperature of 10.9^{o}C and a mean temperature of January of 0.7^{o}C. It had absolute minimum temperature of -13.6^{o}C, and the number of frost-free days of 207 per year. Annual precipitation was 807.5 mm, and annual evaporation was 1148.4 mm. The maximum depth of frozen soil was 20 cm, which lasted 7 days each year.

Donner Foundation Research Grants*

The abstracts of the following six projects from three countries within the PRVN Region receiving this round of research funding from the Donner Foundation are presented below:

CHINA

1. Exploration on the Potential Use of Vetiver in Treating Acid Mine Drainage by Shu, W.S., Zhongshan University; Ye, Z. H., Hong Kong Baptist University; and Xia, H.P., South China Institute of Botany.

Acid mine drainage (AMD) released from mine industries is usually has a low pH and contains a high level of heavy metals, which significantly impacts water quality and ecosystems in southern China. It is also a serious environmental problem around the world. Constructed wetlands have been considered as an effective, low cost and practical approach for the cleanup of different wastewater including AMD. Plant is the major component of wetlands and plays an important role in removal of pollutants. Plant selection is a key step to ensure successful pollutant removal from the wastewater. Vetiver grass has been proved to possess a high tolerance to heavy metals, acidity, salinity, etc., and even has great potential in purifying domestic sewage, landfill leachate and pig farm leachate. However, their potential value in treating AMD is still unknown. Therefore, this project aims at evaluating AMD tolerance and purifying capacity of vetiver comparing these in other three common wetland species including *Typha latifolia*, *Phragmites australis* and *Cyperus alternifolius*, using microcosms and pilot-scale constructed wetland tests. It is expected that this project will provide valuable information related to treating AMD by vetiver, which will be useful for the design of full-scale constructed wetlands for use in such a purpose.

2. A Study on Purification of Vetiver Man-made Wetland for Industrial Wastewater by Xia, H. P., South China Institute of Botany; and Deng, Z.P., Maoming Petrochemical Co.

About 80% of water in China, including 45% of ground water and 90% of cities' drinking water, have been polluted at varying degrees so far. Water crisis has occurred in many cities and regions of China. There are only 2500 m^3 water resources per capita in China, which is less than one-fourth of the world's average.

Guangdong is one of the most developed provinces in China, but its pollution, especially industrial one, is also quite severe. For example, the Maoming Petrochemical Co. of the China Petrochemical Corp. in Guangdong discharges 13.12 million tons of oil-refined wastewater and 7.48 million tons of ethylene-produced wastewater in the year 1999 alone. Therefore the company has a very onerous work for purifying wastewater. The company attaches great importance to the environmental protection, and invests large amount of funding in building up new purifying factories and in enlarging the capacity of the old purifying factories. All these have made the ability of the company to treat wastewater becomes much stronger than before. However, there was still only 63.4% of oil-refined wastewater reaching the effluent standard in 1999, and some main pollutants, such as oil, sulfide, COD, suspended particles, and so on, exceeded the stipulated effluent standard. This indicates that the company still has a lot of work to do with special reference to wastewater purification.

Wetland is considered to be very effective in the aspect of environmental protection, especially for wastewater purification. The mechanism of wetland for purifying wastewater is utilizing vegetation characteristics of filtration, uptake, conglomeration, physical absorption and exchange, and microorganism characteristics of decomposition and precipitation to pollutants.

Due to its low expenses, low energy-consuming, high effectiveness, and sustainability, wetland is regarded as a promising wastewater-treating technique, and is being used by more and more countries.

Many experiments and observations have confirmed that vetiver grass *(Vetiveria zizanioides* (L.) Nash), a perennial, has excellent effects in erosion control, extreme soil amelioration, wastewater purification, and other environmental mitigation uses. For example, Summerfelt *et al*.(1996) found that vetiver established in wetland could effectively remove extra solids and nutrients in aquaculture sludge, and the removal rates of suspended solids, total COD, total Kjeldahl N, total P, and dissolved P were 96~98, 72~91, 86~89, 82~90, and 92~93%, respectively. Xia *et al.* (1999) found that vetiver could purify ammoniac N and total P in garbage leachate over 87 and 74%, respectively. In South China, *Typha latifolia* and *Phragmites communis*, the other two local species, have also been documented to be effective with regards to their ability to remove pollutants. Ye *et al*. reported in 1999 that seedlings of *T. latifolia* from metal-contaminated sites accumulated considerably more metals, up to nearly twice as much Zn and Pb and three times as much Cd, in roots than those from the uncontaminated sites. Li *et al.* (1995) found that *P. communis* realized the remove of NH_4^+-N from wastewater mainly by means of successive nitrification and denitrification, and the removal of PO_4^{3-}P mainly by way of roots precipitation, conglomeration, filtration, absorption to pollutants. However, it seems that there have been no documents so far about wetland constructed with the above three species for the mitigation of industrial wastewater, especially for oil-refined wastewater. In addition, *Thysanolaena maxima*, also a local grass, is quite similar to *V. zizanioides* and *P. communis* in the aspects of appearance and ecological function, but no studies have been conducted with regards to its purification of wastewater. So it would be quite meaningful to compare the abilities of the four species above to purify oil-refined wastewater.

The objectives of this study are:

- Making clear of the influence of oil-refined wastewater on the growth of *Vetiveria zizanioides, Typha latifolia, Phragmites communis,* and *Thysanolaena maxima,* and their respective resistance to oil-refined wastewater.
- Ascertaining the purification and uptake capacities of the four species to pollutants mixed into the oil-refined wastewater.
- Sifting the best species growing in oil-refined wastewater, including the strongest resistance, and the largest purifying or uptake capacity.
- Establishing a high quality demonstration site for the proposed Third International Conference on Vetiver which will be held in China in 2004.

3. The Relationships Between Rats, Snakes, and Vertebrates and Vetiver Hedges by Chen, S., Guangxi University

The research site will be located in Nanning of Guangxi Province. Observation and recording will be implemented every 5-10 days. The animals to be recorded will include: Mammalia, Aves, Reptilia, and Amphibia. But more attention will be paid on rats and snakes, and possibly birds and frogs, in order to understand their relationships in the vetiver hedges. Particular attention will be paid on:

- The relationships between vetiver and different species of rats and of snakes;
- The relationships between animals mentioned above, and vetiver planting and management practice;
- The relationships between different animals and between vertebrates and invertebrates;
- The relationships between animals, vetiver, and other crops;
- The relationships between vetiver, animals, and soil fertility.

The counter measures will be proposed based on the research results. The whole research will last two years.

INDONESIA

1. Study on the Effectiveness of Vetiver Hedges in Reducing Sediment and Pesticide Movement from Agricultural Lands by Edison Purba

Karo Highland, situated in North Sumatra, Indonesia, is well known as area for producing horticultural crops such as cabbage, tomato, potato, chilly, and fruits. The topography of the area is mostly hilly with the altitude of 1,000 m or more above sea level. The land is fertile as it was resulted from mountain lava deposit thousands of years ago.

The area is humid with the rainfall ranging from 2,500 to 3,500 mm per year. Such high humidity suits to fungi development that may damage crops in the field. Farmers, in order to have good quality and quantity of yield, usually spray the crops with pesticides frequently. In addition, the high rainfall has created soil erosion, which possibly transport the pesticides. Such condition is therefore highly possible to pollute the environment, especially rivers where the water from the treated-crop area flows into. This assumption attracted a pesticide residual study in Karo District to be done by the Food Crop and Horticultural Plant Protection Institute in 2000 which found residual pesticides in crops generally undetectable. However, farmers sprayed their crops with pesticides intensively.

The objectives of this study are to quantify and assess the effectiveness of vetiver in reducing sediment and pesticide movement from the cabbage production systems in Karo Highland.

VIETNAM

1. Vetiver Grass Technology for Wave and Current Erosion Control in the Mekong Delta, Vietnam by Dung, L.V. and Danh, L.T., University of Can Tho, Can Tho, Vietnam

In Vietnam, hundred of hectares of land on riverbank have been lost annually and thousands of kilometers of dykes are threatened by wave erosion caused by motorized boats. These figures tend to go up exponentially due to the lack of effective erosion controls and increased usage of modern means of water transport.

A recent flood in the Mekong Delta in July 2000 exacerbated the situation, when an unseasonable rise of water level of the Mekong River took people off guard. The people were too busy harvesting the crop that eroded banks and dykes have not been repaired in time for the flood season.

There are a number of methods to protect riverbanks and dykes from erosion, but these methods are either ineffective or too costly to implement. Literature shows that the Vetiver System (VS) is a new and effective method, which has been proved successful in Australia and in a number of Asian and African countries. VS is low cost and labor intensive, thus is highly suitable for a developing economy like Vietnam.

It is anticipated that VS developed and extensively tested overseas would provide a practical and economical solution to control riverbank erosion in the Mekong Delta.

Objectives of the program are:

- To introduce VS to the Mekong Delta and to implement VS for riverbank and erosion control
- To develop this technology for local conditions and to demonstrate its effectiveness in protecting riverbanks and dykes in the Mekong Delta of Vietnam.
- To teach local people the skills of propagation, and implementation of VS for erosion control

2. Vetiver System for Erosion Control in the Central Highland, Vietnam by Phuoc, P.H.D; Du, L.V.; Hoa, L.P.; and Tai, C.X., University of Agriculture and Forestry, Ho Chi Minh

Land use in Central Highland of Vietnam has undergone a rapid transformation during the last decade. Extensive deforestation and conversion of forest areas to crops such as cashew, black pepper, and especially coffee, have reduced the resilience of the natural upland ecosystems to withstand extreme weather conditions, leading to the occurrence of catastrophic erosion and environmental degradation.

Soil degradation, flash flood, landslide, accumulation of silt in the water reservoir, etc. are happening very fast in the highland of Vietnam due to large-scale deforestation. Inappropriate farming practices are threatening the environment of Vietnam, and causing many problems, both socially and economically, to the local communities.

The newly cleared forest areas are used by million of farmers who migrate from lowland areas and from the North. Due to the lack of capital and knowledge, these farmers prefer practicing low-cost farming system as slash and burn. With this practice, the newly cleared land is kept clean of weeds and the sloping bare soil is subjected to heavy rain which is recorded from 2,000 to 3,500 mm during six months of the rainy season.

Some practices such as building contour banks or terraces on the slope have been demonstrated, but these practices are costly, and time-consuming that the majority of poor farmers could not afford. Some plants have been used for erosion control, such as lemongrass, crotalaria, flemingia, but they could not solve erosion problem.

Vetiver Grass System (VS) is a new and effective method of soil and water conservation, which has been proven successful in developing countries around the world. VS is simple, low cost and labor intensive, and which is highly suitable for Vietnam. Therefore, VS applications have been extensively used in Asia, Africa and South America. It would also be applicable for erosion control in the highlands of Vietnam.

Objectives of the program are:

- To introduce VS to the Central Highlands and to teach the local people the skills of propagation and implementation;
- To implement VS for soil and water conservation;
- To develop this technology for local conditions and demonstrate its effectiveness in the Central Highlands.

Wallace Genetic Foundation Research Grants*

The following research and demonstration projects are being conducted in Australia with grants from the Wallace Genetic Foundation. These are progress reports to the Foundation:

1. Efficiency of Vetiver System in Reducing Volume and Nutrient Load in Effluent

Objective: To determine the efficiency and practicality of VS in reducing secondary treated effluent volume and nutrient load in an environmentally sustainable way.

This project is being carried out in two subprojects:

1a. Hydroponic Project by Hart, B., Codyhart, Environmental Consultant; and Truong, P. DNR&M

This project was carried out to determine the full potential of VS in the absorption of water and nutrients under controlled conditions. In this trial vetiver was grown in a combination of black water (effluent from toilet) and grey water (effluent from kitchen, bath and laundry).

The first stage was completed under glasshouse conditions and the followings are the summary of major findings:

- Dissolved oxygen values increased from <1 mg/L pre-treatment to ~8 mg/L - far greater than the minimum recommended 5 mg/L for a freshwater stream (ANZECC 1992).
- Electrical conductivity values halved.
- pH values decreased by ~1.25 standard units.
- The four vetiver plants per drum absorbed 1.1 L on average per day. (Evaporation already subtracted.)
- The longest root in one drum increased by 0.78 cm per day whilst the longest in the other drum increased by only 0.25 cm per day.
- Total nitrogen values reduced by 94% (dropped from approximately 100 mg/L to 6 mg/L)
- Total phosphorus values decreased by 90% (from approximately 10 mg/L to 1 mg/L)
- Pathogen levels: Before treatment sample from the holding tank was:
  Faecal coliforms _1600 organisms / 100 mL; E coli _1600 organisms / 100 mL
  After four day treatment with vetiver in hydroponic solution:
  Faecal coliforms - 900 organisms / 100 mL; E coli - 140 organisms / 100 mL

Preliminary results also indicate good improvement but we have to ascertain this reduction in the next stage of our trial.

Total coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and warm- and cold-blooded animals. They aid in the digestion of food. A specific subgroup of this collection is the faecal coliform bacteria, the most common member being *Escherichia coli.*

The presence of faecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the faecal material of man or their animals. At the time this occurred, the source water might have been contaminated by pathogens or disease-producing bacteria or viruses, which can also exist in faecal material. Some water-borne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of faecal contamination is an indicator that a potential health risk exists for individuals exposed to this water.

Due to the success of the first phase, the second phase is now being carried out at a field trial on a commercial property, the Jacaranda Motel. This motel occupies a property of about 4 ha overlooking the Pacific Highway just north of Grafton in northern New South Wales, Australia. It offers accommodation in 25 units. Approximately 24,000 L of sewage effluent is pumped-out each week from two septic holding tanks and taken from site at a cost of approximately $A14,000 yearly. It is anticipated that under the VS the cost of establishment would be about $A20,000 with annual maintenance cost of about $1,000. It is expected that these are one-off costs to provide solution to the long-term disposal problem.

1b. Effluent disposal at Beelarong Community Farm by Burnett, K., Beelarong Community Farm; Truong, P., DNR&M; and Hart, B., Codyhart Environmental Consultant

The Beelarong Community Farm is an NGO group set up as "A Sustainable Living Centre" to demonstrate alternative natural methods of environmental protection in a close system in the urban and semi-rural environment. The farm is a demonstration site funded by the local community, DNR, and the Brisbane City Council. This project was carried out to determine the full effect of VS in the absorption of water and nutrients under field conditions, where VS is used to absorb the discharge from a toilet block (black water) on site.

The first phase started with the planting of vetiver in October 2000 and visual observation to date is very impressive. After 5-month growth vetiver is now over 2 m tall and a stand of about 100 plants in an area less than 50 m^2 have completely dried up the black water discharge.

The second phase of monitoring is now being carried out where nutrient load of discharge will be determined above and below the absorption area to demonstrate the efficiency of VS in decontaminating black water effluent.

P., DNR&M

Objectives: To demonstrate the efficiency of VS in off-site pollution control by trapping agrochemicals and nutrients in runoff water from agricultural lands.

Previous sediment and runoff analyses associated with monitoring the quality of water in tropical Queensland rivers have indicated that, in general, greater than 95% of the nitrogen, phosphorus, herbicides and pesticides lost in the runoff are associated with the particulate fraction. The absolute nutrient losses in soluble form are negligible. The key to controlling off-site nutrient movement in runoff is therefore to control sediment movement.

This project was completed and the paper entitled "Techniques to reduce off-farm movement of soil, water, nutrients and pesticides" was presented at the Tenth Australian Cotton Conference in August 2000.

It was concluded that VS is a simple and effective method of filtering sediment and chemicals once they have left the cotton field. Vetiver is one of a number of vegetative systems being used worldwide for this purpose, but the VS has the advantage of being easy to establish, vetiver grass is sterile, and it is highly tolerant to most farm chemicals and heavy metals.

As a result of this work, DNR now requires farmers to use VS as a requirement in their land and water management plan.

3. Vetiver for Water Quality Improvement by Truong, P., DNR&M; Cook, F., CSIRO; and Carlin, G., CSIRO

Objectives: To conduct field trials on the use of VS for canal and drainage channel stabilization on acid sulfate soil (ASS) to improve water quality.

Channel bank erosion is fairly severe along both farmer's drains and canals. The erosion is due mostly to concentrated flow of runoff water from sugarcane fields and also to the erodible nature of ASS. The collapse of the banks results in severe siltation of the channel, reducing the flow capacity and water quality is also affected due to the introduction of ASS to the water.

Research conducted in sugarcane lands in Mackay and cotton farms in Emerald indicated that vetiver hedges are very effective in trapping nutrients and agrochemicals in runoff water.

The objective is to demonstrate the effectiveness of the vetiver grass system in:

- Stabilizing the banks of farm drains, canals, creeks and streams.
- Trapping eroded sediment, nutrients, agrochemicals and sugarcane trash in runoff water.
- Improving water quality in drains and canals that could be reused for irrigation purpose.

The trial site is on Mischkes' sugarcane farm at Pimpama, and the first stage of this project - establishment of vetiver hedges - was conducted in October 2000. The hedges are now at least 1.5 m tall and have attracted a lot of attention from local farmers and Shire Council. The second stage - monitoring of erosion and water quality - will be started in November 2001. The ASS task force - a federal agency - has agreed to provide funding support for the monitoring phase in term of equipment and chemical analysis costs.

4. Vetiver for Riverbank Stabilization by Smith, R., USQ and Truong, P., DNR&M

Objective: To quantitatively assess the hydraulic impacts of vetiver hedges applied to riverbanks and floodways under deep, high velocity flows.

Review: An extensive search and review of the available literature on bioengineering methods for stream bank stabilization has been undertaken. The emphasis of this review has been on the assessment of the hydraulic resistance of thick tall vegetation and of the impacts of this vegetation on the stream characteristics and behavior. The main outcome of this work is expected to be a new quantitative description of the hydraulic resistance offered by vetiver hedges under deep flows. The analysis leading to this model is continuing and a report on the review is being prepared.

Laidley Field Site: A field site has been identified in the Lockyer Valley adjacent to the town of Laidley. The site under investigation is at the upstream end of an urban floodway that is subject to frequent flows about 1 m deep and is susceptible to erosion. Several vetiver grass hedges have been established to help prevent the erosion.

Instrumentation for the site has been acquired. Flow depths and velocities will be measured using four Starflow Ultrasonic Doppler flow meters. Calibration of the meters in the large outdoor flume at USQ is in progress. A compound to house the data connections and power supplies of the meters will be designed and built in conjunction with the local shire council.

The information gathered from the site at Laidley will serve to verify the model of hedge resistance developed from the review.

Callandoon Creek, Goondiwindi: A second field site has been selected at Callandoon Creek in South West Queensland. This creek is a main flood channel off the McIntyre River and is suffering from major stream bank erosion. With the assistance of the local shire council sections of the creek bank will be planted to vetiver.

This site has the advantage that the council has a hydraulic model of its present characteristics. The model will be re-run with the vetiver (using the above description of the hedge hydraulics) to predict the impact of the hedges on the flow characteristics.

Field testing at this site will involve the establishment of a new rating curve (depth *vs* discharge) for the creek once the hedges have reached a mature size. The earlier modeling will be verified by these subsequent field measurements. Periodic measurements of the stream cross sections will gauge the effectiveness of the hedges in stabilizing the creek.

5. Calibrating Vetiver Grass for MEDLI Model Application - Model for Effluent Disposal using Land Irrigation by Truong, P., and Vieritz A., DNR&M; Smeal, C., and Mckenzie, S., Leiner Davis Gelatin; Doley, D., and Mckenzie, S., University of Queensland

Objective: To provide a full data set of vetiver grass for application to the MEDLI model.

Vetiver grass has been used very successfully in Queensland for the safe disposal of black and grey waters from domestic sources. Due partly to the success of the above project and partly to the need for a more effective system to dispose large volume of effluent from industrial plants such as abattoirs, food processing factories and intensive livestock farms, the Queensland EPA has recently recommended these industries to use VS instead of the traditional pasture species.

For applications in these industries, the disposal strategy is based on the use of MEDLI, a computer model used to determine the land area and management practices needed to dispose a certain volume and N and P content of the effluent. To date MEDLI has been based on the use of common tropical and subtropical grasses and forage crops.

To fully demonstrate the effectiveness of VS in the MEDLI model, vetiver grass needs to be calibrated for MEDLI. A new data set is required and this set is specially designed to provide specific data to run MEDLI.

Minutes of TVN Board of Directors' Meeting

At the Board of Directors' Meeting of the Vetiver Network held in May 2001 in Washington, DC, the following minutes were recorded:

"The Directors support a 'Resolution of Gratitude' to Heineken Brouwerijen for providing core support for a comprehensive 2-week Vetiver System Training Program in Thailand for 31 field workers from 15 countries. The Board endorses this application of Heineken green funds, which were used wisely and successfully by the Thai Royal Development Projects Board, and notes that the Heineken curriculum will serve well as a foundation for future activities".

Letters to the Editor

Yellow Vetiver

I have got a message from Pingtan Island in Fujian Province, southern China, which states that vetiver usually turns yellow and wilt in the winter time. This makes the people in the Highways Bureau unhappy. Recently Pingtan farmers/technicians found that the grass remained green in the winter when cattle kept grazing. If they cut the grass every few weeks, the grass remained green. This might be an alternative for the highways and other engineering sectors.

Liyu Xu, Coordinator
China Vetiver Network, Nanjing, China

Thanks for sharing this valuable information with us. Physiologically speaking, this is to be expected when plants are forced to rejuvenate by cutting down the mature, senescent parts, the newly emerging tissue/organ is in its juvenile stage and remains green until senescence sets in. This is why we recommend the farmers to keep cutting down vetiver leaves every three to four months to keep the clump active and encourage more tillers to be produced. Thus, it should be a routine practice to cut down the whole clump to about 20 cm every three to four months. Animal grazing, in a way, has the same effect as cutting. ***-Ed.***

Vetiver Hedge and Water Conservation

I was interested to read in your Editorial on 'Global Warming'*(in Vetiverim 17 - Ed.)*, the problem of the floods in Hat Yai. This is something that I have been advocating for years - planting vetiver hedges in the catchment areas or watersheds of these flood-prone flats to slow down runoff and prevent major floods. Doral Kemper, Senior Soil Conservationist at USDA, agreed that if they had had a system like the vetiver grass hedges, instead of soil conservation banks in the catchment of the Mississippi River, the extreme flooding of the 80s may not have been a problem.

In the United States where soil conservation is law, the extensive system of diversion banks and waterways has one unexpected disadvantage. In the soil conservation design criteria, it clearly states that *runoff should be diverted as quickly and safely as possible to the drainage outlet.* What they had not considered here was *with increased land clearing and cultivation, the increased runoff to and from these banks being delivered at a fast pace to the natural drainage network caused major flooding*. This would not have occurred under natural conditions.

Today, we can't go back to natural ground cover, but we can effectively replace it with strategically-planted and well-managed vetiver hedges. Such a system would hold back runoff, giving it a chance to refill depleted ground water aquifers and increase moisture storage in the soil, delivering far less runoff to the drainage network. This work, initially would have to be financed by the government as a watershed development project, but the resulting increase and sustainability in yields would ultimately cover the cost.

What I would suggest, is taking a small but flood-prone catchment (or micro-watershed) and stabilizing it with vetiver hedges right down to the river bank as an example of how this system could work - doing a cost/benefit study for the project and using it as an example and demonstration area for other larger watersheds. Hectare budgets could be calculated for farmers cropping in the project area.

Another point I would like to raise is, when I first wrote the little 'Green Book' back in India in 1988, in the introduction I emphasized the importance of 'Water'. The Green Book has now been reprinted many times and in many languages, which is good, but it has lost its reference to water in the process. I think clean water will be one of the most important factors in the survival equation of this millennium. Only vetiver hedges are effective at economically

feature should be brought home to villagers as an important use of vetiver to their advantage.

Also, while on the subject of 'water'; when I was trying to get Indian farmers interested in using vetiver hedges, there was no use telling them about soil conservation that had failed them badly in India, for reasons of poor design and loss of land to banks. What I asked them at field days was "Are you interested in increasing your yields by 10%". Now even a tenant farmer pricks his ears up at this, especially if it doesn't cost him too much. So we introduced vetiver hedges as a means to increase soil moisture and therefore increase yields - and it worked. Yields increased by 20-30% on the average. If you are conserving water, you are conserving soil, but the farmers were more interested in conserving moisture for their crops.

John Greenfield, Former World Bank Consultant
Email: <Greenfield@xtra.co.nz>

Thanks for sharing your experience on vetiver hedge and water conservation with us. I fully agree with you that the vetiver hedges have a great potential in mitigating flood and other disasters, in addition to making the soil moist, thereby mitigating drought and increasing crop yield at no extra cost to the farmers. ***-Ed.***

New Effective Approach in Vetiver Propagation

I stumbled on another, perhaps more rapid and less troublesome method to speed up the rooting process of vetiver shoots for more effective multiplication. I am interested in your experience and to hear if any of you are willing to experiment with the method to explore the results in your area (altitude, see below).

I had some vetiver slips sent from a reputable South African supplier (thanks to Duncan Hay of the Southern Africa Vetiver Network). Plants were packed bare-root in carton boxes that had been lined with black plastic, and water had been sprinkled on the tightly packed plants to keep them damp. The plants took about 8 days to arrive, from time packed to clearing customs and delivery. When I opened the cartons, nearly all the bare root slips had new white roots growing from the crowns, some measuring up to 3 cm, especially the carton that had been well sealed and had almost no chance for air or water to escape. There was lower growth in the box that did not have sufficient humidity. We immediately put the plants in damp soil, reducing to a minimum the amount of time roots were exposed to light, and put them in bunches of 25 to await dispatching. We had ordered 4,000 plants that had to go out to several districts in Senegal. Now some 4 weeks later, I have almost 100% growth, and very speedy retakes, faster than the cow-tea bath we often mentioned in multiplication efforts. When I dispatched the plants to other regions (some a week later, sealed, dampened cardboard box trick), we had similar results when unpacked in the field. Since then I have tried to replicate the method, and find that it works, although not as well as the plants that had an 8 hrs airplane ride.

I am looking for other experiences. I suspect the plants, under stress, liked the dark, the cold and the damp, and subsequently sprung roots in their effort to survive. Tell me if testing this method interests you, and if you can replicate. I would be happy to hear the results of your efforts in your respective zones. Richard Grimshaw indicated he had a similar experience years back in India when he received a shipment of vetiver also sent by plane. We are not sure whether it is the plane ride or the dark, humid atmosphere, but perhaps this stumble will lead you and others to experiment.

Criss Juliard, DynEnterprises, Dakar, Chemonics International
<cjuliard@DYNAENTERPRISES.com>

This was a letter sent to various people in the vetiver circle, including the Editor. Keeping the plant materials moist and cool in tightly sealed container is a common practice for horticulturists in transporting them for propagation in other places at a later time. This, no doubt, works well with vetiver during long transportation. Darkness may have some effect, but

Training of Vetiver Handicraft Making

I recall reading in a prior issue of Vetiverim that in Thailand your crafts people are creating beautiful items from vetiver, and that you are willing to train people from other parts of the world. I am a volunteer at The Future Centre in Barbados, West Indies, where we are creating a center for education about sustainability. We want to include an exhibit of vetiver (which, incidentally, was used in Barbados centuries ago in connection with growing of sugar cane), and would like to create a space where crafts people could make and sell items made from vetiver. I have talked with a local basket maker who is using vetiver, but in very simple items; she expressed interest in learning how to create more sophisticated products such as are being made in Thailand. Please, if it is still available, let me know the details of your offer of training.

Marilyn Gilmore, The Future Centre
Edgehill, St. Thomas, Barbados, West Indies
<marilyngilmore@sunbeach.net>

Thanks for your interest in our program. We are now planning to organize the training course on vetiver handicraft making in Thailand, but we are still looking for a donor support, and will let you know if this is successful, otherwise the trainees will have to pay the expenses as stated in Vetiverim 17. – ***Ed.***