Editorial

Global Warming

During the first year of the third millennium, 2000 (or rather the last year of the second millennium?), a large number of people in Thailand, (as well as many other countries,) have suffered from floods, landslides, mudslides, etc. Many provinces in the Northeast had one of the severest and longest (as long as five months!) floods in the recent history. Floods in Hat Yai, southern Thailand, were probably the worst in terms of damage to the economy of this commercial city Hundreds of people died, many injured, and the loss of their properties was incalculable. It was a disaster caused by heavy rains!

But what was the main reason for such heavy rains? Was it the global warming due to the effect of the El Nino or La Nina, or both? As is well known, these phenomena originated as the result of massive deforestation and the release of large amount of CO_2 to the atmosphere, resulting in the greenhouse effect which ultimately ends up in the rise of temperature and several other related phenomena, like heavy rainfalls the melting of polar ice, the rise of mean sea level, etc. Is there a solution to solve this problem, or at least to mitigate such a disaster? In the case of Hat Yai, many years ago His Majesty the King of Thailand suggested the authorities to dig a large canal to drain excess water from the rain down to the sea. Due to the lack of budget (or interest?), it was not done; otherwise, we would not have had such a disaster.

Another of the most favorite subjects of His Majesty, the vetiver grass, can also contribute much to mitigate such a disaster. How can a simple and humble grass like vetiver do such a big thing? A few years ago scientists working a t CIAT 9international Center for Tropical Agriculture in Cali, Colombia) published their most interesting findings in *'Nature'* magazine. They claimed that two grass species in the savannas of South America may remove as much as two billion tons of carbon dioxide (CO_2) - - a greenhouse gas – - from the atmosphere annually. One of these grasses is *Andropogon guyanus,* a closely related species of vetiver (Vetiveria zizanioides). CIAT researchers said that the two grasses store as much as 53 tons of CO_2 as organic matter per hectare per year. This is because the extensive roots of these grasses deposit the organic matter as deep as one meter in the savanna soil. Just imagine with vetiver, whose roots are much more extensive and deeper than those two grasses, how much more CO_2 will be removed from the atmosphere and fixed in their root systems. If a hectare of deep-rooted grass absorbs 53 tons of CO_2, a square meter will about 5 kg of this greenhouse gas during a year of growth. Comparable to these grasses, a full-grown clump of vetiver would absorb at

least 5 kg of CO_2 annually. If we could plant just a million clumps of vetiver, they will absorb 5,000 tons of CO_2 The Doi Tung Development Project in Chiang Rai alone used to plant 100 million vetiver plants a year; that means that it alone has provided 500,000 tons of "atmospheric cooling" benefit. By CIAT calculations, that is as much as CO_2 emitted by 100,000 cars, each driven 20,000 km. As the annual global increase in atmospheric CO_2 is estimated to be about 20 billion tons a year, we only need to plant 4,000 billion veitver plants to absorb all this gas and we probably don't need air-conditioning to cool down the air around us (Vietmeyer 1997; Enoch 1998).

Vetiver is truly a miracle grass, as it can do miracles, including the mitigation of disaster caused by destructive heavy rains, in addition to several other well-known benefits to agricultural and non-agricultural activities. While waiting for a huge budget at the time of our economic crisis (and worsened with commitments to spend our limited national budget on many unnecessary expenditures) to dig large canals for draining excess rain water, will it be safer in ass respects to plant more and more vertiver everywhere throughout the whole country? This is another of His Majesty's wishes since 1992.

Reverends

Enoch, H.Z. 1998. global perspective of vetiver. Proc. ICV-1, pp. 120-127.

Vietmeyer, N.D. 1997. Annex 4 – Conference Summary. *In:* Report of ICV-1. ORDPB, Bangkok, pp. 32-36.

Vetiver Glossary: 3. Species and Related Taxa

This is the third part of the series on Vetiver Glossary. The first one, on the Vetiver and Its Related Terms, was published in Vetiverim-15. The second part, on the Vetiver System, was published in Vetiverim-16. The format used includes the definitions from Webster's New World Dictionary, Third College Edition, and from the Editor, known as Vetiverim's followed by explanation of each term. This deals specifically with the term "species" and its related terms.

Taxonomically speaking, the hierachy exists at every level, from Kingdom, Class, Order, Family, Genus, and Species. At each level, there may be categories above and below which are in between the two levels; e.g. between Family and Genus, there are Subfamily, Tribe, etc.; between Genus and Species, there are Subgenus, Section, etc.; and below the species level, there are categories like Subspecies, Variety, Strain, Ecotype etc.

Species:

Webster's: *n.* a naturally existing population of similar organisms that usually interbreed only among themselves, and are given a unique, latinized binomial name to distinguish them from the other creatures.

Vetiverim's: *n.* 1 a taxonomic subdivision of the ranking genus. 2 a group of interbreeding or of potentially interbreeding organisms, or of apomictics, or of other sexually reproducing organisms comprising a biotype, separated from other sexual and asexual groups in the genus by reproductive isolation. 3 a group of related and interbreeding populations of organisms (plants and animals) sharing common genepool and general characteristics, but are reproductively isolated from other species.

Explanation: In vetiver, 11 species have been recorded, of which two are commonly used for soil and water conservation purposes, viz. *Vetiveria zizanioides* and *V. nemoralis.* A third species, *V. nigritana,* occurs in Africa, and has also been used for soil and water conservation in that continent. Note that it is a common practice based on the nomenclature rule that the whole name, known as scientific or botanical name, is written in italics, with the first letter of the genus being capitalized, while the rest is in small case. To the layman, species is equivalent to 'kind'. In fact, Carolus Linnaeus, the father of systematic biology, called the "kinds" species, and gave each species known to him a name in Latin, many of which are still valid up to this day. According to Linnaeus, a species has morphological distinction and does not contain subdivision as race. This is known as Linnaean species. Although written in the form of plural, species can be in both singular and plural froms (there is no such word as 'specy').

Specific Epithet:

Webster's: none. The term 'epithet' means 'that which is added to'.

Vetiverim's: *n*. latinized name in the specific rank of the binomial system of nomenclature.

Explantion: In taxonomy, 'specific epithet' denotes the species; e.g. *zizanioieds* is the specific epithet of *Vetiveria zizanioides*. Note that specific epithet, by itself (e.g. *zizanioides*), unlike the generic name (e.g. *Vetiveria*), is meaningless and cannot be used to denote a species. It has to be preceded by the generic name. It is mostly misunderstood as species or specific name. Note the following used:

Botanical or scientific names of vetiver are: *Vetiveria zizznioides* and *V. nemoralis*

Generic (or just genus) name of the vetiver is: *Vetiveria*

Specific epithets of vetiver are: *zizanioides and nemoralis*

Subspecies (or race as used in animal, including man):

Webster's: *n.* any natural subdivision of a species that exhibits small, but persistent, morphological variations from other subdivisions of the same species living in different geographical regions or time.

Vetiverim's: n. 1 a geographical localized population of organism within a species which differs genetically or taxonomically from other subdivisions of the species. 2 distinct populations of a species that can, and often do, cross and exchange genes.

Explanation: The subspecies name is usually the third term (not capitalized) in a trinomial. Hybridization of subspecies may, and sometimes does, lead to their fusion in a single population. This rank does not exist in the whole genus of Vetiveria, i.e. all species of Vetiveria are not further subdivided into subspecies. However, distinct populations of vetiver do exist, but since the distinction is not great enough to be classified as subspecies, they are thus classified as ecotypes.

Genus (pl. Genera):

Webster's: *n.* one of the major taxonomic groups used to scientifically classify plants or animals.

Vetiverim's: *n.* a taxonomic group below the tribe (if any) or family, usually containing two or more species whose structural features are so similar that the species are considered as having a common ancestor.

Explanation: Several closely related species, or rarely one species, make up one genus; while several genera, or rarely one genus, make up a family. The first letter of the latinized generic name is capitalized and the whole name is italicized, and precedes the specific epithet, which is italicized but not capitalized. *Vetiveria* is the genus to which all species of vetiver belong.

Subgenus:

Webster's: none.

Vetiverim's: *n.* a taxonomic category between genus and species, for the definition of groups of related species.

Explanation: This taxon does not exist in most genera including the genus *Vetiveria* whose subdivision is directly to 11 species.

Ecotype:

Webster's: *n.* a group, or race, within a species, having unique physical characteristics genetically adapted to particular environmental conditions.

Vetiverim's: *n.* 1 an ecological race or subspecies distinguished by morphological and physiological characters that are induced by the selective effects in a particular environment. 2 a population of plants whose origin is derived from a given habitat, area or region, e.g. in swamp, in meadow, along the beach, on high mountain, in acid sulfate soil, etc.

Explanation: Ecotypes of the same ecospecies are interfertile and have fertile offspring. They may be distinguished as edifice, climatic, climatic, or biotic. In case of vetiver, they are referred to the type that was collected from a particular location having certain unique characteristics. Ecogypes exist for both *V. zizaniodes* and *V. nemoralis*, at least in Thailand where several ecotypes have been identified, e.g. 'Surat Thani' , 'Kamphang Phet'.

(Botanical) Variety:

Webster's: *n. Biol*. Loosely, a group having characteristics of its own within a species or subspecies; subdivision of a species. *Bot.* a variant form of wild plants that has been recognized as a true taxon ranking below subspecies even though it may have been brought under cultivation: e.g. cabbage *(Brassica oleracea var. capitata).*

Vetiverim's: 1 an indefinite subdivision of a species usually applicable to a morphological variant or variant group. 2 a variant in color, or in habitat. 3 a taxon lower than species (and also subspecies, if exists).

Explanation: The work is often used synonymously but erroneously for "cultivated variety" or "cultivar" (see below). Note that the name of botanical variety is latinized and, therefore, italicized.

Cultivar:

Webster's: *n.* variety of a plant species originating or continuing in cultivation and given a name in modern language.

Vetiverim's: a shortened version of cultivated variety, specifying a variety of cultivated plants.

Explanation: This term is used to describe a distinct population of cultivated plant of a given species whose characteristics are distinct from the other (if any). A species, e.g. mango, may have as many as 100 cultivars. In horticultural crops, cultivars are normally asexually propagated, like in fruit crops; in field crops, they may be sexually or asexually propagated. Most people prefer to use the term 'variety' in place of 'cultivar'. One should bear in mind that the term 'variety' is meant for 'botanical variety', i.e. wild or naturally occurring plants. However, since the term 'variety' has been popularly used by agriculturists, it is alright to use it, provided that the user realizes that it is not 'botanical variety' , but it is 'cultivated variety' . Depending on the degree of cultivation, cultivar can be separated into: (i) primitive cultivar, and (ii) advanced cultivar (also called improved cultivar, modern cultivar, high-yielding variety) which are crops grown commercially, deriving from either selected materials (without breeding), or through breeding. In vetiver, many so called ' varieties' are known, e.g. 'Sunshine','Monto'. Although their breeding history is not known, it is assumed that they have been bred by certain institutions, probably for their high yield of essential oils, rather than for use in soil and water conservation. The name of the cultivar is not latinized, and is conventionally put between two single inverted commas, e.g. *Vetiveria zizanioides* cv. 'Sunshine'.

Cultigen:

Webster's: *n.* a cultivated plant not known in a wild form and presumably originated in cultivation.

Vetiverim's: *n*. a cultivar that has been consciously selected and the genetic identity maintained.

Explanation: A good example of cultigen is the pummelo (not pomelo!) in which all the present day 'varieties' are derived form a wild form through a long period of cultivation, selection and clonal propagation. In the case of vetiver, the term 'cultigen' can also be used in place of the commonly used term 'variety'. The reason is that the wild vetiver is weedy; it is a seedy plant that has fertile pollen and normal meiosis, and it gets around on its own. However, the traditional oil-type vetiver is domesticated; it is not fit for survival in the wild. Because of pollen sterility and irregular meiosis in the South India type, it is a domesticate. Humans have made the sterility persistent by intervention. Thus it is a cultigen. What we have with all these differently named vetiver varieties are a series of cultigens that were selected by humans over the past several centuries for their particular agronomic qualities. They have a distinct genetic identity that has been purpose fully maintained. Many of them are well characterized phenotypically, and DNA finger-printing has shown that these groupings are feflected genotypically.

Clone:

Webster's: *n.* 1 all the descendants derived asexually from a single individual, as by cuttings, bulbs, etc. or by fission, parthenogenesis, etc. 2 am individual produced by cloning.

Vetiverim's: *n.* A group of organisms produced from a single organism by any form of asexual propagation, as by division, offsets, rhizomes, stolons, budding, cuttings, grafts, mitotic division, etc.; such a group of organisms has the same genotype as the parent organism.

Explanation: Vetiver is essentially a clone of a given ecotype or cultivar or line as it is usually clonal propagated.

Population:

Webster's: *n.* all the organisms living in a given area.

Vetiverim's: *n.* 1 group of organisms of the same species that occupy a particular geographic area or region. 2 An interbreeding group of organisms delimited by the environment or by the breeding system.

Explanation: In general, individuals within a population interbreed with one another.

Genotype:

Webster's: *n.* 1 the fundamental constitution of an organism in terms of its hereditary factors. 2 a group of organisms each having the name hereditary characteristics. 3 the type species of a genus.

Vetiverim's: *n.* 1 the genetic constitution of an organism or groups of organisms that may be either expressed or unexpressed, contrasted with phenotype, depending on the environmental effects of a given location. 2 The hereditary properties and materials of an individual.

Explanation: Since we now know the genetic relationships among many different vetiver 'varieties' or 'cultivars' , we can speak of various vetiver genotypes. In particular, we can say that the cultivars 'Monot' , 'Vallonia', and 'Sunshine' are all one genotype. In this context, 'variety' implies reproduction or genetic selection/breed line.

This is an ambiguous term, since it can refer to the genetic constitution at any level of organization (taxa) – thus, has a "plant genotype" , a "monocotyledon genotype" , a "grass genotype" , etc.; because of this, genotype is generally used with an adjective to clarify the specific level referred to, which is generally the most specific level for which knowledge is available, as a means of stating genetic identity (more accurately, homology) between two specimens. With many vetiver varieties, such as the Thai and Yoon collocations, genotype refers to essentially total co-identity-all Surat Thani genotypes (now known as 'Surat Thani' ecotype) share identical (non-polymorphic) genomes.

Phenotype:

Webster's: *n.* 1 the manifest characteristic of an organism collectively, indulging anatomical and physiological traits, that result from both its hereditary and its environment. 2a a group of individual of such a group. 2b an individual of such a group.

Vetiverim's: *n.* 1 the sum total of the environmental and genetic (hereditary) influences on an organism. 2 the visible characteristics of an organism. 3 the total of character exertions of an individual, as contrasted with its genotype (genetic constitution).

Explanation: Individuals of the same phenotype look alike, but may have different genotypes. In the case of clonally propagated vetiver, it can be stated that the same phenotype means the same genotype. Although it takes lots of experience to look at a vetive4r and say it is a nonfertile type, we are pretty certain that uniform genotype means uniform phenotype, and *vice versa*, which is not the case with sexually-propagated plant that are segregating.

Biodiversity (Biological Diversity):

Webster's: *n.* diversity, or variety, in the living things in a particular area or region.

Vetiverim's: the variability among living organisms and the ecological complexes in which they occur.

Explanation: Being largely a wild population, vetiver's is large. However, those of the cultivars are of narrow genetic base as they were all derived from a few cultivars by clonal propagation. This could be dangerous. An insect or disease adapted to a particular genotype could spread and

decimate millions of plants of erosion control terraces. Thus, diverse ecotypes should be used as hedgerows in such a system to avoid catastrophe.

Collection:

Webster's: *n.* **1** the act or process of collecting. **2** things collected.

Vetiverim's: *n.* specimens of a certain group (mostly applied to plants) collected for certain purposed, e.g. for identification, multiplication, breeding, or other botanical studies. (*cf* germplasm collection).

Explanation: This is a multi-purpose collection maintained by scientists for various purposed, mostly of varieties or cultivars having potential for practical applications.

Germplasm Collection:

Webster's: n. none.

Vetivrim's: *n.* a collection of many different varieties, species of subspecies representing a diverse collection of genotypes and, hence, genetic diversity.

Explanation: Vetiver germplasm collections maintained in many stations are mainly used as type specimens for identification purpose. The specimens are in the form of wild populations of known specific identity (e.g. *V. zizaniodes* or *V. nemoralis*), known cultivars (e.g. 'Monto' or 'Sunshine'), known ecotypes (e.g. 'Surat Thani' or 'Songkhla 1'), or just simply of the locations they were collected (e.g. Mae La Noi or Sakon Nakhon).

Fuel for Thought*

I don't know whether I am lacking in imagination, or we all are. I have for many years considered that the reason so many major cities of past civilizations disappeared leaving only their ruins, was that they over cultivated their soils to a point where they were eroded away or could not produce enough food to support their inhabitants, or they salinized vast tracts of land, rendering them infertile because of poorly designed irrigation schemes that had not included appropriate drainage.

Looking at the problems today of Easter Island, Machu Picchu in Peru, or the ruins of Zimbabwe, or Petra in Jordan, to mention just a few. These cities more likely ran out of fuel! Without fuel they had no way to cook and no way to build or heat their houses, make weapons to defend themselves, build boats or farm implements, no way to break up granite for building, in the case of Zimbabwe. But most important, as I now see it, they had simply had no more fuel. Hundreds of years

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ago, some civilizations could move to new areas where there were vast forests, providing all the fuel[1] they needed, others couldn't and just battled each other over the remaining fuel supplies, or just disappeared.

At least half of all the timber cut in the world today still serves its original role for humans-as fuel for cooking, and in cooler mountainous regions, home heating. Nine-tenths of the people in the poorest countries today depend on firewood as their chief source of fuel.

Today, the growth in human population is out pacing the growth of new trees. This is not surprising when the average user burns as much as a ton of firewood a year. This results in soaring wood prices, a growing drain on incomes and physical energies in order to collect the basic fuel needs. It is a costly diversion of animal manure (in some countries the only source of crop fertilizer they have) from production uses to cooking, and ultimately to an ecologically disastrous spread of a treeless landscape.

For the family that needs firewood for fuel, wood is crucial to their daily existence, and the price for this basic life-support is steadily increasing. The world's fossil fuel crisis and the world's abhorrence of using atomic energy (until we know a safer way of handling it) is creating a firewood scarcity of unprecedented and generally unacknowledged magnitude in developing countries. What had been the most feasible substitute for firewood, kerosene, has now been pulled even farther out of reach of the world's poor by the resent and increasing fuel crisis. As a result, wood gathering is on the rise but is being made more difficult than ever by the increasing deforestation and erosion of woodlands exacerbated by no recognition of the problem and no planting of fast growing wood lots. In the tropics, woodlots could easily be planted in "alang alang *(Imperata cyclindrica)* deserts", the result of deserted 'slash-and-burn' subsistence farming. Charcoal prices have risen faster than kerosene prices. Something has to be done and done soon. Trees do not grow over night!

One of the already tried and proven species of fuelwood production is leucaena *(Leucaena leucocephala)* which can be adapted to more arid areas with the use of strategically planted vetiver hedges. Average annual growth increments of leucaena are expected to be between 30 and 40 m^3/ha after 8 years, but the trees have to be trimmed for best results; thinning can be used for fuelwood.

[1/] Eckhol, E.P. 1976. Losing ground: Environment stress and world food prospects. Worldwatch Institute)

[2/] National Academy of Science. 1977. Leucaena – Promising forage and tree crop for the tropics. Washington, DC.

However, it does grow well in semiarid and savannah regions[1/] of the dry tropics, as well as the more humid lowland tropics where the need for fuelwood is still substantial. Growing leucaena in plantations, along roadsides, in shelter belts, on farms and on unused land throughout rural areas could be one step toward relieving firewood scarcities. In rural areas, leucaena wood can, not only provide energy for cooking, heating and cottage industries, but also provide jobs and cash income form the production and sale of wood and charcoal to nearby urban regions.

Vetiver hedges would ensure the sustainability of all newly planted tree lots by providing their moisture and nutrient needs, while at the same time making marginal and rocky hill lands productive for wood lots by planting vetiver hedges across the slope from rock to rock, something that is impossible with constructed methods of conservation.

By planting the vetiver hedges across the slope to establish these tree lots, shade would not be a hindrance to vetiver's growth as they would both be using full light to establish. One established, my feeling is that vetiver would remain viable in the leucaena wood lots, even better than it does in sugarcane fields due to the light canopy of the leucaena and the fact that leucaena produces a considerable quantity of nitrogen form its litter and root system. The two could grow together in a benign symbiotic relationship – the leucaena feeding the vetiver – the vetiver protecting the leucaena land during establishment and coppicing after harvest.

Wood producing projects must be undertaken on a far greater scale than now conceived. With the assistance of vetiver acting as a 'nurse hedge' to get young leucaena wood lots established, and when the hedges are green, acting as a fire break for the wood lots, they can be produced on land unsuited for food crops. Once established leucaena is persistent and can be harvested over and over without continual replanting.

On Mount Makiling in Los Banos, the Philippines, leucaena stands have been continuously harvested for firewood for over 55 years and are as vigorous as ever.

The El Salvador-ltype varieties of leucaena grow fast and produce a great quantity of wood which makes them suitable candidates for large-scale "energy plantations" grown specifically for fueling:

- Electricity generators,
- Railroad locomotives,
- Driers for fish, tobacco, grain, and other agricultural produces,
- Facilities for processing cassava, sugar, rubber, or tannins form wattle bark,
- Brick and charcoal kilns, sawmills etc. [2/]

With the problem of forest fires, it may also be worth considering planting *Eucalyptus* spp. Example would e *E. citriodora* in the drier areas, would do well in Thailand as well as some other countries, and could withstand grass fires, or *E. maculata*, the 'spotted gum'. Eucalyptus forests can also be protected in their establishment and enhanced in growth by vetiver hedges. I have done this very successfully in India.

Highlights of the Report on the Visit to Southern China and Vietnam*

A. CHINA

A shot visit to Guangkong was organized by Dr. Xia Hanping to review his research and various joint projects with private companies. I also had the opportunity to discuss the possibility of having ICV-3 in Guangzhou and to seek support from various levels of government during the visit.

Research Projects

Water Submergence: The results of Dr. Xia's current submergence experiment were reviewed. Results to date indicate that vetiver can survive after seven periods of inundation, ranging from 3 to 25 days. Most of the other plants have died.

DNA Screening Trial: Observation was made on growth and behavior of the 13 genotypes being tested by Dr. Adams. According to Dr. Xia the Karnataka genotype so far performed best under southern China conditions.

Meeting South China Agricultural University Researchers: A very interesting and informative meeting was held with Dr. Liao Xin Di of the Animal Science Department, South China Agricultural University, who for the last four years has exhaustively tested vetiver for its suitability and effectiveness in decontaminating wastewater form pig farms in constructed wetland. Among 12 wetland species tested, vetiver came second to *Cyperus alternifolius* in removing BOD, COD, N, P, Cu and Zn from the wastewater. He also found that vetiver can adapt the change from dryland to wetland conditions by increasing the size and density of air chambers in the top.

Native Vetiver Natural Habitat: I also had the opportunity to visit Wu Chun, the home of 'wild vetiver' according to Dr. Xia. In this county, vetiver can be found in most low-lying areas with high water table and often inundated in the season, According to the local people, vetiver has been growing in this area for hundreds of years; it is confined to this habitat and exists nowhere else in China. From its growth pattern and leaf structure, I belivev it is *V. zizznioieds*, not *V. nemoralis*, and

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* *By Paul Truong, Queensland Natural Resources Centre, Brisbane, Queensland, Australia.*

from its widely scattered clumps and self-propagated, it must be a seeded genotype. Although Dr. Xia strongly believes that it is 'native', I think that it was introduced to China centuries ago for essential oil production and has spread from the farms to the wetland by seeds. I was told that in the past vetiver was harvested as fuel for brick production.

Projects and Nurseries

Quarry Rehabilitation: To provide rocks for infrastructure and housing constructions, in addition to the Chinese people's love of rock structures, quarries are a big industry in China. In fact I was never out of sight of some quarries during the 2.5-hour drive from Shenzheng to Guangzhou.

The trial conducted by Mrs. Xu's Garden Engineering Co. at the Shenou Quarry near Shenzheng is highly successful. This very difficult and steep site has been completely stabilized. But the vetiver growth and vigor would be much improved if they had fertilized them at planting and in the following spring. The company's normal practice is to fertilize vetiver only when they pot them, neither at planting nor any follow-up applications. Due to this success, the company has won a very large contract to rehabilitate a number of quarries with the Hongling Quarries.

Pearl-River-Bank Stabilization at San Shui: A very expensive trial is being carried out at San Shui to protect the levee bank of the Pearl River. The combination of massive rock groynes, rock riprap, rock wall, reinforced turf, and vetiver was used at this site. If successful they will have at least another 30 dm to go (and another 30 quarries to go with it). As Dr. Xia was not able to convince the government project engineer, vetiver was only planted on the top of the wall.

Oil-Shale Rehabilitation: Dr. Xia established two trial sites; one on the flat and one on the very steep slope; both sites are very successful, and the company is now ready to extend their planting to cover all their old dumps. As the oil extraction method was not very efficient then, at least 10-15% of the oil-bearing rock was wasted, giving a very high oil content on the waste rocks.

Steep-Slope Stabilization: Mr. Hong, Chairman of the Hongri Group Co., showed me the successful trial on a very steep (almost 90^0) and rocky surface in a suburb of Zhongshan City. Mr. Liang, the city's Principal Architect and Vice Chief of the Construction Committee, was so pleased with the result that he has commissioned Hongri to rehabilitate an old quarry in the city.

Lake-Side Stabilization: Xingfengjiang (Evergreen) Lake near Heyuan City, is the largest lake (360 km^2) in southern China that supplies water to Guangzhou, Shenzeng and Hong Kong However, its capacity and water quality are threatened by the massive erosion of its banks and the surrounding hills. Hongri started planting vetiver on the lakeshore and a very steep and badly eroded hill near the lake last year to demonstrate the effectiveness of VS in stabilizing erodible slopes.

Commercial Nurseries: I visited two large commercial nurseries near Guangzhou. The one operated by the Garden Engineering Co. has a 13 ha area and according to the manager, the nursery currently has at least 50 million tillers, ready for planting this summer at the Hongling Quarries.

The other quarry operated by the Hongri Group has 11 ha area with the current holding of at least 25 million tillers. These are also earmarked for planting this summer on projects won by the company.

B. VIETNAM

The Mekong Delta

The Mekong River is 4,350 km long. Starting in Tibet and finishing in the South China Sea, it has a catchment of over 810,600 km^2 , it flows through is six countries, i.e. China, Myanmar, Laos, Thailand, Cambodia and finally Vietnam.

Over millennia the sediment load of its water has created a massive delta, a very rich alluvial plain, providing the most important agricultural and fishery resources for Vietnam.

Because of the alluvial soil, high water table, numerous rivers and streams, road infrastructure in the delta is very expensive to build and to maintain. The road system in the delta is scarce and poor, therefroe the nework of rivers and canals has always been the main thoroughfares in the delta, providing the main means of transportation for its people and their produces. Over centuries, in addition to the myriad rivers and streams, to improve irrigation, drainage and transportation, numerous canals were also built.

Historically erosion on the banks of rivers in the delta has been an on-going process caused by the siltation of its channels resulting in changes in river hydrology and occasional floods. The erosion was confined mainly to the banks of the Mekong itself; practically no erosion occurred on its tributaries and canals as most boats and barges were manually powered.

Riverbank Erosion: In recent years, almost all boats travelling on the rivers and canals are motorized. These boats produce waves, which relentlessly pounded the banks of these watercourses causing massive erosion. As the texture of these alluvial soil ranges from silt to loam, these riverbanks are extremely erodible when wet. The problem has been intensified in recent years with the introduction of more powerful engines, such as old car and truck V6 and V8 engines. Boats fitted with these engines produce huge waves and the severity of the problems is worse in remote areas as they need faster means of transportation.

Local Measures:

Vegetative method: Water hyacinth and a local water plants *(Phragmites vallatioria L.)* are commonly used to combat the erosion. Water hyacinth is a floating weed, which can choke up rivers and canals. *Phragmits vallatoria* is a perennial grass up to 3 m high, with erect, stout and hollow stem of about 1-1.5 cm in diameter. The stems are not flexible and break easily under pressure. It has a relatively shallow root system of about 0.5 m depth. But due to various reasons, the vegetative means of bank stabilization used locally are not effective or at best provide only temporary relief.

Engineering method: Various constructed barriers such as sandbags, wall constructed with bamboo, wood, rocks, rock basket, concrete and even steel are being widely used, they are expensive to build but their effectiveness depends on the costly maintenance. However most of these structures are inherently not stable as they are built on the soft and highly erodible alluvial foundation.

The combination of vegetative and constructed measures seems to provide the best solution to the erosion problem, but they are very expensive to install and not suitable and practical for most situations.

The Vetiver Solution: *The vetiver system is an effective, practical and low-cost method of riverbank stabilization for low-lying, tropical and alluvial flood lands, it is particularly suited for the Mekong delta because:*

- The Mekong Delta is a “Meandeer Plains” changing its course once it has silted up its present ‘bed’
- The Vetiver System can be applied to all rivers and canals from fresh to brackish water zones and acid sulfate soils of the Delta.
- For the Mekong River itself, as the river its course, the low-cost and fast-growing VS moves with it.
- For the less erodible tributaries and canals, the VS will provide a long-term erosion control measure.

The Central Highland

Land use in Central Highland of Vietnam has undergone a rapid transformation during the last decade. Extensive deforestation and clearing of forest for annual crops and perennial crops such as cashew, black pepper, and especially coffee has caused serious land degradation and erosion leading to the occurrence of catastrophic events such as land slides and flash floods in the lowland.

In Dak Lak Province alone, in the last 10 years the area of coffee has increased from 20,000 to 260,000 ha. The increase in cropping land is mainly resulted from the destruction of open forest.

The newly-cleared forest areas are used by millions of farmers who migrate from lowland areas and from the North. These farmers have very little of no knowledge of cultivation on the sloping land and slash-and-burn is the standard practice. This newly-cleared land is kept clean of weeds. The bare soil on these steep slopes is exposed to heavy rain, between 2,000 and 3,500 mm of rain falling mainly over the period of six months in the rainy season.

The big flash floods, which occurred frequently in the last few years in the lowland, are partly resulted form thee cultural practices. In addition, it has been recorded that wind velocity is increasing, water table is going down and siltation is increasing in all water reservoirs on the highland. Although some conservation practices such as contour banks or terraces on the slope have been demonstrated, these practices are costly, the time-consuming that the majority of poor farmers could not afford them. Some plants have been used for erosion control such as lemon grass, *Crotalaria, Flemingia*, but they are also found ineffective.

The Vetiver Solution: Application of the Vetiver System on sloping land as practiced around the tropical world would be the obvious solution to this problem and VS is urgently needed here.

The problem is no longer confined to land degradation and erosion control. Recently it has become a political issue as the government is now trying to stop the slash-and-burn practice to save the little forest resource left. This ban has resulted in riot in the Central Highland by peasant farmers which was unprecedented in the Communist Vietnam where troops and helicopters had to be used to control them.

Vetiver Hedgerows: A hedge Against Environmental Pollution and for Landscape Gardening

In the fourth-coming conference on "Hedgerows of the World – Their Ecological Functions in Different Landscapes" , organized by the British Center for Ecology and Hydrology, to be held on 5-8 September 2001 in Birmingham, UK, Dr. Paul N.V. Truong of the Queensland's Natural Resources Department and Mr. Michael Pease, the Coordinator of the European and Mediterranean Vetiver Network, will jointly present a paper entitled "Vetiver Hedgerows: A Hedge Against Environmental Pollution and for Landscape Gardening". The abstract of their paper is presented below:

Hedgerows of vetiver grass (*Vetiveria zizanioides* L. Nash) form the base of the Vetiver System which has been used worldwide for soil erosion and pollution control as well as landscaping. Due to its special morphological characteristics when planted close together in line, vetiver grass forms a dense, uniform and attractive hedge under tropical and subtropical climates. Research has shown that vetiver hedgerows can be established under the most adverse climatic and edaphic conditions due to its

extraordinary physiological characteristics. Vetiver grass survives temperatures ranging from 50^0 to -15^0C and is highly tolerant to acidic, alkaline, sodic, saline, and magnesic conditions, high nutrient loads, and elevated heavy metals in both soil and water.

When applied correctly, vetiver hedgerows form a highly effective environmental protection system. Vetiver hedgerows have been successfully for soil and water conservation, windbreak, sediment and agrochemical trapping, and flood erosion control in farmland, steep slope stabilization for infrastructure protection, filter trips, effluent disposal, mine tailings rehabilitation and phyto-remediation. Vetiver hedgerows have been used successfully for landscaping gardens in Asia, Australia and Africa.

This presentation will highlight research data and illustrate various applications of the vetiver hedgerows is gardens, farmlands, highways, industrial and mining wastes.

Vetiver Exhibits for His Majesty the King of Thailand's Viewing

The Royal Project Foundation of Thailand has a firm belief that, in addition to being the plant for soil and water conservation, vetiver can be considered as a gook income-generatign crop. Thus, on 12 April 2001, the Royal Project Foundation, in cooperation with the Thailand Institute of Scientific and Technological Research, the Department of Agricultural Extension, the Land Development Department, the Department of Science Services, the King Mongkut Institute of Technology North Bangkok, Chiang Mai University, the Asian Institute of Technology, the Thai-China Flavours and fragrances Industry Co. Ltd., and the M.F.C. Do. Ltd., put up the vetiver exhibits for His Majesty the King of Thailand's viewing at Chitralada Palace. The theme of the exhibits was "Vetiver as an income-generating plant: A Vertical integration approach". There were altogether ten boards posted, whose details are given below:

Board No. 1: Utilization of vetiver as raw material for the construction of low-cost silo with Demonstration on making silo with vetiver culms and leaves mixed with mud.

Board No. 2: Promoting the cultivation of vetiver as a cash crop for the farmers to produce raw material for the industry.

Board No. 3: Etraction of essential oil from vetiver roots for perfume and cosmetic industries.

Board No. 4: The inhibitory effect of vetiver root extract on pathogens and insect pests.

Board No. 5: Processing of vetiver into industrial pulp and paper.

Board No. 6: Production of melamine products from vetiver.

Board No. 7: Production of wood-substituted vetiver furniture and interior decorative appliances.

Board No. 8: Production of low-cost, environmental-friendly, and energy-saving construction material from vetiver ashes.

Board No. 9: Hydrological model to demonstrate runoff, erosion, and accumulation of silt as the results of vetiver hedgerow planting.

Board No. 10: Intellectual Property Right resulting from R&D on vetiver of the Royal Project Foundation.

Details of all the above exhibits will be presented as the Technical Bulletin No. 2/2001 of PRVN, scheduled to be issued in September 2001.

Seminar on Vetiver and Termites

His Majesty the King of Thailand has asked the Chairman of the Board of the National Research Council of Thailand to conduct research on making particle board with dried vetiver and find out if the board can repel or prevent termites. In order to follow His initiatives, the Office of the National Research Council organized a seminar on "Vetiver and Termites" on 3 May 2001 with the following objectives:

1. To provide a forum for researchers from various agencies to exchange views on vetiver and termites and also to introduce new concept and technology concerned.
2. To provide a guideline for future research and development on vetiver and termites.
3. To induce researchers to put more emphasis on their studies on vetiver and termites.
4. To spedd up and stimulate the issuance of patent on vetiver and termites, and to provide an opportunity for technical officials as well as experts on vetiver to exchange ideas and propose new techniques concerning vetiver and termites.

The seminar was attended by 150 participants comprising of researchers from both public and private organizations, businessmen, as well as relevant exporters. Topics presented in the seminar include "The Importance and Utilization of Vetiver" by the Office of the Royal Development Projects Board, "Vetiver and Soil Conservation" by the Land Development Department, and "Concepts on Using Particle Board Made of Vetiver to Prevent Termites" by the Royal Forest Department. Then the Panel Discussion on "Guidelines for Future Research on Vetiver and Termites" was presented.

It was concluded that researches on vetiver and termites need a considerable period of time, as does the further research to find out if the particle board made of vetiver can repel or prevent termites.

Vetiver Grass: Useful Tools against Formosan Subterranean Termites*

Vetiver grass *(Vetiveria zizanioides)* is an Indian native plant whose domesticated type is cultivated worldwide and subtropical regions for its efficacy against soil erosion and for the commercial importance of its oil, extracted form the roots. People may be familiar with this plant since many soaps, perfumes and after-shaves include vetiver oil as active ingredient. Moreover, nootkatone, one of the 300 components of vetiver oil, is used to aromatize drinks with is distinctive its distinctive grapefruit flavor. What people ignore is that the same pleasant aromas can be our next, natural remedy against those exotic, tiny, whitish bugs devouring houses and kind of wooden structures, and represent the major insect pests in the southern United States.

As part of our research on natural product efficacy against Formosan subterranean termites, we are performing experiments to test the response of *Coptotermes formosanus* to substrates and food sources treated with vetiver oil and some of its components, like nootkatone. The results show that these compounds are able to disrupt termite behavior and physiology as a consequence of direct physical contact, ingestion, or exposure to the vapors. In the presence of these compounds termites show a “lingering behavior” , remaining on the surface all clumped together, unable to organize themselves to reach potential food sources through tunneling activity or building shelter tubes. Moreover, ingestion of wood treated with vetiver oil or nootkatone caused the progressive death of

Fig. 1. Tunnel length of Formosan subterranean termites through sand to reach food source.

Fig. 2. Protozoa population in termite gut.

* *By Lara maistrello and Gregg Henderson, LSU Ag. Center, Dept. of Entomology, Baton Rouge, LA, USA.*

the protozoa living inside the termite gut. Killing these symbiont microorganisms, on which these insects rely on for the digestion of their wooden, would mean a progressive decline of a termite colony through starvation, until total extinction.

These pictures show the results of an experiment in which Formosan subterranean termites had to tunnel through sand in order to reach the food source, a wood slice which had been treated with 1% solutions of vetiver oil (V1) or nootkatone (N1) or Tim-Bor ®, a commonly used pesticide to prevent wood damaging by termites (T1).

The effects on the protozoa population (average number of protozoa per termite gut) show that wood treated with vetiver oil or nootkatone was as effective as the one treated with Tim-Bor ®, inducting a high, significant reduction in the number of these microorganisms, indispensable to termites.

The 17th World Congress of Soil Science

The 17th World Congress of Soil Science (WCSS) will be held in Bangkok, Thailand from 14-21 August 2002. All correspondence should be directed to:

The Secretariat, 17th WCSS Office

Kasetsart University, PO Box 1048

Bangkok 10903, THAILAND

Telephone: (66-2) 640-5787 or 5707 or 5708; Facsimile: (66-2) 940-5788

E-mail: o.sfst@nontri.ku.ac.th; *Website: <www.17wcss.ku.ac.th>*

The readers may also visit the website of the Soil and Fertilizer Society of Thailand at <www.lsfst.org>. All vetiverites are urged to attend the 17th WCSS as there will be number of papers related to vetiver R&D to be presented in this Congress.

Poster on The Vetiver System – Vetiver Grass

The Vetiver Network has recently published a colorful poster on The Vetiver System: A Proven Solution – Veitver Grass: A Hedge Against Erosion. It is printed on a 120 g art pater of the size 41.5 x 59.0 cm on both sides. The illustrated topics include an introductory past on: (i) The problems we face are growing at a pace that challenges our ability to solve them, (ii) Solutions are often too complex or costly given existing resources and capacity, (iii) Many of these problems share a common solution in The System. The main headings include: The Plant – Vetiver Grass – *Vetiveria zizanioedes*, Why Vetiver Grass, VS for Agriculture, VS of Bioengineering, VS for Water Related Applications, VS for Bioengineering, and VS for Other Uses. All Vetiver Network Coordination who would like to have

copies of the poster are requested to write to Network Coordinator, The Vetiver Network, 3601 B, 14th Street, Arlington, VA 22201, U.S.A., Fax: (001) 703-243-6203, E-mail: <coordinator@vetiver.org>, Homepage: <www.vetiver.org>.

Vetiver for Highway Embankment in Jujian Provinec*

As a recognized worldwide, vetiver is an ideal plant for soil erosion control and fertility recovery. We have been doing. Our best to popularize the vetiver system (VS) among the staff of the Hiaghway Bureau of our province. The cities like Fuzhou and Nanping have planted the grass on high-altitude highways on a large scale since 1998, while Quanzhou and Ningde Cities started in 1999. There were over one millionn tillers being planted, most of them around National Highway No.316. The grass reached 2m high and the roots was over 1m long with 30 tillers/clump. The slopes of the highway embankments which were planted with vetiver grass were stabilized and erosion was controlled.

Since the economy has been developed unequally in different cities of our province, and since there was a difference of the importance with which different people considered, VS has been extended unevenly from city. The technology has been extended rapidly in Fuzhou and Nanping. In Yanping District of Nanping City, for example, a 20,000 m^2 demonstration plot was established. Besides, another demonstration was established in Minhou County of Fuzhou City. Recently, 40,000 m^2 of vetiver were planted on the embankments of the highway from Datian to yongchun. In addition, 135,000 tillers were planted on the highway of the Gu Tian section of National Highway No. 205 in Longyan City.

Vetiver technology achieved good results in stabilizing slopes according to the application in our province. In the next stage, our bureau will popularize vetiver technology continuously. I hope to get your valuable comments and you are welcome to visit Fujian and provide more instruction to the highway greening project of our province.

Notes: Fujian Province was the first province in China to use the VS for highway embankment stabilization. The Highway Bureau released an official document in 1998 requesting engineers and technicians of all cities/prefectures and all counties of the province to study VS and read the paper "Application of Vetiver System for Engineering Purpose" earnestly, and collect experiences form time

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** Extracted from the letter of Mr. Chai yangsong, Director of the Highway Bureau of Fujian Province, China, to Mr. Liyu Xu, Coordinator, China Vetiver Network.*

to time in order to extend VS more rapidly and smoothly. The aforementioned paper was prepared by the China Vetiver Network based on Diti Hengchaovanich's technical bulletin, entitled, "Vetiver Grass for Slop Stabilization and Erosion Control" published by the Pacific Rim Vetiver Network (Technical Bulletin No. 1998/2).

Vetiverim Available in E-mail Edition

As requested by many subscribers that advanced copy of each issue of the Vetiverim be sent to them by e-mail, the management of the Vetiverim decided to comply to this request starting from No. 18. October 2001. The advantages of sending the manuscript by e-mail are cutting down the mailing cost and the time it takes for the subscribers to receive the copy. It also eliminates the use of paper (thereby saving the natural resources), and reduces the workload of the PRVN Secretariat staff as well as the National Coordinators who presently handle the individual mailing to the subscribers within their own countries once they receive copies of the Vetiveim on bulk from PRVN Headquarters.

However, it is also realized that at the present time a great number of our subscribers still do not have access of the e-mail facility. Thus, hard copy will still be produced and mailed out to such members and, especially the libraries. All Vetioverim subscribers are, therefore, requested to notify the PRVN Secretariat by e-mail at <pasiri@mail.rdpb.go.th> of their intention to receive e-mail edition of the Vetiverim, starting from No. 18, October 2001.

Proposal for a Training Course on Handicraft Making

The Office of the Royal Development Projects Board (ORDPB) of Thailand has from time to time received a number of requests from many vetiver-using countries which, in addition to utilizing vetiver for soil and water conservation, want to add more value to vetiver by making handicrafts from vetiver. This is in particular the case for NGO's and the private sector responsible or rural development projects. The ORDPB believes that Thailand has a number of specialists in handicraft – making from vetiver had is willing to pass on the knowledge to other countries. Thus, it has decided to offer a training course on vetiver handicraft-making. The proposed duration of the hands-on training will be two weeks. The venue will be somewhere in Thailand and the trainers will be from the Department of Industrial Promotion. The estimated cost for the training has not been finalized but will be approximately US$ 350 per person, excluding international travel. Unfortunately, there is no budget allocated for this training. Therefore the ORDPB is proposing two means of budget acquisition: (i) to sedk donor support, or (ii) the trainees find their own source of fund. The ORDPB welcomes all suggestions and ideas from the readers of Vetiverim about this training course.

Letters to the Editor

Manuscript of Vetiverim 16

Your work has been so useful to me, and the way you always show the drafts before you publish is an example we should all adopt. I have a few small comments regarding Vetiverim 16:

1. ***Termites:*** As you might know, we have initiated a 3-mouth study on the uses of vetiver in Senegal. It is amazing how many different applications the wild species *(Viteiveria nigritana)* has been put to by farmers who are completely unknown to the 'learned' and research community. Besides being used in a very old and traditional granary (grain storage) as a way to preserve rice crop, the vetiver leaves are soaked in sea water, placed on the ground with rock salt, then the newly harvested rice is placed on the leaf bed. An additional layer of vetiver leaves, also soked in salt water and sprinkled with sea salt, it then placed on top. This method, developed by coastal farmers, is claimed by the practitioners that it eliminates loss by invading pests and mold. The plant is also used for "termite control' in the southeastern part of Senegal.

2. ***Green Book:*** We have completed the French translation, and the book should be available soon from a printer in Senegal. The pictures have slightly modified to reflect an African setting.

3. ***Vetiver oil and Aromatherapy:*** You might add that in the 'Healing Encyclopedia', it is also mentioned that vetive oil, mixed base oil, is *'particularly useful for jet lag'*. In fact I use it regularly when I travel and it does have effect! Not very scientific.

Criss Juliard, DynEnterprises, Chemonics International

<cjuliard@DYNAENTERPRISES.com>

*Thanks for your valuable comments on termites, the green book, and vetiver oil and aromatherapy. – **Ed.***

Vetiver in Senegal

I am baffled by the varieties of vetiver application we are finding in Senegal. The team of researchers whom we have sent to the main ecological regions of Senegal returned with truly incredible pictures, video clips and testimonies of people who swear by the usefulness of the plant, both root and leaf. Yet there in nothing written, of 'known' among the scientific, agricultural, engineering, environmental of forestry community about vetiver ('sepp' in Wolof language, 'sodorde' in Poulaar, 'khamara' in Bamabara). I have seen reforestation documents that only mention trees, irrigation projects that only talk of mechanical structures, road construction projects that lament the lack of financial resources to protect concrete works, and environmental projects that spend large resources trying to stop saltwater infiltration, sanding of cultivation fields, and lament the lack of technologies to fight wind and water erosion. Yet no one 'knows' about vetiver. We have pictures (all of

Vetiveria nigritana) of beehives made of vetiver leaves, comparative pictures that show how vetiver protects against termites (a large problem in West Africa), survival of vetiver under harsh drought, delimited fields with rows of vetiver, some handicraft, mud construction blocks reinforced with vetiver leaves that 'reduce cracking in the walls' , thatched roofs, even small vegetable plots surrounded by rows of vetiver. All of these are out in isolated villages where people do not have 5 Francs to rub together, and where there has never been an extension agent, an engineer, a school, or a forestry station. I am marveled how the technology is truly a farmer's system.

I am working with a group of interested folks to see how we can turn this limited usage into commercial ventures. It's a challenge, and I would be delighted to get suggestions. Our offices are deluged by request for information, technical support, and help in getting plants and knowledge out to potential end users. So far I have resisted doing much promotion until we can get a decent supply base of private nurseries. I hope to be able to send you all summaries of what is happening in Senegal, and how I am trying what was presented at ICV-2. I have just imported 3,000 tillers of *V.zizanioides* form South Africa in an effort to multiply the material, as there in none in country at this time.

Criss Juliard

*Thanks for sharing an interesting event with us. Although your first letter has already appeared (above), but this is also very interesting, thus appears once again. Perhaps your summaries of what is happening in Senegal will be of interest to our readers. Please sent them to us whenever they are ready. – **Ed**.*

The "Green Book"

Once again, congratulations on a great newsletter. Also on republishing the "Gre3enBook". When I first wrote this book in India, I designed it as a co-publishing handbook for extension workers, small enough to fit in their top pocket and made from quality paper so that it would last. By 'co-publishing' what is meant is that all the diagrams are printed on one side of the paper with very little, if any, script on them; just finger numbers Fig. 1 or Fig. 23 etc. referring to the text which is printed on the back of the page. When the book is assembled and stapled in the middle, the text and diagrams are now side by side. This allowed the extension workers to de-staple a copy of the book and translate the text into their own language or dialect on the back of the diagram page, them have it copied, re-staple and issued to their people in their own language. Lately with more information going in to it and more reprints coming out, it has been improved greatly, but has lost this useful ability to be easily translated and reprinted, and is becoming more like a little book. This is great, but I am thinking that there is still a need for the original design and simple message when, for example it could be issued to extension workers in Myanmar of somewhere not familiar with the system. The reason it has done so

well in the past was that I had a team top artists copy photographs for the diagrams, emphasizing the salient features that I was trying to get across and leaving out the scenery in the photos that can sometimes be confusing. Having these photos put in to black-and-white line drawings meant that they would photo copy much better than the original photo itself, even with poor quality photo-copying equipment. The extension workers in many countries seldom have any reference material or books supplied, they are usually at the point of an inverted triangle of administration, yet they are the most important part of that system as they are the ones contacting the farmers – they are where the 'rubber meets the road' as the try manufactures would say. The farmers are always impressed if their extension worker pulls out his little book and shows them the diagram of what they are trying to achieve, the farmer and the extension worker can share the information while they plan the work together.

John Greenfield

<Greenfield@xtra.co.nz>

*Thanks for the useful, historical information about the Green Book, a bible for every vetiverite. – **Ed**.*