VETIVERIM

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Editorial

The Third International Conference on Vetiver

The Third International Conference on Vetiver (ICV-3) is scheduled to be held in Guangzhou, Guangdong, China, the country which has achieved a lot in terms of vetiver research and development during the past decade.

The theme of ICV-3, "Vetiver and Water: An Eco-Technology for Water Quality Improvement, Land Stabilization, and Environmental Enhancement", is most appropriate at the present time when there are increasing international undertakings on conservation and control of global water resources. As has been shown in a number of experiments, both the quantity and quality of water can be improved through the use of the Vetiver System (VS). At least two other international conferences having water as the main theme were also held this year; these are the "International Year of Freshwater" and the "Third World Water Forum", both of which were held in Japan in March 2003.

At ICV-3, a number of vetiver experts will present their findings related to the vetiver's role in water resources improvement. However, ICV-3 will also feature a wide range of the VS applications in other aspects.

As the host of ICV-3, China plans to show the rest of the world of her achievements in vetiver R&D, as well as its problems with respect to water resources. China is, in fact, a country that needs the VS more than most others, simply because it is the largest country in the world in terms of population and the second largest in terms of size, with enormous problems of too much or too little water as well as of wastewater treatment, water pollution, and eutrophication of the water.

It is hoped that all participants regardless of nationality would benefit greatly from their participation at ICV-3. The academic knowledge presented by the vetiver experts, in both the oral and poster sessions, will be supplemented by the practical knowledge from the study tours to the sites where vetiver has been put to work in Guangzhou and other nearby areas in Guangdong Province.

It should be pointed out that nowhere in the world that a country has more than ten private firms involving in consultancy of the application of the VS, some of which will be the highlights of the ICV-3 study tour.

Messages from the Coordinators of the Major Vetiver Networks on the Occasion of ICV-3

The Vetiver Network (TVN)

I have been working with vetiver since 1996. At that time, Dick Grimshaw came to Madagascar where I was working and was swept up by his message and his persona. I think he has that effect on all of us.

I will be taking over from Joan Miller who has volunteered her time above and beyond the call of duty for more than five years now. A respite from this is greatly deserved by her. My principal duties will include being responsible for correspondence and mailings, the annual newsletter, the annual report, contributing to fund raising, coordinating the awards process, and most importantly obtaining a consensus on our activities over the next five year period. Inherent to the last point is a desire on my part to find ways and means to support your local networks and research. Sustainability is the important concept in my approach.

Briefly, I am a sustainable agriculturalist having worked on long-term assignments in Francophone Africa over the past 25 years. I started as a US Peace Corps Volunteer in the Ivory Coast in 1973. Most of my work has been with the USAID, either as a long term consultant or as a project manager within USAID. I recently moved to the US and am now living in the Washington DC area, where I volunteered to become the new TVN Coordinator for the next few years.

The ICV-3 in China in October 2003 will give me an opportunity to meet face-to-face and will provide a forum to discuss profoundly the issues surrounding vetiver as a positive change agent to protect our planet. I have seen much misery in my work in agriculture, but I remain optimistic that life can only get better, especially if tools such as vetiver technology for soil and water conservation are used.

Dale Rachmeler, Coordinator, TVN
Bethesda, MD, USA

The Europe and Mediterranean Vetiver Network (EMVN)

We should not forget that the vetiver system concept has important application in countries to the north and south of where known accessions of *V. zizanioides* are currently most used for soil and water conservation, pollution control and soil stabilization. Elsewhere, similar problems exist and need to be addressed, quite possibly through appropriate vegetative solutions. Other plants are being examined for their suitability in expanding the boundaries of vegetative soil and water conservation in, for instance, china and the united states. I wonder what is being done to breed *V. zizanioides* accessions appropriate for conditions outside the tropics and sub tropics?

ICV-3 promises to be an important and valuable occasion especially since the focus of the conference is on water, an issue that is vital to the global well-being of the new millennium. I have no doubt that the chinese will prove magnificent hosts and that the conference will yield much important information and will, therefore, be a great success.

Michael Pease, Coordinator, EMVN
Lagos, Algarve, Portugal

The Latin American Vetiver Network (LAVN)

There are a lot of expectations about ICV-3 in Latin America. After two successful conferences held in Thailand, the first in 1996, “Vetiver. A Miracle Grass”, and the second in 2000, “Vetiver and the Environment”, where the multiple actual and potential applications of vetiver were highlighted, the third conference to be held in China in 2003, “Vetiver and Water”, promises to be an event that will put together the last innovations on vetiver technology, particularly with respect to water issues. Latin America, as many other regions in the world, has suffered from extreme storms that caused many human and material losses. Also droughts have

impacted negatively many Latin American countries. Water contamination by industrial and urban activities in general, as well as agriculture in rural areas, is threatening water quality of main fresh water sources. If vetiver technology, as a simple and economical tool, can help to solve some of these troubles, it will be welcomed by environmentalists and society in general. Vetiver technology has achieved a good reputation as a tool for erosion control and bioengineering applications in Latin America. New applications of vetiver to solve water-related problems and enhance the environment are flourishing and will be discussed at ICV-3. We are sure that ICV-3 will be a successful event that will bring more information on Vetiver System (VS) to be promoted and applied around the world and particularly in tropical and subtropical Latin America.

Oscar S. Rodriguez P., Coordinator, LAVN
El Lomon-Maracay, Venezuela

The Pacific Rim Vetiver Network (PRVN)

The PRVN is proud to be a part of this global vetiver network. We provide technical services, not only to the scientists and institutions of its 20 member countries, but also of the countries in other regions. Our main activity is to publish a quarterly newsletter – Vetiverim – now No. 26. We also publish technical bulletins at the frequency of 1-3 issues per year; altogether, 13 bulletins have been published since April 1998. A special bulletin on, "Vibrant Versatile Vetiver – An Archive of Useful Information on Vetiver", has also been published.

We are very happy that the Third International Conference on Vetiver (ICV-3) will be held in Guangzhou, China, one of the most active member countries of the PRVN. Since the PRVN Secretariat Office, the Office of the Royal Development Projects Board (ORDPB), and His Majesty's own Chaipattana Foundation are located in practically the same office in Bangkok, the PRVN, which is closely linked with the other two offices, has a major role to play during the entire period of the ICV-3 preparatory stage soon after ICV-2 in Cha-am, Phetchaburi, Thailand was over.

In addition to being the PRVN Coordinator, I also hold a few other related positions, including the Editor of Vetiverim as well as of other PRVN publications, the Secretary of the Continuing Committee of ICV, and a member of the ORDPB's Committee on Vetiver. I have engaged in various activities related to the preparation of ICV-3, starting from the nomination of China as the host country for ICV-3, the selection of Guangzhou as the venue for ICV-3, the acceptance of papers submitted for presentation at ICV-3, the provision of funding supports, the decision of having the Conference held on schedule after being threatened by the incidence of SARS, the coordination with the Organizers on the program arrangement and study tour, and as the Vice Chairman of the Academic Committee of the ICV-3 Organizing Committee, etc. Thus, I feel as if I were one of the Organizers, and thus, naturally wish ICV-3 – and I am confident that it is going to be – a grand success. I would like to take this opportunity to thank each and every one of you who have contributed so much to the success of this prestigious conference.

Narong Chomchalow, Coordinator, PRVN
Bangkok, Thailand

The Southern Africa Vetiver Network (SAVN)

"Vetiver and Water" – an apt theme for ICV-3. The connection between soil, water and vegetation cannot be overemphasized. We are all aware of vetiver's potential (if applied correctly) in having large positive impacts on soil erosion control and water quality and quantity enhancement. In southern Africa, we have seen the benefits associated with the use of vetiver grass in many applications, from large-scale industry to rural agriculture.

The challenge lies in getting the message to those who need – and stand to benefit the most – from its use, the rural poor. This is why I inserted the proviso of *correct application*.

Our target audience often does not appreciate the indirect benefits of soil and water conservation over the long-term. That the grass can work is beyond doubt, but it is about people – people need to understand the benefits, apply the grass correctly and realize these benefits for the grass to really work. It is for this reason that we view the vetiver not only as a tool for ameliorating environmental problems, but also a tool for economic empowerment. The simplicity of the Vetiver System means it can be grown and sold as well as applied on behalf of clients by such rural communities. The grass now has a direct cash value, making it more valuable, and thus more likely to be utilized correctly and, subsequently, work.

The opportunity for the vetiver to improve water quantity and quality need to be realized. What better forum for this to take place than at ICV-3? We look forward to the results of research that will be presented. It is our intention to take this research and make it accessible, through application, to the people. This is vitally important in our water scarce continent.

Jon McGosh, Coordinator, SAVN
Scottsville, South Africa

Vibrant Versatile Vetiver

The PRVN has recently issued its first Special Bulletin (No. 2003/1) entitled, "Vibrant Versatile Vetiver", written by Dr. Narong Chomchalow, Coordinator of PRVN and Secretary of the Continuing Committee of the International Conference on Vetiver (ICV). The main objective of producing this Special Bulletin is to provide useful information on vetiver to the 'vetiverites' (those who work on vetiver), especially the participants of ICV-3, to be held in Guangzhou, China, 6-9 October 2003. The title of this bulletin contains two adjectives that appropriately describe what vetiver is and can do. Webster's Dictionary defines 'vibrant' as "throbbing with life and activity; vigorous, energetic, radiant, sparkling, vivacious"; while 'versatile' is defined as "competent in many things; adaptable to many uses or functions". Working with vetiver for over 25 years, the author is convinced that vetiver is really 'throbbing with life and activity'. It is also 'vigorous, radiant, sparkling and vivacious'. Moreover, it is so versatile that it can be used in various capacities in both agricultural and non-agricultural applications; it can also be used and utilized in various ways. It is thought that valuable information about it should be made available to those interested in vetiver. It is hoped that this Special Bulletin will serve this purpose.

This 82-page Special Bulletin contains information on world's vetiver networks, world's vetiver awards, conferences, meetings, etc. on vetiver, vernacular names of vetiver, and glossary of vetiver terms. Copies of this (violet-colored cover) bulletin (4Vs) have been sent to key personnel on vetiver around the world. It will be distributed to every participant of ICV-3. Other persons interested in having a copy of this bulletin may write to the Secretariat of PRVN.

Introducing the New Vietnam Vetiver Network Coordinator*

I would like to welcome Dr. Tran Tan Van as the new Coordinator of the Vietnam Vetiver Network. Dr. Van is a geologist and geotechnical engineer with training in the former Soviet Union (Azerbaijan State University), Thailand (Asian Institute of Technology), and Japan (Saitama University). He is currently working as a geologist-geotechnical engineer at the Research Institute of Geology and Mineral Resources (RIGMR), Ministry of Natural Resources and Environment (MNRE) and an active member of VNVN.

** By Paul Truong, TVN East Asia and South Pacific Representative*

Dr. Van's group has recently conducted a research project on geohazards (landslide, coastal and river bank erosion, earthquake, etc.) and compiled inventory and forecast maps and recommended appropriate mitigation measures for central Vietnam.

Although quite new to vetiver, he has been a keen supporter and user of it. Among other tasks, the above-mentioned project on, "Geohazards Assessment and Mitigation in Central Vietnam", involved a Dutch Embassy-funded pilot application (together with Elise Pinners from VECO Vietnam) of vetiver grass for riverbank, shrimp pond, and road embankment protection in Da Nang, and mitigation of sand storm and sand flow in Quang Binh. Their results were reported in Vetiverim-24.

Dr. Van is currently working on a project on geology and environmental protection along the Ho Chi Minh Highway, including geohazard assessment and mitigation, where VS is considered as a suitable technology by the Ministry of Transport. He is also helping the Dyke Department, which is interested in trying VS on mitigating flood throughout central Vietnam. The Department, which is so far more interested in flood control, also wants to expand that program to the mountainous area to include landslide, soil erosion, etc.

In addition Dr. Van is assisting a AUSAID-funded project on flood mitigation in Quang Ngai and some working with other NGOs, such as Danish Red Cross and World Vision to try VS for natural disaster mitigation purposes in Thai Binh, Nam Dinh and Quang Tri provinces.

Dr. Van can be contacted at < trantv@hn.vnn.vn >.

Vetiver Victorious: The Systematic Use of Vetiver to Save Madagascar's FCE Railway

The second technical bulletin of PRVN for the year 2003 (No. 2003/2) has recently been published and distributed. It is entitled, "Vetiver Victorious: The Systematic Use of Vetiver to Save Madagascar's FCE Railway", written by Diti Hengchaovanich, of APT Consult Co. Ltd., Bangkok, Thailand, and Karen Schoonmaker Freudenberger, of the FCER Project, Madagascar. The abstract of this technical bulletin is presented below:

In 2000, two cyclones hit the island nation of Madagascar in a two-week period. The devastation to infrastructures was enormous. Among the worst hit was the FCE train line that suffered more than 280 landslides. The line was closed for three months, causing severe hardship to the more than 100,000 people living along its route. Two Thai vetiver specialists went to Madagascar soon after the cyclones to investigate the possible use of vetiver in restoring the rail line and protecting it from future erosion damage. In the three years since, the Landscape Development Intervention (LDI) and FCE Rehabilitation (FCER) projects, in collaboration with the FCE Railway, have worked to systematically disseminate vetiver technology along the line, both in a technical intervention designed to restore areas hit by severe landslides, and in a community-based intervention that has enlisted more than 600 farmers in slope stabilization activities along the train line. Using an innovative 'vetiver-for-vetiver loan / reimbursement+' plan and a 'modular cropping' system that have facilitated dissemination and implementation with farmers over a three-year period, more than 2.6 million vetiver slips have been planted along the 163 km long train line. This has significantly reduced erosion damage and strengthened slopes and infrastructures along the line. The vetiver intervention also provides farmers with a sustainable agriculture alternative to traditional slash-and-burn practices, enhances soil fertility and improves farmers' income. The success achieved has prompted an adoption of these vetiver intervention techniques by a privatized railway line in the northern part of Madagascar.

Editor's note: This paper has also won the King of Thailand Vetiver Award – Series 3 in the category, "Outstanding Vetiver Dissemination – Non-Government Agency". See details in the article "The Winners of the King of Thailand Vetiver Awards – Third Series" in this issue of Vetiverim (on p.10)

The Vetiver System for Wastewater Treatment

The third technical bulletin of PRVN for this year (No. 2003/3) has recently been published and distributed. It is entitled, "Research, Development and Implementation of the Vetiver System for Wastewater Treatment", written by Paul Truong, of The Vetiver Network and Veticon Consulting, Brisbane, Queensland, Australia; and Cameron Smeal, of 'GELITA Queensland', Beaudesert, Queensland, Australia. The abstract of this technical bulletin is presented below:

The disposal of industrial wastewater in Queensland is subjected to the strict environmental guidelines enforced by the Environmental Protection Authority. The most common method of treating industrial wastewater in Queensland is by land irrigation, which is based on tropical and subtropical pasture plants. However, with limited land area available for irrigation, these plants are not efficient enough to sustainably dispose of all the effluent produced by the industries. Therefore, to comply with the new standards, most industries are now under strong pressure to upgrade their treatment processes.

Over the past two years a series of research projects have been conducted at GELITA Queensland's gelatine factory in Beaudesert, Queensland to determine a viable means to achieve these goals. The Vetiver System has been identified as having the potential to meet all the criteria:

- Vetiver has the potential of producing up to 132 t/ha/year of dry matter yield as compared to 23 t/ha/year and 20 t/ha/year for Kikuyu and Rhodes grass, respectively.

- With this production vetiver planting has the potential of exporting up to 1,920 kg/ha/year of N and 198 kg/ha/year of P as compared to 687 kg/ha/year of N and 77 kg/ha/year of P for Kikuyu and 399 kg/ha/year of N and 26 kg/ha/year of P for Rhodes grass, respectively.

- Vetiver growth can respond positively to N supply up to 6,000 kg/ha/year and to ensure this extraordinary growth and N uptake, P supply level should be at 250 kg/ha/year.

Based on the above results, 'GELITA Queensland' gelatine factory in Beaudesert, Queensland has developed long-term implementation plans for effluent and other solid waste product disposal.

The Winners of the King of Thailand Vetiver Awards – Third Series

In conjunction with the Third International Conference on Vetiver (ICV-3), Her Royal Highness Princess Maha Chakri Sirindhorn, Chairperson of His Majesty the King of Thailand's Chaipattana Foundation, has graciously granted US$10,000 from the Chaipattana Foundation for "The King of Thailand Vetiver Awards" for the most outstanding achievements on vetiver. The Awards were split into two categories, valued at US$5,000 each; one prize for the most outstanding research on the vetiver system, and the other for the most outstanding dissemination of the Vetiver System (VS). The Research Category was further split into two prizes, namely: Agricultural Application (US$2,500); and Non-Agricultural Application (US$2,500). The Dissemination Category was also further split into two prizes, namely: Government Agency (US$ 2,500); and Non-Government Agency (US$2,500).

The announcement of the awards has been made in various media including, among others, PRVN's Vetiverim and its website, TVN's Vetiver Newsleter and its website, etc. The Chaipattana Foundation will provide financial assistance to enable the senior authors to attend and present their award-winning papers at ICV-3. The winners will receive the awards from H.R.H. Princess Maha Chakri Sirindhorn at the Opening Ceremony of ICV-3 on 6 October 2003 in Guangzhou, China. The winning papers will also be presented at ICV-3 on 6 October, 17:10-18:30.

The deadline for submission of the papers was 31 July 2003. The Office of the Royal Development Projects Board, on behalf of the Chaipattana Foundation, appointed two sets of committee (Research and Dissemination) to select the winners of the two categories. The criteria used in the judgement of each category were set as follows:

Research Category:

(i) The research possesses vetiver as its main component (20 points).
(ii) The experimentation or study has been conducted by researcher(s) or institute(s) of acceptable status (20 points).
(iii) Possesses dependable methods and the results of experimentation are accompanied by scientific approach in data collection and analysis (20 points).
(iv) Based on experimentation that has actually been conducted in the laboratory or in the field (20 points).
(v) The result leads to a new knowledge in the field of science, agriculture or environment, and can be applied broadly by the public at large (20 points).

Dissemination Category:

(i) The work demonstrates the method of dissemination of the technology to the farmers or users most effectively, and can actually be applied for utilization (20 points).
(ii) The dissemination of the technology should lead to sustainable development (20 points).
(iii) The method employed should be able to be applied broadly (20 points).
(iv) The method should be based on appropriate technology that is environmental friendly (20 points).
(v) The method should be based on scientific reasoning which is verifiable and acceptable (10 points).
(vi) The method can be used for supplementary income generation or reduction in the cost of production input (10 points).

1. Research Category

1.1 Agricultural Application:

Title: Vetiver Research for Agricultural Production on Red Soils

Author: Shengluan Lu

Affiliation: Red Soil Research Institute of Jiangxi Province, Jingxian, Jiangxi Province, China

Abstract: More than ten experiments were conducted on the adaptability of vetiver to bare soil, vetiver utilization for agriculture production, and the techniques of vetiver propagation since 1990. The results show that:

1. Vetiver is an excellent grass for soil and water conservation as it is high adaptive to barren soil.

2. When vetiver leaves were cut and used as green manure, they improved the soil chemical and physical properties as well as increased the crop yield.

3. Vetiver growth and its biomass could be promoted by applying proper N and P fertilizers.

4. Planting vetiver in a paddy field in the summer is an effective measure for tiller production. A set of techniques for vetiver propagation is proposed.

Statement of Merit: This paper describes the results of experiments conducted since 1990 by the Red Soil Research Institute of Jiangxi Province using vetiver to increase agricultural production of barren soils where no crops could be produced earlier. Vetiver was found to be adaptive to barren soil with strong resistance to drought and remarkable effect on soil and water conservation. In addition, the cut leaves of vetiver applied to the soil significantly increased the amounts of organic matter and nutrients resulting in higher yield of crops. In order to promote

the use of vetiver in 16 southern provinces of China, the author developed a technique to promote tiller's growth by applying nutrient solution, and the use of inorganic fertilizers to promote growth of the vetiver plant, both of which were quite successful.

1.2 Non-Agricultural Application:

Title: Ecological Effectiveness of Vetiver Constructed Wetlands in Treating Oil-Refined Wastewater

Authors: Hanping Xia [1/] , Honghua Ke [2/], Zhaoping Deng [2/], Peng Tan [2/], and Shizhong Liu [1/]

Affiliations: [1/] South China Institute of Botany, Chinese Academy of Sciences, Guangzhou, China; [2/] SINOPEC Maoming Refining & Chemical Co. Ltd., Maoming, Guangdong, China

Abstract: Wastewater produced from the oil refinery of the Maoming Petro-Chemical Company, China Petro-Chemical Corporation contains high concentrations of organic and inorganic pollutants, therefore it cannot be discharged directly into the river or sea unless it is treated first. Four plant species, *Vetiveria zizanioides*, *Phragmites australis*, *Typha latifolia*, and *Lepironia articutala* were planted in large containers as a vertical flow wetland to test their efficiencies in the purification of oil refined wastewater and their growth in wetlands soaked with oil-refined wastewater. The results from a 2-month treatment indicated that the purifying rates of constructed wetlands for oil refined wastewater were all very high at the beginning,. Results included the removal of 97.7% of ammonia N, 78.2% of COD, 91.4% of BOD, and 95.3% of oil in the first batch of highly-concentrated wastewater (HCW), and 97.1% of ammonia N, 71.5% of COD, 73.7% of BOD, and 89.8% of oil in the first batch of low-concentrated wastewater (LCW). The performance of wetlands however was decreased and became basically stable as time passed. The efficiency of wetlands in removing the pollutants was always in order of ammonia N > oil > BOD > COD, but the net removal from plants was ranked as COD > BOD > oil and ammonia N. In the beginning, the purifying function of plants was quite weak, but it gradually increased with the acceleration of plants growth. However, there was almost no significant difference in the removal efficiencies among the four species. The four tested species produced better growth in wetlands (HCW or LCW) than with clean water, but *V. zizanioides*, *P. australis*, *T. latifolia* produced fewer tillers in HCW than those in LCW, while this was contrary to *L. articutala.* This could infer HCW might damage the first three species, and promote the growth of *L. articutala* During the period of clean water cultivation before the start of the trial, the new tiller producing rate of *V. zizanioides* was the lowest among the four species, but it gradually rose during the period of waste water treatment, while the tiller-producing rates of the other three species were distinctly lowered. This suggested that *V. zizanioides* might have a stronger adaptation to the harsh environment than other species tested, especially in the situation of long time of adaptation to the environment. However, the above results remains to be further verified due to the limited observation time of only two months. At present, the further application and verification is ongoing; furthermore the preliminary application result has already shown that the performance of vetiver is becoming better and better, and seems to be far better than that of the other three species.

Statement of Merit: This paper investigates the growth and tillering performance of four herbaceous plants in constructed wetlands filled with oil-refined wastewater, and the effects of the constructed wetlands in treating wastewater. The results indicated that the purifying rates of constructed wetlands for oil-refined wastewater were high. During the period of cultivation in clean water, the rate of producing new tillers of vetiver was the lowest among the four species, but gradually rose during the period of cultivation in wastewater, while the tiller-producing rates of the other three species were distinctly lowered. This suggests that vetiver might have a stronger adaptation to the harsh environment than three other species, especially if grown for long duration in the harsh environment. This experiment confirms that vetiver is a good species for constructed wetlands to treat oil-refined wastewater, better than the three hydrophyte species: *Phragmites australis*, *Typha latifolia*, and *Lepironia articutala*.

2. Dissemination Category

2.1 Government Agency:

Title: The Use of Vetiver for Soil Erosion Prevention in Cassava Fields in Thailand

Authors: Wilawan Vongkasem [1/], Kaival Klakhaeng [1/], Watana Watananonta [2/], and Reinhardt H. Howeler [3/]

Affiliations: [1/] Department of Agricultural Extension, Bangkok, Thailand; [2/] Department of Agriculture (DOA), Bangkok, Thailand; [3/] CIAT Regional Cassava Office for Asia, DOA, Bangkok, Thailand.

Abstract: Cassava is a crop that induces high rate of soil erosion, especially if grown in sloping sandy soils. The joint research of the Centro Internacional de Agricultura Tropical (CIAT), the Department of Agriculture (DOA), and Kasetsart University (KU) revealed that planting methods or planting system adjustment could reduce soil erosion. Each method has certain advantages and disadvantages. While some methods give extra income, some others need more management or high investment; thus it was not certain whether or not the farmers would adopt any of these methods.

During the first phase (1994-98) of the Project, two pilot sites were selected at Soeng Sang District of Nakhon Ratchasima Province, and Wang Sombun District of Sa Kaeo Province. Farmer Participatory Research (FPR) trials on methods to reduce soil erosion were conducted for three consecutive years. After narrowing down the number of suitable options, farmers in both sites finally selected and adopted the contour strip cropping of cassava with vetiver hedgerows. They also requested further support to extend the vetiver on a larger scale to their cassava fields. In Soeng Sang District, farmers in Sap Pong Phot Village got together to set up a Soil Conservation group

Statement of Merit: The project used a farmer participatory approach in that the farmers themselves were experimenting with and, after realizing its performance, accepting for trial in their own fields. The result of seven years of investigation had a great impact on the farmer's awareness of the importance of soil erosion prevention. They adopted the technique of vetiver hedgerows across the slopes and planted vetiver strips in the cassava fields in 21villages located in 17 districts, 8 provinces. Altogether, 865 farmers participated in the planting of 130 km-long vetiver strips in their cassava fields, employing a total of 1.3 million vetiver slips. In addition "Cassava Development Villages" were established. The establishment of these villages is a way to strengthen rural communities in the future. At present, members of the farmer's groups have access to a revolving fund, which ranges in size from Baht 40,000 to 380,000 per group, with a total of Baht 1,475,868 to be used for the development of the community.

2.2 Non-Government Agency:

Title: Vetiver Victorious: The Systematic Use of Vetiver to Save Madagascar's FCE Railway

Authors: Diti Hengchaovanich [1/], and Karen Schoonmaker Freudenberger [2/]

Affiliation: [1/] APT Consult Co. Ltd., Bangkok, Thailand; [2/] FCER Project, Madagascar

Abstract: In 2000, two cyclones hit the island nation of Madagascar in a two-week period. The devastation to infrastructures was enormous. Among the worst hit was the FCE train line in the southeastern part of the country that suffered more than 280 landslides. The line was closed for three months, causing severe hardship to the more than 100,000 people living along its route. Two Thai vetiver specialists went to Madagascar soon after the cyclones to investigate the possible uses of vetiver in restoring the rail line and protecting it from future erosion damage. In the three years since, the Land Development Intervention (LDI) and FCER projects, in collaboration with the FCE Railway, have worked to systematically disseminate vetiver along the line, both in a technical intervention designed to restore areas hit by severe landslides, and in a community based intervention that has enlisted more than 600 farmers in slope stabilization

activities along the train line. Using an innovative 'vetiver-for-vetiver loan / reimbursement' plan and a 'modular cropping' system that have facilitated dissemination and implementation with farmers over a three-year period, more than 2.6 million vetiver slips have been planted along the 163 km long train line. This has significantly reduced erosion damage and strengthened slopes and infrastructures along the line. The vetiver intervention also provides farmers with a sustainable agriculture alternative to traditional slash-and-burn practices, enhances soil fertility and improves farmers' income. The success achieved has prompted an adoption of these vetiver intervention techniques by another railway line in the northern part of Madagascar.

Statement of Merit: This paper describes a dissemination model for enlisting community support in the protection of transport infrastructures with the Vetiver System (VS). Following cyclones that devastated the Madagascar's FCE railway, VS was introduced to eliminate erosion and / or landslide causing agricultural practices while improving soil fertility and enhancing farmers' income. Three years later, the train line again operates properly (providing an economic lifeline to 100,000 people without other transport options), and is protected from future cyclone damage by more than 2.6 million vetiver plants. 90% of this vetiver was planted by farmers who replaced erosion-inducing annual crops on extremely steep slopes abutting the line with a vetiver-based perennial crop system. Rapid dissemination has been achieved using an innovative scheme in which the farmer borrows vetiver that is then reimbursed the following year, and a modular system that allows farmers to customize their intervention while respecting agricultural and slope stabilization norms.

Certificates of Excellence for the King of Thailand Vetiver Awards

After scrutinizing through all the papers submitted, the two Selection Committees of the King of Thailand Vetiver Awards have realized that there are a number of outstanding papers submitted for consideration by the Selection Committees but only one for each of the four sub-categories is entitled to receive the award. It was proposed that recognition should be given to those papers having high standard of achievements. It was then unanimously agreed that "Certificates of Excellence" be conferred to these papers, and that there shall be two certificates given for each of the four sub-categories. This proposal has received favorable response from the Chaipattana Foundation, the institute bestowing the King of Thailand Vetiver Awards. Although there is no prize money or any other direct benefit attached to the Certificate, it should be borne in mind of every one seeing the Certificate that it signifies outstanding achievement in each specific sub-category.

The following is the list of the title of papers, the authors, their affiliations, and the brief citations of all four categories receiving the Certificates of Excellence:

1. Research Category

1.1 Agricultural Application:

i. Title: The Use of Vetiver Grass (*Vetiveria zizanioides* (L.) Nash) to Rehabilitate City Garbage Leachate through Nuclear Techniques

Authors: Jittiwan Mahisarakul, S. Topungtium, S. Srisaichua, P. Lekkong, P. Chamraskul, and R. Chaichaaum

***Affiliation*:** Nuclear Research in Agriculture Section, Agricultural Chemistry Group, Department of Agriculture, Chatuchak, Bangkok, Thailand

Citation: Demonstrate the use of ^{32}P to detect the absorption of city garbage leachate by the dense roots of the vetiver plant, resulting in practical application of using vetiver to rehabilitate city garbage leachate

ii. Title: Working with Farmers: the Key to Adoption of Vetiver Grass Hedgerows to Control Erosion in Cassava Fields in Thailand

Authors: Reinhardt Howeler [1/], Wattana Watananonta [2/], Wilawan Vongkasem [3/], Kaival Klakhaeng [3/], Somjate Jantawat [5/], Supha Randaway [1/], and Banyat Vankaew [6/]

Affiliation: [1/] CIAT Cassava Office for Asia, DOA, Bangkok, Thailand; [2/] Field Crops Research Institute, DOA, Bangkok, Thailand; [3/] Field Crops Promotion Division, Department of Agricultural Extension, Bangkok, Thailand; [4/] Soil Science Department Kasetsart University, Bangkok, Thailand; [5/] Soil and Water Conservation Division, Department of Land Development, Bangkok, Thailand; [6/] Thai Tapioca Development Institute, Dan Khun Thot, Nakhon Ratchasima, Thailand

Citation: Using a farmer participatory research approach to enhance the adoption of soil conserving practices and improve the sustainability of cassava production, resulting in the farmers selected the planting of contour hedgerows of vetiver as the most effective and most suitable practice to control soil erosion in the sloping cassava fields.

1.2 Non-Agricultural Application:

i. Title: Vetiver System for Industrial Wastewater Treatment in Queensland, Australia

Authors: Cameron Smeal [1/], Margo Heckett [1/], and Paul Truong [2/]

Affiliation: [1/] GELITA Queensland, Beaudesert, Queensland, Australia; [2/] Veticon Consulting, Brisbane, Queensland, Australia

Citation: Recognition of the role of VS in industrial wastewater treatment and application of vetiver in computer model –MEDLI- Model for Effluent Disposal by Land Irrigation.

ii. Title: Utilization of Vetiver Grass as Construction Material for Paddy Storage

Authors: Thammanoon Hengsadeekul and Pichai Nimityongskul

Affiliation: Structural Engineering and Construction Program, School of Civil Engineering, Asian Institute of Technology, Pathum Thani, Thailand

Citation: Demonstrate the use of vetiver stems and leaves as natural fiber mixed with clay to build silos for paddy storage.

2. Dissemination Category

2.1 Government Agency:

i. Title: The Application of the Vetiver System in Erosion Control and Stabilization for Highways Construction and Maintenance in Thailand

Authors: Surapol Sanguankaeo, Surachai Chaisintarakul, and Ekawit Veerapunth

Affiliation: Department of Highways, Bangkok, Thailand

Citation: Effective method of the application of the Vetiver System in erosion control and stabilization for highway construction and maintenance.

ii. Title: The Output and Outcome of the Vetiver Grass Usage at the Land Development Village

Authors: Piratcha Wassananukul, Mena Narkvilai, Darm Tainsun Therabunsiri, and Ard Somrang

Affiliation: Department of Land Development, Bangkok, Thailand

Citation: Effective usage of the vetiver system for soil and water conservation in the Land Development villages

2.2 Non-Government Agency:

i. Title: Vetiver – More Than Grass

Authors: Jon McGosh and Donald Guy

Affiliation: Southern African Vetiver Network, Scottsville, South Africa
Citation: Effective method of extension program of the Vetiver System through poster and video presentations.

ii. Title: Revegetation of Quarry Using the Complex Vetiver Eco-Engineering Techniques
Authors: Hanping Xia [1/] and Ping Zhang [2/]
Affiliation: [1/] South China Institute of Botany, Guangzhou, China; [2/]Guangzhou EcoEnvironment Science and Technology Co. Ltd., Guangzhou, China
Citation: Effective method in using vetiver to revegetate the rocky headwall of the quarries.

Note: All Certificates of Excellence have been sent to the authors as of 10 September 2003, with the plea that the authors should make every attempt to present their papers at ICV-3. Together with the announcement of the King of Thailand Vetiver Awards, details of all Certificates of Excellence will be posted at the Exhibition of Thailand's booth, under the category of His Majesty the King's Roles on Vetiver Research and Development in Thailand.

The Winners of The Vetiver Network Awards – Series Three

The Vetiver Network (TVN) has announced the results of selection of the winners of the seven categories of its Series Three's Awards as follows:

1. Water Applications

a. Watershed Protection/Improvement:
First Prize: US$ 3,000
Title: Vetiver System for wave and current erosion control in the Mekong Delta, Vietnam
Authors: Le Viet Dung, Luu Thai Danh, Le Thanh Phong, and Paul Truong
Country: Vietnam
Second Prize: US$ 1,000
Title: (No exact title, but it is the award for the application of watershed protection and improvement)
Author: Ngwainmbi Simon
Country: Cameroon
Third Prize: US$ 500
Title: Can we replace earthen bund with vegetative barrier for natural resource conservation?
Author: K.C. Shashidhar
Country: India

b. Engineering – Natural and Constructed
First Prize: US$ 3,000
Title: Use of vetiver in controlling water borne erosion with particular reference to Bangladesh coastal region
Author: M. Nazrul Islam
Country: Bangladesh
Second Prize: US$ 1,000
Title: Hydraulic characteristic of vetiver hedges in deep flows
Authors: Oscar Metcalfe, Paul Truong, and Rod Smith
Country: Australia

c. Quality – Pollution Control and Treatment
First Prize: US$ 3,000

Title: Efficacy of vetiver grass in hydroponic treatment of post septic tank effluent
Authors: Barbara Hart, Ron Cody, and Paul Truong
Country: Australia

Second Prize: US$ 1,000

Title: Modeling Monto vetiver growth and nutrient uptake for effluent irrigation schemes
Authors: Alison Vieritz, Paul Truong, Ted Gardner, and Cameron Smeal
Country: Australia

Third Prize: US$ 500

Title: The use of vetiver grass wetlands for sewerage treatment in Australia
Authors: Ralph Ash, and Taul Truong
Country: Australia

2. Engineering/Infrastructure Protection

First Prize: US$ 3,000

Title: Vetiver Victorious: The systematic use of vetiver to save Madagascar's FCE
Authors: Karen Schoonmaker Freudenberger, and Jean Schoonmaker Freudenberger
Country: Madagascar

Second Prize: US$ 1,000

Title: The progress of the use of vetiver grass system for erosion control and slope stabilization along the Yadana Gas Pipeline right-of-way
Author: Songkiert Tansamrit
Country: Thailand

Third Prize: US$ 500 (to be split into two prizes, US$ 250 each)

i. ***Title:*** Introduction of Vetiver System for highway protection in Lishui City of Zhejiang Province
Author: Biying Pan
Country: China

ii. ***Title:*** Ecological engineering on the introduction of vetiver for highway embankment erosion control stabilization and greening
Author: Zhaoqing Zhao
Country: China

3. Land Reclamation

First Prize: US$ 3,000

Title: Revegetation of quarry, using the complex vetiver eco-engineering technique
Authors: Ping Zhang, and Hanping Xia
Country: China

Second Prize: US$ 1,000

Title: Land reclamation, integrated vetiver techniques for remediation of heavy metal contamination: Potential and practice
Authors: Wensheng Shu, and Hanping Xia
Country: China

Third Prize: US$ 500 (to be split into two prizes, US$ 250 each)

i. ***Title:*** Utilization of Vetiver System for landfill phytoremediation
Author: Binhua Zeng
Country: China

ii. ***Title:*** Coastal dune stabilization in Central Vietnam
Authors: Tran Tan Van, Elise Pinners, and Paul Truong
Country: Vietnam

4. Dissemination

First Prize: US$ 3,000

Title: Dissemination of the Pacific Rim Vetiver Network
Author: Narong Chomchalow
Country: Thailand

Second Prize: US$ 1,000

Title: Dissemination of the China Vetiver Network
Author: Liyu Xu
Country: China

Third Prize: US$ 500 (to be split into two prizes, US$ 250 each)

i. Title: Dissemination of the Cameroon Vetiver Network
Author: Ngwainmbi Simon
Country: Cameroon

ii. Title: Dissemination on the rehabilitation of the FCE Railway
Authors: Karen Schoonmaker Freudenberger, Fenomanana Raheliosoa, and Etienne Razafindraboto
Country: Madagascar

Special Memorial Award **(No prize money)**

Title: China National Vetiver Information Dissemination
Author: Song Ruiling
Country: China

5. Country Vetiver Award

First Prize: US$ 3,000

Title: China Vetiver Network for erosion control, slope stabilization, and civil construction protection
Author: Liyu Xu
Country: China

Second Prize: US$ 1,000

Title: Senegal Country Vetiver Award
Author: Abdul Rahman
Country: Senegal

Third Prize: US$ 500

Title: Vietnam Country Vetiver Award
Authors: Tran Tan Van, Elise Pinners, and Paul Truong
Country: Vietnam

6. Farmer/User Awards – Regional

A. Asia

First Prize: US$ 1,500

Title: The key to sustainable development on Bali
Authors: David J. Booth, and Nengah Ardika Adinata
Country: Indonesia (Ekoturin Foundation, Bali)

Second Prize: US$ 750 (to be split into two prizes, US$ 375 each)

i. Title: The key to adoption of vetiver grass hedgerows to control erosion in cassava fields in Thailand
Authors: Reinhardt Howeler, Watana Watananonta, Somjate Jantawat, Supha Ranaway, and Banyat Vankaew
Country: Thailand

ii. Title: Introduction to Vetiver System to the Dabie Mountains
Author: Hausheng Zhang
Country: China

B. Africa

First Prize: US$ 1,500

Title: (No exact title, but it is the Application for Farmer User Award)
Author: Michelia Ward and Ngwainmbi Simon
Country: Cameroon

Second Prize: US$ 750 (to be split into two prizes, US$ 375 each)

i. Title: (No exact title, but it is the Application for Farmer User Award)
Author: Esau Mwanganda
Country: Kenya

ii. Title: The rehabilitation of the FCE railway
Author: Karen Schoonmaker Freudenberger, Fenomanana Rahelisoa, and Etienne Razafindraboto
Country: Madagascar

C. Latin America – No award made

D. Other

First Prize: US$ 1,500

Title: Can vetiver be used to manage insect pests on crops?
Author: J. Van den Berg, C. Midega, L.J. Wadhams, and Z.R. Khan
Country: South Africa

7. Vetiver Champion

First Prize: US$ 4,000

Title: The Vetiver System: A technique I pursue and esteem all my life
Author: Hanping Xia
Country: China

Abstracts of Reviewer's and Case Study Papers of the ICV-3 Plenary Session

The ICV-3 Plenary Session will take place at 10:30-17:30 hours of 6 October 2003. There will be eight presentations in the Plenary Session. Each presentation comprises two parts. The main presentation gives a comprehensive introduction, known as Reviewer's Paper, to be presented by an established vetiver specialist. The secondary presentation (if any) provides Case Study to support the main presentation. The abstracts of Reviewer's Papers and Case Study Papers are presented below:

Plenary No. 1 (10:30-11:00)
Vetiver Grass - A World Technology and Its Impact on Water

Reviewer's Paper:

Speaker: Richard G. Grimshaw (Chairman, The Vetiver Network, Washington D.C., USA)
E-mail Contact: <dickgrimshaw@vetiver.org>

Abstract: This paper recognizes the important work of worldwide vetiver researchers and developers. It describes how vetiver has developed as world technology over four phases of application: soil and water conservation in poor rural areas; infrastructure stabilization; rehabilitation of difficult and often polluted sites; and lastly water quality enhancement and site rehabilitation in relation to industry and intensive commercial agricultural. The paper then goes on to describe how the Vetiver System™ can be used for water conservation and water quality enhancement as applied in the broad categories of upper, middle and lower watershed areas. The

paper reviews some progress in technology dissemination and the increasing role of the private sector. Finally the paper looks at some changes in the Vetiver Network and introduces a new program of certification that will recognize those who excel in research and development of the Vetiver System™.

Keywords: Vetiver Systems™, soil and water conservation, infrastructure stabilization, water quality, pollution control, technology dissemination, technical certification.

Case Study Paper: None.

Plenary No. 2 (11:00-11:40)
Vetiver System for Water Quality Improvement

Reviewer's Paper:

Specific Topic: Clean Water Shortage, an Imminent Global Crisis - How Vetiver System can Reduce Its Impact

Speaker: Paul Truong (TVN East Asia and South Pacific Representative; Veticon Consulting, Brisbane, Queensland, Australia)

E-mail Contact: <truong@uqconnect.net>

Abstract: Fresh water scarcity is predicted to become the greatest single threat to international stability, human health, global food supply and even the spectre of war over water. According to the World Resources Institute, within 25 years, more than half of the world population will be suffering severe fresh water shortages.

Earlier research has demonstrated vetiver grass's extraordinary ability to withstand highly adverse climatic and edaphic conditions including elevated levels of salt, acidity, alkalinity, sodicity as well as a whole range of heavy metals. Latest research also shows its extraordinary ability to absorb and tolerate extreme levels of nutrients and consume a large quantity of water in the process of producing a massive growth. These attributes indicate that vetiver is ideally suitable for treating contaminated and polluted wastewater from industries as well as domestic discharge.

This review covers past and current research and applications of Vetiver System in treating wastewater, including:

- Wastewater volume or quantity by: seepage control, land irrigation and wetland.
- Wastewater quality by: trapping sediment and particles, tolerating and absorbing pollutants, and heavy metals and detoxification of industrial, mining and agrochemical wastes.

But the most significant advance recently, is the use of vetiver grass in computer modeling to treat industrial wastewater. For this application, not only all known aspects of vetiver physiological and morphological attributes, but also its potential were carefully studied and analysed in the calibration process. The results again establish and confirm our admiration for this unique plant.

Keywords: Vetiver, pollution, wastewater, effluent, landfill leachate, MEDLI.

Case Study Paper:

Topic: Vetiver System for Industrial Wastewater Treatment in Queensland, Australia

Speakers: Cameron Smeal (Environmental Manager, GELITA Australia, Queensland, Australia), Margo Hackett (Environmental Officer, Teys Bros., Queensland, Australia), and Paul Truong (Veticon Consulting, Brisbane, Queensland, Australia)

E-mail Contacts: <cameron.smeal@gelita.com>; <truong@uqconnect.net>

Abstract: The disposal of industrial wastewater in Queensland is subjected to the strict environmental guidelines enforced by the Environmental Protection Authority. The most common method of treating industrial wastewater in Queensland is by land irrigation, which is presently based on tropical and subtropical pasture plants. However with limited land area available for irrigation, these plants are not efficient enough to sustainably dispose of all the effluent produced by the industries. Therefore to comply with the new standards, most industries are now under strong pressure to upgrade their treatment processes.

Over the past two years a series of research projects conducted at GELITA Australia gelatine factory in Beaudesert, Queensland and at Teys Bros. abattoir in Beenleigh to determine a viable means to achieve these goals. The Vetiver System has been identified as having the potential to meet all the criteria.

Vetiver has the potential of producing up to 132 t/ha/year of dry matter yield as compared to 23 and 20 t/ha/year for Kikuyu and Rhodes grass. With this production vetiver planting has the potential of exporting up to 1,920 kg/ha/year of N and 198 kg/ha/year of P as compared to 687 of N and 77 kg/ha/year of P for Kikuyu, and 399 of N and 26 kg/ha/year of P for Rhodes grass. Vetiver growth can respond positively to N supply up to 6,000 kg/ha/year and to ensure this extraordinary growth and N uptake, P supply level should be at 250 kg/ha/year.

Based on the above results, the two companies have developed long term implementation plans for effluent and other solid waste product disposal.

Keywords: Vetiver, effluent disposal, irrigation, nutrient, fodder

Plenary No. 3 (11:40-12:10)
Vetiver Systems for Agriculture Development

Reviewer's Paper:

Speaker: Liyu Xu (Coordinator, China Vetiver Network, c/o Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China)

E-mail Contact: Liyu Xu <vetiver@jlonline.com>

Abstract: Early in 1988, less than a year after it was introduced as a pilot experiment in the red earth area in South China, vetiver has attracted a wide attention for its 'magical' characteristics, such as its wide adaptability and rapid growth. At that time, many agricultural officers, scientists and technicians, as well as some farmers were involved in research, experimentation, application, and promotion of vetiver. During the past 15 years, the Vetiver System (VS) has been applied widely in agricultural sector, including sustainable agriculture development; soil and water conservation in orchards, in tea gardens and on sloping farmland; ecological and environmental improvement of farmland; moisture retention by mulching with vetiver leaves and stems to avoid drought; increased crop production; soil fertility by using leaves and straw for manure; environmental protection; windbreaks to prevent shifting sands from invading farmland; livestock production; fodder production by using the tender leaves and straw for cattle and sheep feed; and rural economic development by using vetiver straw to culture edible mushroom such as Jew's ear *(Auricularia auricula-judae)*.

Case Study Paper:

Topic: Introduction to China Vetiver and Agroforestry Technology Project

Author: Liyu Xu (Coordinator, China Vetiver Network, c/o Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China)

E-mail Contact: <vetiver@jlonline.com>

Abstract: China Vetiver and Agroforestry Technology Project was launched in the Dabie Mountains to increase food production, relief poverty and protect natural resources. Vetiver System and Agroforestry were introduced and demonstrated, 8,416,000 economic trees were planted, five pumping stations constructed in two villages of bordering counties of two provinces. A series of training courses have been organized, and 944 persons have been trained. The experience and information were most widely distributed through indirect training, information dissemination, visiting, and national and international networking. Because the project combined vetiver system extension with economic tree production and food production, it was warmly welcomed by local governments and farmers.

Keywords: Vetiver, agroforestry, soil erosion

Plenary No. 4 (13:30-14:00)
Vetiver System for Slope Stabilization

Reviewer's Paper:

Speaker: Diti Hengchaovanich

E-mail Contact: <diti@samart.co.th>

Abstract: Vetiver, a plant promoted to help conserve soil and water for farmlands by the World Bank in the 1980s, has evolved strongly to become an important soil bioengineering tool ever since the late 1990s. The benchmark experiments on vetiver root strength in 1996 have played a role toward its wider acceptance. New grounds or harder grounds recently broken into by vetiver include cost-effective stabilization of karst stony slopes in high altitude region and the revegetation of barren quarried face by an innovative patented method by vetiver combined with other ancillary works, were conceived and implemented in China. Riverbank stabilization has been successfully carried out on a major scale in fresh and brackish water environment in the Mekong Delta in Vietnam subjected to waves caused by motorized boat traffic, as well as on the Hanjiang River (a Yangzi River tributary) in China. Trials on the use of vetiver for beach protection were successfully achieved in Senegal and slope stabilization of 100 km length of 18 coastal polders by vetiver was attempted in Bangladesh with varying successes. Flume tests were conducted in Australia to throw light on hydraulic characteristics of vetiver in deep flow that would aid in the design of channel stabilization and flood erosion control.

Keywords: Slope stabilization, roots, tensile strength, karst region, quarried face revegetation, river bank stabilization, polder, hydraulic characteristics.

Case Study Paper: None

Plenary No. 5 (14:00-14:40)
Vetiver System for Land Reclamation

Reviewer's Paper:

Specific Topic: Application of the Vetiver System in the Reclamation of Degraded Land

Speakers: Hanping Xia (South China Institute of Botany, Guangzhou, China), and Wensheng Shu (School of Life Sciences, Sun Yatsen [Zhongshan] University, Guangzhou, China)

E-mail Contact: <xiahanp@scib.ac.cn>; <ls53@zsu.edu.cn>

Abstract: Land degradation is becoming one of the severest environmental issues in the world, especially in developing nations. Land degradation, usually accompanied by soil erosion, always results in a decrease or complete loss of land productivity, and produces on-site and off-site pollution to soil and water. The methods for land reclamation are various, including physical, chemical and biological. The cost for reclamation of degraded land using old methods is huge, but far cheaper,using new biological methods. Vegetation or revegetation is a chief biological measure, but the key is choosing the right species. Trees, shrubs, creepers, and herbs can be used to reclaim degraded land, but the best species are grasses due to their strong resistance to adverse conditions, and fast-growing feature. Among them, vetiver (*Vetiveria zizanioides*) is the most typical representative. As a species of land reclamation, vetiver has various kinds of miraculous characteristics and functions, such as rapid growth, huge biomass, massive and long roots, strong abilities to control erosion and stabilize slopes, and huge capacities of phytoremediation. Applications around the globe as well as in China indicate that vetiver is really a miracle species for land reclamation, including reclamation to barren mountains or hills, contaminated water and soil, mined lands, quarries, etc. It exhibits a very wonderful future in South China for land reclamation.

Keywords: Vetiver System, land reclamation, phytoremediation, erosion control, sustainable development

Case Study Paper:

Topic: Integrated Vetiver Technique for Remediation of Heavy Metal Contamination: Potential and Practice

Authors: Wensheng Shu (School of Life Science, Sun Yatsen [Zhongshan] University, Guangzhou, China), Hanping Xia (South China Institute of Botany, Chinese Academy of Sciences, Guangzhou, China)

E-mail Contacts: <ls53@zsu.edu.cn>; <xiahanp@scib.ac.cn>

Abstract: Metalliferous mining activities produce a large quantity of waste materials (such as tailings), which frequently contain excessive concentrations of heavy metals. These mining activities and waste materials have created heavy metal pollution problems through wind and water erosion. An integrated vetiver technique (IVT) for remediation of heavy metal contamination raised from mining activities is suggested in this paper. The remediation technique includes three aspects: phytostablization of mining wastes to reduce wind and water erosion, phytofiltration of heavy metals in wastewater with utilization of constructed wetlands, and phytoextraction of heavy metals from contaminated soils. Vetiver grass, due to its unique characteristics, such as higher biomass, fast growth, strong root system and higher metal tolerance etc., can play an important role in these aspects. Progress in the three aspects has been summarized based on our series of research (five experiments). The limits and further necessary research of these techniques is also discussed.

Keywords: Phytoremediation, phytoextraction, phytostablization, integrated vetiver technique, heavy metal, contamination

Plenary No. 6 (14:40-15:20)
Vetiver System and Private Sector

Reviewer's Paper:

Speaker: Criss L. Juliard, DynaEntreprises, Dakar, Senegal

E-mail Contact: <njuliard@yahoo.com>

Abstract: The introduction of the Vetiver System (VS) in most countries arrived either through multi-donor organizations (FAO, World Bank), government Ministries or non-governmental organizations (NGOs). Success of these public and non-for profit sectors' approach, measured by effectiveness of dissemination, penetration and acceptance rates, ranged from 'low' to 'moderate', and usually spanned a period of 6-10 years before reaching an acceptable level of sustainability. (China, Thailand, Australia). 'Non-sustainability' might be defined as an activity that shrinks or disappears once public or outside support is withdrawn.

To accelerate dissemination and address the sustainability issue of VS, we tested an inverted approach West Africa's Senegal. We introduced the Vetiver System for soil and water conservation in Senegal while working in a donor-supported business development project. VS was introduced in mid-2000 with the first importation of *Vetiveria zizanioides* from South Africa, and subsequently disseminated solely through for-profit private sector channels. The strategy was based on three assumptions:

Vetiver has commercial value, thus entrepreneurs might be well placed to rapidly market the product and its application. Sufficient information on the vetiver system is available, based on experience and research conducted in other countries, to provide a cogent case for entrepreneurs to become proponents of the technology, and private nurseries can adjust plant supplies to shifting market signals more rapidly than public agencies.

After three years from the time VS was introduced in Senegal, its use and application reached an acceptable level of sustainability. There are autonomous suppliers and providers of VS in all of Senegal's main ecological zones, and a sufficient flow of information about various applications of VS that research and new users are expanding on a broad scale. Within three years, government agencies were approaching the private sector to explore ways they could participate in VS usage and to engage in disseminating campaigns. Public agencies showed

interest in vetiver when they witnessed a rapid acceptance rate and the spread of VS technology; however, they remain minor 'consumers' of the technology.

The dissemination strategy, which consisted of a "facilitator" that targeted private suppliers, buyers and service providers, proved to be a rapid, low cost and a low labor model. Major strides were made in innovative uses of vetiver in large part because they were entrepreneurial driven. Today, a self-sustaining loop is solidifying links between the business sector, and NGOs and public agencies, which includes the National Education system, research institutions, extension agencies, Water and Forestry departments, the Environment Ministry, and local governments.

Keywords: Senegal; private sector; sustainability, market signals, vetiver system; nurseries; public agencies; commercial sector; NGOs.

Case Study Paper:

Topic: Vetiver Technology - System Innovation and Their Application

Speaker: Hao Hong[1/] [2/], and Wenzhi Quan[2/] ([1/]Guangdong Association of Grass & Environment, Guangzhou, China; [2/] Hongri Group, Beijing, China)

E-mail Contact: <office@chinahongri.com>

Abstract: Vetiver has been studied for many years in many countries in the world, but as a good mature product and technology, it has been applied only in last decade in China. The authors take the vetiver application as the basis and technology-system innovation as the frame to discuss vetiver-technology innovation, and at the same time establish the application mode to make the technology serves practice well. The paper analyzes each key component, viz. the government, the public, and the private enterprise, in order to make sure vetiver-technology application can bring larger economic, social, and ecological effects.

Keywords: Application mode, technology-system innovation, government, public, private enterprise.

Coffee Break (15:20-15:40)

Plenary No. 7 (15:40-16:20)
Vetiver's Other Applications

Reviewer's Paper:

Specific Topic: Other Uses, and Utilization of Vetiver

Speaker: Narong Chomchalow (Coordinator, Pacific Rim Vetiver Network, Bangkok, Thailand) and Keith Chapman (Plant Production Officer, FAO Regional Office for Asia and the Pacific, Bangkok, Thailand)

E-mail Contact: <narongchc@au.edu>; <KeithChapman@fao.org>

Abstract: In addition to being used to perform specific functions in soil and water conservation, environmental protection, etc., vetiver plant has also a few other uses, e.g. as forage for livestock, ornamentals, and miscellaneous other uses. Harvested vetiver leaves, culms and roots are utilized after some degree of processing in various ways, e.g. as input of agriculture-related activities (mulch, compost, nursery block/planting medium, animal feed stuff, mushroom cultivation, botanical pesticides, and allelopathy), handicraft and art works, medicinal applications, fragrance, input of construction-related activities (roof thatch, hut, mud brick, vetiver-clay composite storage bin, fiber board, artificial pozzalans, ash for concrete work, and straw bale), containers (pottery, melamine utensils, water containers), bouquet, energy sources (ethanol, green fuel), industrial products (pulp and paper, panel), and miscellaneous other utilization. This paper also discusses: (i) the main objective of growing vetiver, (ii) the growing of vetiver as a cash crop for utilization, (iii) the ecological benefit of growing vetiver, and (iv) botanical pesticides from vetiver.

Keywords: Use, utilization, ornamentals, mulch, botanical pesticides, handicraft, traditional medicines, perfumery, aromatherapy, industrial products.

Case Study Paper 1:

Topic: Vetiver Oil

Author: U.C. Lavania (Central Institute of Medicinal and Aromatic Plants, Lucknow, India)

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Abstract: Vetiver, a native of India is known for its perfumery and medicinal value since ancient times, much before the world became familiar with rose scents. The annual world trade in vetiver oil is estimated to be around 250 tons, with Haiti, Indonesia (Java), China, India, Brazil, Japan being the main producers, and USA, Europe, India, and Japan being the main consumers. It is a gift of India to modern world, and finds its greatest use in modern perfume creations. The essential oil distilled from the roots of vetiver, is one of the most complex mixtures of sesquiterpene alcohols and hydrocarbons, and also one of the most viscous oils with an extremely slow rate of volatility. Slow evaporation rate of vetiver oil coupled with its pleasant aroma makes it a perfume by itself. Its high solubility in alcohol that improves its miscibility with other perfumery material, makes it unique perfume resource, for which no synthetic substitute is yet available. The essential oil produced in different countries possesses distinct odor note – Reunion (Bourbon) and Haitian oil with roseate note is highly regarded in perfumery industry, but the vetiver (khus) oil obtained from wild 'Khus' roots in India is considered to be the best for its balsamic woody note. Washed fresh or soaked semidried roots when distilled by hydro-distillation / steam distillation produce an amber or dark brown oil with a viscous texture. When the oil is distilled using traditional copper vessel in conventional slow fire stills, the oil produced is of dark green color. Normally 15 - 18 month old roots, harvested during December - January are most suitable to realize high concentration and good quality of essential oil. Depending upon the biotype, cultural practice, age of roots and mode and duration of distillation, vetiver roots may give an yield of about 0.3 to 2% essential oil on fresh root weight basis. Under ideal steam distillation conditions the economic distillation of essential oil is realized within 15-18 hrs.; but low temperature wood-fired distillers may require over 24 hrs. Lately, molecular extraction by liquid carbon dioxide is gaining preference over hydro-distillation methods to realize high-grade essential oil.

Chemical composition of vetiver oil is extremely complex, mainly comprising of sesquiterpenes and sesquiterpene derivatives, of which vetiverols, their carbonyl compounds and esters, are the main constituents, and their relative abundance normally establishes the oil quality. Three carbonyl compounds, _-vetivone, _-vetivone and khusimone, are considered the primary odor-influencing components; _-vetivone has the better odor, and is considered the most important, while its major isomer nordihydro _-vetivone has a strong, rich, woody-peppery note. The oil and its constituents are used extensively for blending oriental type of perfumes and floral compounds, as well as in other cosmetic and aromatherapy applications. It is very persistent and one of the finest fixatives known. Vetiver oil is a main ingredient in 36% of all western quality perfumes and 20% of all men's fragrances. Dried roots are used as sachets / stuffing material to prepare ventilating screens that provide cool air effect and pleasant aroma when moistened.

Keywords: Khus oil, vetiver oil, vetiver perfume, essential oil, vetiver roots, perfume fixative, perfume blender, aromatic plant, aromatherapy.

Case Study Paper 2:

Topic: Utilization of Vetiver Grass as Construction Materials

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Abstract: The development of a new building material based on vetiver grass ash (hereinafter referred to as VGA) for use in the rural areas of the developing countries is experimentally investigated. The properties of VGA were experimentally studied to consider the possibility of

using VGA as a pozzolanic material. An experimental program was conducted to determine the physical and mechanical properties of VGA and cement mortar containing VGA. Moreover, the possible applications of VGA mortar are indicated.

The parameters considered in the experimental program are the ecotypes of vetiver grass as raw material and percentages of VGA replacement. The ecotypes of vetiver grass used in the parametric study were *Vetiveria zizanioides* and *Vetiveria nemoralis* namely 'Phraratchathan' and 'Nakhon Sawan', respectively. The percentages of VGA replacement used in the parametric study were 0, 20, 40, and 60%. For VGA fineness, chemical composition and setting time were investigated. For mortar, compressive strength, amount of water requirement, water permeability, and resistance of acidic attack were investigated. The test results were compared with this of the ordinary Portland cement (hereinafter referred to as OPC) mixes.

Test results revealed that the silica content of VGA was approximately 7% higher and potassium oxide content about seven times higher than in fly ash. According to ASTM requirement VGA can be classified as class C pozzolana. VGA mortar can be suitably adopted as a construction material for foundations, marine structures, sewers, and other chemically exposed structures.

Keywords: Vetiver grass ash (VGA), fly ash, pozzolanic material, cementitious material, mortar, ordinary Portland cement (OPC).

Plenary No. 8 (16:20-17:00)
Advance of Scientific Research on Vetiver System

Plenary Paper:

Specific Topic: Vetiver Grass, a Little Recent History and Thoughts for the Future.

Speaker: John Greenfield, The Vetiver Network Board Director, New Zealand

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Abstract: A brief history of how the Vetiver System started 50 years ago in Fiji. In the past soil conservation around the world was soley based on the engineering approach developed in the US in the 1930s. This is a system of constructed contour banks, diversion banks, and absorption banks waterways leading to low dams or the drainage network. It was the accepted system of soil conservation. Vegetative methods had been tried in the past in many parts of the world using trees, shrubs and grasses, but somehow they never really amounted to much or were never fully recognized, written about or talked about.

In western Fiji, where the annual rainfall is about 1 700mm. How do you design contour banks for that capapcity on very steep slopes? so vegetative methods of control were tested to compare with contour banks. Among the 20 shrubs and grasses tried as conservation hedges, one was Vetiver grass, which came out as a winner.

However all the evidence on the use and safety of vetiver grass was anecdotal. Some quality research work was desperately needed on *Vetiveria zizanioides* for it to be accepted by the professional communities. It wasn't until Dr. P.K.Yoon, took up the challenge to do some detailed research in to vetiver, and our claims, that we started to get the results we needed. Dr. Yoon's Report "A Looksee at Vetiver" was a classic and our first breakthrough giving some credence to our claims of the value of vetiver. Our colleague Dr. Paul Truong. has documented some outstanding discoveries for other uses of vetiver apart from soil erosion control, in phytoremediation, reclamation of mine dumps, landfills, sewage, its tolerance of heavy metals and ability to filter toxins before they enter the watertable, to name a few. In Thailand, Diti Hengchaovanich's research confirming that vetiver's use for slope stabilization and erosion control can be the basis for road engineers to use the grass to stabilize road cuts and fills. But let us not forget the main strength of this plant - improving the lives of the poor subsistence farmers throughout the world.

For future research we need to know: - Vetiver can take the toxins out of effluent, but the vetiver root system turns over almost seasonally. What happens to the toxins it takes up? - Can

vetiver be recommended as a sustainable control of septic tank outlets and prevent their nutrient load and toxins from entering the ground water or flowing in to the sea. Is this treatment, sustainable over the long term? - Vetiver has been found to be effective in stabilising coastal sand dune and beach sand, but can vetiver hedges stabilize sand dunes in semi-arid areas. We have to think of ways the vetiver system can be used to alleviate the suffering of farmers in the dry regions of countries like Ethiopia. - Do vetiver hedges repel or otherwise affect insect pests from field crops like coffee, etc.?

Answers to each of these topics will improve production or services for vetiver users, and for those downstream. Thankfully, unlike most technologies, the vetiver system becomes organically more self-sufficient with time, and cheaper, requiring mostly labour rather than off-farm inputs.

Keywords: Soil and water conservation, bioremediation, water purification, sanitation integrated pest management.

Case Study Paper: None.

Royal Thai Army's Campaign on Planting Vetiver

On 14 May 2003, the Royal Thai Army, as member of the Committee on the Development and Promotion of the Utilization of Vetiver Grass According to His Majesty's Initiatives, organized a press conference at its Headquarters. The conference was chaired by the Commander-in-Chief of the Army, and attended by many high-ranking officials of various government agencies, such as Mr. Panthep Klanarongran, Secretary-General of the Royal Development Projects Board; Mr. Ard Somrang, Director-General of the Land Development Department; Mr. Suthep Limthongkul, Deputy Director-General of the Department of Agriculture; and M.R. Samjamjaras Ratchanee, Chairman of the Vetiver Technology Research and Development Project under the Royal Projects Foundation. The objectives of the conference were: (i) To widely disseminate information and knowledge on the development and promotion of the utilization of vetiver grass according to His Majesty's initiatives among the military officers, their families and general public, especially the farmers' groups. It is because at present the people are still deprived of the knowledge, understanding and awareness of the importance of the use of vetiver. (ii) To inform the public of the Royal Thai Army's project implementation, which adheres to His Majesty's Initiatives as guidelines. The emphasis is placed on the cultivation of vetiver for soil and water conservation as well as for rehabilitation and development of natural resources in general. The operation is based on the cooperation from all parties with the people being the first priority. Other uses of the vetiver are secondary.

The Chair also mentioned about guidelines of project implementation to develop and promote the use of vetiver grass in an integrated and continuous manner and in the ways that induce optimal benefits. The implementation includes:

1. Building and enhancing the knowledge on vetiver among the unit commanders, the battalion commanders up to the commanding generals of the Army Area Command throughout the country. In this respect, lecturers were provided by the Office of the Royal Development Projects Board, the Department of Land Development, the Department of Agriculture, and the Royal Projects Foundation.

2. After a period of implementation, a monitoring and evaluation unit will be formed comprising representatives from four agencies, namely: the Royal Thai Army, the Office of the Royal Development Projects Board, the Department of Land Development, and the Department of Agriculture. The unit members will jointly set the standard criteria for the monitoring work and advise the implementing agencies stationed throughout the country to ensure that they proceed their work in the same direction.

Letter to the Editor

Vetiver in Tea Plantation

I have read Vetiverim-25 and found the 'Glossary' & 'Commendable Names of Vetiver' in particular, very informative and exciting. Your comments for my request for publication are interesting; I realize how you value old and new information on vetiver.

I hasten to inform that the reference to vetiver in tea made in the book 'TEA' by T. Eden is not a detailed report. The book was published in 1958 (205 pages). In Chapter V, under 'Soil Conservation', our plant is referred to, on page 39, as follows: "Grass strips used as erosion barriers can easily get out of hand and do considerable damage to adjacent tea. An exception is Khus Khus grass, *Vetiveria zizanioides*, a tussock grass reasonably restricted in root range. It needs to be controlled by periodical cutting."

Tea planters who took notice of Eden's work then had used vetiver for soil conservation in tea fields in Sri Lanka although not in a massive way.

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Thanks for sending me the photocopy of Chapter V (Soil Conservation) of T. Eden's book. It is interesting to note that vetiver has been used to control soil erosion in tea estate in Sri Lanka as early as 1958, and that 'it needs to be controlled by periodical cutting'. We have now confirmed that what has been recorded in 1958 is true.