VETIVERIM

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Editorial

Extreme Slope Stabilization

Having read through Paul Truong's illustrated monograph on, "Extreme Slope Stabilization Using Vetiver System", the Editor was so fascinated on how vetiver plants could do its many functions. The author was able to obtain facts and figures from various sites throughout the globe on the successful applications of the Vetiver System (VS) on the extreme slopes, without geofabrics and hard structure, with geofabrics, as well as with hard structures. In addition, VS application has been used with bags, with eco-mortar, with soil nails and with geogrids.

Geotropism, the growth movement by plants in response to gravity, is responsible for this stabilization process. The VS can be used effectively to control surface shallow failure of road slope, between 30-60^{o} and can be applied to cope with erosion and shallow failure to road slope. However, it should not be applied solely; thus it must combine with geotextiles and/or any other mechanical methods.

There are several options for slope protection through the use of vetiver. They are: (1) hard structures only, (2) combination of hard structures and soft bioengineering, including geofabrics, and (3) bioengineering alone, including geofabrics on erodible soil.

The successful application of vetiver to stabilize extreme slopes provides the following facts: (1) the VS can be used effectively to control surface erosion and shallow failure or road slope, (2) the VS can be used effectively at any slope between 30-60^{o}, (3) the VS could be applied by road authorities to cope with erosion and shallow failure of road slope, and (4) at road slope >60^{o}, vetiver technology is not recommended to be applied solely (must combine with geotextiles and/or mechanical methods).

It is interesting to note that sand bags have been used to reinforce rehabilitation, especially in extreme slopes, for example in Brazaville, Congo for urban ravine rehabilitation. The bags can be filled with sand, soil and fertilizer or a mixture of sand and soil where local soil is poor or rocky. A weak shortcrete, which is a mixture of cement soil and fiber, has been developed and used extensively in several sites.

Acitivities of the Yunnan Vetiver Network*

Through technological exploration and engineering practices over the past five years, Yunnan Vetiver Network (YVN) was established by Kunming Zhongjiyuanchuang Technology Co. Ltd. in combination with Kunming Guangbao Biotechnology Engineering Co. Ltd. The former dominantly involves in vetiver slip production, mining rehabilitation, and industrial development and the latter is engaged in water ecological restoration and sewage treatment, production and marketing of microbiological materials, and engineering construction of ecological remediation and slope stabilization. The YVN studies and integrates a full set of technology system on vetiver seedling breeding and engineering design and its implementation and the comprehensive utilization of vetiver as a resource. Furthermore, demonstrated project in Yunnan, Sichuan, Ningxia, and Gansu provinces was conducted and satisfactory results were obtained with positive market reaction. The YVN is trying to become technical facilitators or communicators of vetiver system in Yunnan and further in Southwest China. Following is the chronicle of events for YVN.

1. Built up vetiver slip production base to provide large quantity of slips: There is a total territory area of 384,000 km^2 in Yunnan Province, 94% of which being mountainous land. Annual precipitation is about 1,109 mm with distinct dry and moist seasons, 90% of which happens in rainy season (May-September). Thus, water and soil loss and even geological disasters such as landslide and debris flow take place frequently because of having large mountainous areas with steep slopes and concentrated rainfall. The demand to plant materials is increased more and more when VS is quickly applied in Yunnan Province and other provinces in southwestern China. Tremendous demand tends to become the bottleneck of VS application. Therefore, YVN has been trying to expand the mass production of vetiver grass slips. A slip propagation center using tissue culture covering an area of 500 m^2 was established in March 2012 with ability to cultivate one million slips a year. Meanwhile, vetiver slips from several sites with different climate patterns were collected, restructured and planted in order to cultivate and offer best slops (Photos 1 and 2).

Slip production bases of varying scales have been established in the field in Honghe, Chuxiong, and Wenshan of Yunnan Province and Xichang and Wenchuan of Sichuan Province with a total area of more than 67 ha. Over 100 million slips are produced per year (Photos 3-5)

Collaborated with China Construction Group, a vetiver seedlings production sites with an area of about 3 ha was established in the Republic of Congo in 2012 (Photos 6-7), which laid foundation for the application and propagation of vetiver system in the country and other African countries.

2. Experimental project and demonstration implementation: The Yunnan Vetiver Network is getting increasing development from experimental projects to demonstration, promoting vigorously the application of VS to different fields in Yunnan province and other provinces of Southwest China, doing every effort for environmental protection and economic development in this region.

2.1 Actively participated in the colorful Yunnan protection action: In 2007, the "Colorful Yunnan Protection Action" was totally initiated and implemented in the whole Yunnan Province. The action's slogan was "Cleaner water, greener mountains, more blue sky, better resource protection, and more prominent biodiversity". The YVN applied VS to initiate the action and carried out projects for ecological rehabilitation of quarry and mines of gold, manganese, and copper, which has been a big problem for Yunnan for a long time as a mining province. The projects included the followings: "Ecological rehabilitation of open-pit mining area with 50 has in Jianshui manganese mining of Yunnan"; "Ecological rehabilitation of the quarry in Jiulongwan of Kunming City and water and soil loss control of quarry in Luquan of Kunming City (over 100 ha)", "Protection of the

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terraces in Yuanyang County of Yunnan, a world heritage site." As a pioneer plant, vetiver adapts well, grows quickly on the barren land, and improves the micro-climate environment so that the growth of indigenous plants is promoted to improve the environment (Photos 8-13).

VS technology was meanwhile applied in Sichuan Province. In Xichang City, Sichuan Province, the first-stage project on control of soil and water loss and ecological rehabilitation in Taihe mining field belonging to Chongqing Steel Group was conducted in June, 2012. The project restored the ecological system of bare hills with about 2.7 ha in the mining field.

2.2 Application of VS to poverty reduction: In addition, a comparison of protein content showed that fresh and tender vetiver stems and leaves (at 65 days) was higher than alfalfa, clover, sweet potato vine and rice straw but slightly lower than that of Chinese milk vetch *(Astragalus sinicus).* Although protein content in dry vetiver (at 65 4 and 215 days) was lower than alfalfa, it was higher than that in corn silage and other common winter fodders such as rice straw and wild oat straw. Moreover, the methionine content of vetiver was almost the same as other fodders, while the lysine content was much higher. These measurements indicated that tender vetiver grass clippings a suitable as fodder for cattle, sheep, pigs, rabbit and fish. Also vetiver seemed very palatable with cattle and sheep. Thus, when fast growing vetiver is applied for water and soil control to resist drought and desertification, its fresh and dry shoots can be fed to livestock so that it can improve farmers' income through developing animal husbandry. From May, 2015, the YVN has applied vetiver system technology for the project of poverty reduction in Yunnan province, which met the provincial strategy of Vigorous Development of Mountainous Husbandry in Plateau Area and the vetiver grass has become a good fodder source (Photo 14). Local government plans to plant vetiver for about 7000 ha along the basins of Jinsha and Luzhi Rivers. At the same time, in Chuxiong, Kunming, Honghe areas, the microbial strain GB1 that was developed by Kunming Guangbao Biotechnology Engineering Co. Ltd was applied to fermentation and production of high-quality fodders as a service to local domestic animal farms.

2.3 Vetiver System for environmental governance and rehabilitation after earthquake disaster: The tensile strength of vetiver root system reaches 40-120 MPa (averaging 75 MPa) being equivalent to 1/6 of the ultimate tensile strength of common steel, it is greater than that of tree and bush root system. Meanwhile, vetiver root system has large soil contacting area and a strong soil-fixing ability due to being large numbers forming a net and going down to a great depth. So, the root system can play an enhanced role in fixing soil through a strong tensile, frictional force. Photo 14 vetiver is used to feed cattle adhesive ability. In April, 2011, the demonstration project of ecological rehabilitation and governance in Wenchuan earthquake disaster region was conducted under the support of forestry department of Wenchuan County in cooperation with University of Chinese Academy of Sciences. A total of 3 ha of slop distributed in five sites in Wenchuan and Lixian County were protected and rehabilitated. The effect appeared good so far and the technology was extended by local institutions. In 2013, the local government carried out rehabilitation project along Minjiang river bank with total area of 20 ha.

2.4 Vetiver system for the protection and ecological rehabilitation in hydro-power station construction sites: In combination with ecological rehabilitation in hydro-power station construction sites of Yunnan and Sichuan provinces, the projects on broken hill governance and ecological rehabilitation in Dahua hydro-power stations of China Huaneng Group and Yazuihe hydro-power stations of China Resources in Sichuan province were implemented. These kinds of projects will be a main direction in the future.

2.5 Vetiver system for highway construction in Africa: During 2012-2013, under the collaboration of China State Construction Engineering Corporation, YVN applied VS to the Republic of Congo (Photos 15, 16) and accomplished slope stabilization project at the National Highway No 1 (Photos 17, 18). With this success, YVN is going to apply in the whole country and even for the Republic of the Sudan (Photo 15). Vetiver grass seedling base in NKAYI (Photo 16). Training vetiver planting technology (Photos 17, 18). Slope stabilization of National Highway No. 1, the Republic of Congo.

2.6 Vetiver-agroforestry system: Vetiver grass grows rapidly and has large amount of biomass. It can grow higher than 2 m after one season (5-6 months). Vetiver hedges planted in fruit and tea garden and slope cropland can be cut to obtain fresh shoot yield of 8-15 kg/m^2 through 3-4 cuts. On a pure vetiver planting plot, 58-100 t/ha of shoot and 24 t/ha of roots can be harvested. The vetiver hedges planted along with commercial crop fields can effectively control water and soil loss and facilitate the runoff, and let it penetrate into lower horizon of the soil. Meanwhile soil organic matter and soil fertility can be improved. Thus, agro-economic benefit is increased and natural disaster can be reduced. In cooperation with local agriculture, forestry, and animal husbandry institutions, the YVN interplanted vetiver with fruits trees and achieved soil and water retention improvement, insect protection and increased income. For examples, vetiver intercropped with: Grape in vineyard in Baixian County of Chuxiang↓, coffee in Nujiang river valley of Baoshan↓, Pseudo-ginseng in pseudo-ginseng science and technology demonstration park of Wenshan↓, *Paris polyphilla* in Dali↓, and apple in Fumin County↓. In October 2014, vetiver was also applied in orange plantation in order to control water and soil loss in the citrus grove. The applications widens the use of the VS.

2.7 Amelioration of stony and deserted soils: The VS was applied in the project on amelioration of stony desert soils in 2013-2014 in Xundian, Shilin, Gejiu, Yanshan counties of Yunnan Province covering about 70 ha and achieved the functions of retaining water and soil and preventing pest through intercropping. At the same time, in 2013-2014, VS was extended to Lingwu County of Ningxia Province and Minqin, Jingtai, Tongwei, Lintao counties of Gansu Province in Northwest China. Trials were conducted and a seedling production in an area of 0.3 ha was set up at each site (Photos 19, 20). Vetiver System used to ameliorate saline soil in desert of Linwu County in Ninxia (Photo 20) Demonstration of vetiver intercropping with Russian olive was shown during June 2012-December 2013. Although investigation in October 2015 found that all of the vetiver seedlings had died from cold winter, it is still useful as information collection.

3. Deeply developed utilization and industrialization of vetiver resource: In the last few years, besides the application of VS to infrastructure protection, engineering and environmental protection, protection and prevention of natural disasters, and agroforstry, the YVN had continually devoted to develop new products and technologies.

(1) A series of vetiver products, including vetiver hydrolat (sold in market), a series of edible fungi (*Coprinus comatus*, oyster mushroom, and needle mushroom), a series of smoking mate and burning incense developed using the inherent sandalwood flavor of vetiver were developed (Photo 21). The company has built up a workshop for the production. Photo 21 shows a series of products from vetiver.

(2) In combination with animal husbandry institutions, the technologies on fodder production using vetiver shoot and leaf were mastered.

(3) Herb gardens with membership was proposed and organized in order to develop plantation economy and to advetise the application of the VS. “Healthy breeding starts from the planting grass” ideology was put forward and vetiver system was applied to in process of the “Industrialization of Mountainous Livestock Husbandry Plateau Area”. In addition, vetiver pastry series and fresh grass juice were developed.

(4) From 2011 to present, collaborated with Yunan Branch of Petro-China Kunlun Gas Co. Ltd., biogas was produced based on the characteristic of high content of C of vetiver. So far the mid-trial was finished.

(5) From 2011, the YVN attended the exhibitions held by People’s Government of Yunnan Province and China Ministry of Science and Technology, Agricultural Exposition Kunming Pan-Asia International in 2012 and 2014. In the exhibition, the application of the Vetiver Technology and a series of products were demonstrated and advertised, with much attention paid by officers, the government and market.

Photo 1 Tissue culture of vetiver in lab

Photo 2 Tissue culture in greenhouse

Photo 3 Nursery in Honghe

Photo 4 Nursery in Baoshan

Photo 5 Nursery in Chuxiong

Photo 6 Working in vetiver nursery

Photo 7 Watering vetiver seedlings

Photo 8, 9 Before and after ecological rehabilitation of quarry in Lianmiansi, Panlong, Kunming City (From April, 2013-September, 2014)

Photo 10, 11 Before and after ecological rehabilitation of quarry in Jiulongwan, Panlong, Kunming City (From May 16, 2013-September, 2014)

Photo 12,13 Before and after Ecological rehabilitation of Liangmiansi Quarry, Longpan District of Kunming （April 2013-Sep.2014）

Photo 15 Vetiver grass seedling base in NKAYI

Photo 16 Training vetiver planting technology

Photo 17, 18 Slope stabilization of National Highway No. 1, the Republic of Congo

Photo 19 Vetiver system used to ameliorate saline soil in desert of Linwu counties in Ninxia (2012, left)

Photo 20 Demonstration of vetiver intercropping with Russian olive (June, 2012-December, 2013, right)

Photo 21 Series products from vetiver

Vetiver Monitoring and Tracking System*

Inspired by the accomplishments of Thailand's Land Development Department – the work that earned TVNI's Innovation Award at ICV-6 – the Royal Projects Development Board and the Land Development Department of Thailand and TVNI are collaborating to develop a smart-phone app that will allow users around the world to upload basic information on their Vetiver Grass Technology (VGT) applications to a global database. The potential value and benefits from the database for all current and potential VGT users are enormous!

While TVNI arguably is best positioned to have a global overview of what is transpiring with VGT, it is likely that we know much less than 10% of what is actually in the ground, what it is accomplishing and, at least if not more importantly, who is responsible. Most of the queries we get at TVNI are from interested users looking for where they can source knowledge and expertise to develop their own VGT applications. We do our best to find them local sources but our limited knowledge more often than not allows us only to direct them to other network members that may provide virtual assistance through the internet. If successful, the *Vetiver Monitoring and Tracking System* will allow anyone to identify where their nearest neighbor is that might help them. It will also provide the confidence to new users that VGT works in their context. Seeing is believing and access to hands on experience and learning are the most powerful ways to extend and expand upon the use of Vetiver. Knowing more about the magnitude and distribution of VGT utilization will also be a large step in overcoming the types of challenges that Dick Grimshaw referred in a recent post to the TVNI website (www.vetiver.org) entitled "*Why, Why, Why, don't those responsible for public works protection and maintenance use the Vetiver System?*" His answer to the question of "*Why is [Vetiver] not being used widely? The most important being: lack of knowledge, "too good, too cheap" syndrome (in other words, PROFITS), and entrenched traditional habits or ignorance by those responsible.* If successful, we think the app will allow us to seriously address at least two of these: lack of knowledge and ignorance.

General Objectives

TVNI and VS users can monitor and track VGT installations and applications around the world and identify and contact the persons responsible for these purposes for: (i) monitoring, tracking and reporting on national and global trends with installation and applications of VGT; and (ii) facilitation of learning and exchange between interested users at the local level y in order to source Vetiver and interchange knowledge, experience and lessons learned.

Specific Objectives

Registered users, in the field, able to upload coordinates and basic information, including photographs, to a global VGT database of installations and applications.

1. Registered users able to access the VGT database and make simple search/queries to obtain specific records based on location and/or application type and/or installer/contact person.
2. TVNI able to access and download information for purposes of analysis and generation of evaluation reports and products.

Key Stakeholders

1. All interested parties – individuals and institutions – that are willing to register to obtain access to the database for the purpose of uploading information on VGT applications and/or obtaining information on VGT applications contained in the database.
2. TVNI System operator/Database administrator.

Basic Principles Guiding Design

A wiki, i.e., a system that allows collaborative editing of its content by its users. There fore, open access database for registered users to upload information, make searches and queries, and

By James Smyle, President, The Vetiver Network International, Washington, DC, USA

edit existing

1. Records for purposes of correction or addition of information. Access primarily thru smart-phones, rather than internet-based devices (i.e., through a smart phone app).
2. Utilizes existing, no cost platforms to the fullest extent possible (e.g., Google Maps and Google Earth).
3. System is for strategic purposes, it is not a tool for operational control or to assess adequacy and/or technical quality of use.

General Requirements

1. Open Source, but registration required.
2. Registration to be approved by "moderator" / "administrator".
3. Log in ID and password (user generated as part of profile).
4. Administrator must have ability to delete/ban membership for misconduct/misinformation.
5. Multi-platforms – IOS, android, tablet, smart phone, computer (Mac, Windows browsers).
6. Must be able to record location (GPS) and store data even in absence of cellular connectivity (upload when in the range of wireless or cellular connectivity).
7. Data to be stored in downloadable Excel or pdf format.
8. Multi-country data input and mapping.
9. Mapping with Google Earthand Google Maps.
10. Maps to show vetiver locations.
11. Registered users able to edit/modify existing records (as in Wikipedia) should corrections be required (e.g. false or erroneous information) or additional information desirable (e.g. addition of updated photos or other information).

Examples of Data Input Fields

1. Latitude and Longitudeautomatically generated.
2. Date of entry (mm, yr) from Drop Down Menu (DDM).
3. Country name from DDM.
4. Data Inputer name generated automatically from login info.
5. Organization name and type.
6. Vetiver type from DDM.
7. Vetiver application (On-farm soil/moisture conservation, road, highway, railway, river, canal, drain, phytoremediation (land or water), biofuel) from DDM or other (specify).
8. Ownership of planting (community, individual, company, government)from DDM.
9. Annual rainfall (mm) or climate class from DDM.
10. Altitude (m).
11. Linear meters planted (m).
12. Number of plants planted (#).
13. Area protected (ha).
14. Date of Planting (mm/yr) from DDM.
15. Condition (good, poor, absent, revert to natives) from DDM.
16. Photos (up to three).
17. Comments.

If all goes well, the app and database will be up and running in 2016. For which, TVNI would like to thank the Royal Projects Development Board and the Land Development Department of Thailand; Drs. Kittima Sivaarthitkul, Chunphen Larpchitr, Pornpat Nopmalai and Weera Pathakheenang who developed Thailand's Vetiver Grass Tracking System (Land Development Department), Dr. Pitayakon Limtong (Land Development Department) and Ms. Suwanna Pasiri (Royal Projects Development Board). Without their support and commitment, none of this useful tool would be made available.

Vetiver Inspires People, Builds Up Strong Friendship*

PTT Public Company Limited was recently invited to help coordinate and participate in the Vetiver Handicraft Training Course in the 6th International Conference on Vetiver (ICV-6) in Danang, Vietnam from the 5-12 May 2015. The main objectives of this training course is to transfer knowledge and to share the experiences of the vetiver handicraft making technique. From our training and demonstrations, Thailand received very good feedback and got a lot of interest from the other international participants such as South Africa, Kenya, the Philippines, Indonesia, Guam, the USA, Italy, Vietnam and many others.

As a result of the training, many countries expressed serious interest in further cooperation about the vetiver handicraft making training, and the need for support from TVNI Thailand to send the instructors and materials to transfer knowledge and the proper techniques to people in their countries in the future.

At the ICV-6, the South Africa Vetiver Network (SAVN) was the one most impressed with the vetiver handicraft training workshop. Official request was sent to the Office of the Royal Development Projects Board (ORDPB) of Thailand and invited PTT to be the representative from Thailand to join "the Sustainable Living Exhibition 2015" in Durban, South Africa during 14-16 August 2015. The national exhibition had 300 organizations which participated in raising the awareness of sustainable living to South African people. PTT joined the exhibition in the Environmental Conservation Section by presenting "The Utilization and the Promotion of Vetiver Under the Royal Initiatives by H.M. the King of Thailand Exhibition". It aimed to inspire and share the knowledge of vetiver utilization; a case study in Thailand from the upstream to downstream.

Moreover, the PTT brought a number of vetiver handicrafts from Thailand for display. The information and video presentation of the demonstration of vetiver handicrafts were provided to people interested in the benefit of the vetiver leaves. Those vetiver products from Thailand caught a lot of attention by their finely designed products and with their exquisitely-made techniques. These products were able to inspire the local people in South Africa to develop and apply value addition to their vetiver handicrafts. This exhibition also gave PTT a chance to exchange knowledge and lessons learned with Mr. Roley Nöffke, a board member of The Vetiver Network International (TVNI) and PTT received the best hospitality and warmest welcome from SAVN and the Sukyo Mahikari (Cliff, Robin, Selvan and others), Durban local authorities, local communities, organizations, education sector and government departments of South Africa.

From this event, I saw that the potential of the people in South Africa to utilize vetiver is the same as I have found it in Thailand. They are trying their best to promote the vetiver network countrywide to conserve soil and water, to reduce environmental problems, to reduce poverty and unemployment in South Africa. All of their actions start from internal belief and trust in vetiver, with their aim to create the awareness of people to make a sustainable and happy society for all. However, the continued cooperation from the TVNI members and their government is still needed.

I was so proud to hear all of the gratitude from the local South African people to H.M the King and the Thai royal family and also the kind appreciation for Thailand Vetiver Network, the Thai government and the PTT. Although I spent only a few days in Durban, I was able to learn one very important thing, *"Vetiver is truly a miracle gras; it inspires, gathers people, and builds up strong friendships"*.

** By Pichapong Pokapun, CSR Department, PTT Public Company Limited, Bangkok, Thailand*

Request for Training on Vetiver Handicraft

Dear Narong,

I am an engineer work for the Government of Sri Lanka and an engage in an urban development project. Mrs. Sureka is a social development officer. As a part of our project we are going to use a large number of vetiver plants to purify a polluted Beira Lake in Colombo. At the same time some families were resettled and they are very poor. There are women in need of employment. So we have plans to train them to use vetiver leaves for income generation as social safeguards. Here in Sri Lanka there are handicrafts made from reed, but not vetiver. We have learned about many uses of the vetiver plants through The Vetiver Network International (TVNI) website. Dale Rachmeler from TVNI advised me to contact you to get the best training opportunity. We will be very thankful to you, if you can advise us and help arrange a vetiver handicraft training programme in Colombo, Sri Lanka. We understand that you have trained people in this topic, and you are well experienced in this training programme. Many thanks.

Chandanie

Eng. Mrs. Chandanie Jayatilake,Senior Engineer/ PMU
Metro Colombo Urban Development Project
Ministry of Megapolise and Western Development, New Building, Sethsiripaya,
Battaramulla, Sri Lanka

Dear Mrs. Jayatilake,

I have forwarded your request to the Office of the Royal Development Projects Board (ORDPB) that coordinates the activities on vetiver in Thailand. I am sure they will provide a positive reply to your request. Although ORDPB does not have facilities to conduct such a training by itself, it can ask other agencies which have such facilities. There is one that I know of, which has offered such a training course, both in Thailand and abroad – it is the PTT Public Company.

Narong Chomchalow, Editor, Vetiverim

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