

# VETIVER GRASS TECHNOLOGY DEVELOPMENT AND DISSEMINATION IN CHINA

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## Abstract

Soil erosion has become a critical issue facing our global society, and vetiver, a miracle grass, can play an important role in soil erosion control, land rehabilitation, earth work protection, etc. The China Vetiver Network (CVN) has promoted the dissemination and extension of vetiver grass technology (VGT) throughout the country, through national information services, technology distribution via public media, many conferences, workshops and training courses, joint field surveys and investigations, demonstrations and bilateral visits, distribution of planting materials and mini-grants, etc.

Recent investigations indicate that non-agricultural practices cause 72.0 and 89.4% of the total erosion area and soil loss, respectively, which worsen flooding and other natural disasters, harm farming production and threaten people's lives. In the past two years, CVN has put emphasis on the application of VGT for infrastructure stabilization and highway embankment fixing.

Methodologically, the networking was to find factors which might affect VGT dissemination and solve problems through various methods so that the best approaches to dissemination of VGT are developed.

## Introduction

Soil erosion results in soil fertility decline and ecological environmental deterioration and forms one of the most critical issues facing our global society. As population increases, the problem becomes more serious. The total erosion area in China has increased from 150 million ha in the 1950s to 170 million ha at present, which accounts for one sixth of the country land, and soil erosion takes place in the cultivated lands over 45.4 million ha, almost one third of the total cultivated land (Gong and Luo 1998).

Although there are many soil conservation measures, the most outstanding of these is the use of vegetative soil and moisture conservation measures that are cheap, replicable, sustainable and fully effective in stopping erosive degradation and increasing crop yield. Many examples from all over the world show vetiver as a boundary hedge to be the ideal plant to conserve soil and rehabilitate eroded land.

## Background of Vetiver Technology Development in China

Vetiver (*Vetiveria zizanioides*) was disseminated in China in the late 1980s as a plant for soil erosion control, although it had been introduced into the country as early as the 1950s as a plant for extracting oil from its roots. Since the 1980s, vetiver grass has been experimented or tested in most provinces of southern China, i.e. Jiangxi, Fujian, Sichuan, Hunan, Guizhou, Hainan, Guangdong, Gansu, Henan, Shandong and Zhejiang provinces. The dissemination of the technology was promoted through the World Bank-supported Red Soil Project (Hu and Xue 1998), while some of the activities also involved the Asian Development Bank (Haagsma et al. 1998). The main results were as follows:

- Some nurseries have been established and experiments carried out or proposed on the biological characteristics; hedge establishment and maintenance; hedgerow impact on soil fertility, moisture, crop yield and soil losses;
- Vetiver hedgerows were established in tea, tea oil (*camellia*) or citrus plantations in many provinces;
- The green *Vetiver Handbook* was translated and distributed countrywide;
- Vetiver was used to feed fish and livestock and to mulch the ground surface of orchards;
- Vetiver hedgerows were established to protect river banks and fish ponds;

- Vetiver was planted on saline soil to improve the soil properties in Fujian province of southern China;
- Vetiver pruning was used to cultivate edible fungi and to make small items.

To speed up the extension of the technology in southern China, where 70% of the land is mountainous and soil erosion is a critical problem, the China Vetiver Network (CVN) was established at the end of 1996. The main task of CVN is countrywide VGT extension, i.e. to extend VGT to new areas and to use the grass for new applications.

## **Multiple Measures for VGT Dissemination**

### **National Information Service through CVN Publications**

CVN has been developed based on and in cooperation with the existing national agroforestry network which has developed for more than seven years and has over 1 000 members. The national information service focuses its attention on the southern part of China where tropical and subtropical climates are dominant. The vetiver publications were distributed to many national universities, research institutions, governmental offices, provincial institutions, and also many county-level and some township-level extension stations. Many disciplines were involved, including soil and water conservation, agriculture, forestry, ecology, environmental protection, botany, soil science, etc. The publications include:

- The *Vetiver Newsletter* in Chinese, four issues of which, with a total of 4 000 copies, are disseminated each year. The newsletter introduces new developments, new technology and activities in China and foreign countries.
- Vetiver fact sheets (*Vetiver & Soil Conservation*), which introduce substantial technology to extension stations. The four issues a year totalling 8 000 copies are mostly distributed to county extension stations.
- *Agroforestry Today*, a quarterly journal in Chinese, in which vetiver grass is one of the main subjects. This seven-year-old publication has an average circulation of about 1 200 copies per issue.
- *Vetiver Research and Development*, the proceedings of the International Vetiver Workshop held in Fuzhou, China, in 1997, with a total distribution of 1 000 copies (Xu 1998).

Different publications have been produced and distributed to different readers with different cultural backgrounds, from scientists to master farmers. They bridge the gap between research and extension and accelerate the dissemination of the technology.

### **Technology Dissemination through Public Media**

Although many thousands of copies of vetiver publications have been released countrywide in the past few years, there is still a strong demand for vetiver information dissemination. As a large agricultural country, China has thousands of research institutions at national, provincial and prefecture levels. Besides, there are thousands of extension stations at county and township levels involved in agriculture, forestry, soil and fertilizer, soil and water conservation, livestock, etc. There are also thousands of institutions involved in engineering subjects as well as ecology and the environment. To accelerate technology extension, numerous papers introducing vetiver were prepared and published in national or regional journals, newspapers, and for television stations. Here are just a few examples of periodicals which published such papers:

- *Chinese Journal of Ecology*
- *Soil and Water Conservation*
- *Soil Science*
- *Soil and Water Conservation in Fujian*
- *Science of Jiangxi province*
- *Resources and Environment in the Yangtze Valley*
- *Reference Information* (a daily newspaper)
- *Journal of Ecology*

## **Conferences and Training Courses**

To promote vetiver technology dissemination, various conferences were organized by CVN in cooperation with different regional, national or international institutions. These conferences provided opportunity for scientists and technicians to exchange ideas, learn new technologies, establish cooperation and linkages, and seek new projects with joint efforts. Besides, many small training courses were held for master farmers and technicians to disseminate substantial technology.

For example, supported by The World Bank, The Vetiver Network and the Natural Science Foundation of China, an international vetiver workshop was organized in Fuzhou of China in October 1997. One hundred participants attended the workshop. The main topics included:

- Results and achievement of vetiver research, experiments, application, and extension in the past decade.
- New vetiver applications and vetiver management of extreme soil rehabilitation (seriously eroded red soil, mobile sandy dunes, toxic soils, etc), watershed management, waterway stabilization, earth works reinforcing, pollution control, disaster prevention, etc.
- The needs of vetiver application to satisfy farmers' basic needs (fuel production for example).
- Application and management of vetiver in different agroforestry systems and different areas.
- Economic and policy considerations on vetiver application and extension.
- Considerations and proposals for new vetiver projects.

Through the workshops, many old users learned new vetiver applications, while new users obtained basic information and started their tests after the conference. And many vetiver users established cooperation with their neighbours.

Just two years later, another international conference, entitled Conference on Vetiver Bioengineering Technology for Erosion and Sediment Control and Civil Construction Stabilization, was organized in Nanchang in October 1999. In addition, some other meetings with vetiver as the only topic or as one of the main topics have been organized by CVN or its cooperative institutions in recent years, such as:

- South China Soil and Water Conservation Meeting (Xiamen)
- Soil Erosion and Conservation Workshop (Jiangxi)
- Vetiver Network Meeting of Fujian province (Fuzhou)
- Yangtze River Flooding and Soil Conservation (Wuhan)
- Sustainable Agriculture in the Yangtze River Basin (Nanjing)
- Vetiver for Edible Fungi Cultivation (Fuzhou)
- One-day training courses in Fujian and Anhui provinces

All of these conferences plus many small training courses played an important role in disseminating VGT and establishing follow-up cooperation. Because the different meetings put emphasis on different subjects and different groups of people, VGT was disseminated to universities and national research institutions as well as extension stations at county or township level.

## **Joint Field Surveys and Investigations**

Aiming at disseminating VGT and exploring new users and new vetiver applications, field surveys and investigations have been carried out in Fujian, Jiangxi, Guangdong, Hubei, Hunan and Anhui provinces in recent years. These investigations were organized by CVN with the cooperation of numerous multi-disciplinary institutions at national, provincial, prefecture, county and township levels. Through these investigations, team members learned experiences from established vetiver application models and proposed new applications. In addition, by distributing vetiver publications and discussing with local technicians and farmers, team members encouraged more and more people to test and use the grass.

## **Demonstrations and Visits**

Watching is better than hearing. To encourage people to use VGT, various demonstrations were established by CVN in cooperation with numerous institutions. The demonstrations showed different applications, such as:

- vetiver for tea and orange tree garden terrace protection
- vetiver for red soil amelioration
- vetiver as a component of agroforestry systems
- vetiver for newly built terrace stabilization
- vetiver for edible fungi cultivation
- vetiver for river and coastal bank and fish pond stabilization
- vetiver for sand dune fixing
- vetiver nursery management

Accompanied by the organization of conference tours, these different models were extended quickly and smoothly. Most of the demonstrations were established at sites with transportation facilities, with local technicians acting as interpreters, which was good for visitors to accept and duplicate the new technology. Different demonstrations were established for different groups of people. For example, in AgriWorld of Suzhou city the grass was planted along riverbanks, field borders and ditches as an “environmental grass” introduced to college and middle-school students.

### **Distribution of Planting Materials and Mini-grants**

In order to encourage new users to start vetiver programs, mini-grants were established and granted to institutions with different disciplines. For example, in 1998, altogether US\$10 375 was sent to 17 recipients from seven provinces. The mini-grants were approved based on:

- the applicants’ responsibility, i.e. it was hoped that the grant recipients could work well and would send feedback to CVN;
- the regional distribution and subject balance;
- whether the recipients could get money from other sources.

In addition, CVN organized millions of plants and transported them to hundreds of institutions free of charge. All of these encouraged more scientists and technicians to test and use the grass. So far, most of the recipients have sent us feedback and have used the mini-grants and the planting material very effectively and successfully. As most of the recipients were those who had not known or even seen the grass before, the first thing they did when they received planting material was to establish nurseries for reproduction. Then they distributed both planting material and technology to their neighbours.

### **Introducing VGT to Engineering Institutions**

Generally speaking, since the 1980s vetiver grass has been used mostly for agricultural purpose. Millions of hectares of range land have been protected by vetiver grass. However, in the last 20 years, following the national economic reform, the rapid development of various constructions has led to dramatic disturbance of earth materials and has resulted in large amounts of new soil erosion affecting agricultural production and causing the destruction of ditches, dams and reservoirs, which has caused frequent flooding threatening people’s lives. Taking Guangdong province as an example, in the period of 1986-1992, agricultural practice caused soil erosion over 811.30 km<sup>2</sup> with an amount of soil loss of 21 716 100 m<sup>3</sup>, accounting for 28.0 % and 10.6 % of the total erosion area and soil loss respectively (Li and Guo 1998), i.e. non-agricultural practices caused 72.0 and 89.4% of the total erosion area and soil loss, respectively. Most of the eroded area and most eroded materials were caused by mining, construction of highways and railways, power construction, quarry, etc (Table 1). These non-agricultural practices caused huge sediments in ditches, rivers and reservoirs, and dramatically influenced agricultural production and threatened people’s lives. Among non-agricultural factors, the construction of highways was an important component. Since the national economic reform, the construction of highways has been the main component of economic development and has been deemed an important channel for poverty alleviation. The total length of highway increased from 1 118 000 km in 1994 to 1 186 000 km

in 1996. The annual increase reached 34 000 km. However, due to financial limitations, many highway embankments were not properly protected and caused serious new erosion.

Consequently, we decided to do our best to introduce VGT to highway and other engineering institutions:

- 1) CVN translated the article on vetiver grass in engineering application written by Diti Hengchaovanich into Chinese and distributed it to 1 200 highway institutions via our vetiver newsletters.
- 2) In cooperation with experts and engineers from the Highway Bureau and the Survey and Design Academy of Communications of Jiangsu province, we prepared articles to introduce vetiver and its application to highways. These articles were published in several highway journals, namely:
  - *Highway Journal of China*
  - *East China Highway Journal*
  - *Guangdong Highway Journal*
  - *Newsletter of Highway Society of Jiangsu Province*
  - *Science and Technology of Communications of Zhejiang Province*
  - *Proceeding of the National Super Way Conference, Kunming, November 1998*
  - *Highway Survey and Design of Fujian Province*
  - *Science and Technology of Communications of Yunnan Province*
- 3) CVN introduced vetiver at several regional and national highway conferences, such as the East China Highway Conference in Xiamen in June 1998 and the National Super Way Conference in Kunming in November 1998.
- 4) In addition to the international vetiver workshop organized in Fuzhou in October 1997, we organized the International Conference on Vetiver Bioengineering Technology for Erosion and Sediment Control and Civil Construction Stabilization in Nanchang in 1999.
- 5) CVN invited senior engineers and directors to go abroad to visit demonstrations. When they came back they acted as active technology disseminators. It was proved that they played a very important role in technology dissemination.

Now, almost all of the highway institutions from national to provincial to county levels know vetiver and have started to or wish to use the grass. Besides, some of the institutions from railway, mining, power stations, etc, also know the grass more or less.

### **Experiences in National Networking**

From the above description we can see that CVN has played an important role in VGT dissemination and extension throughout the country. Generally speaking, what CVN has done is to encourage as many people as possible to test vetiver and to transfer the technology to others. Methodologically, the networking is to find factors which might influence VGT dissemination and solve problems on time so that VGT can be disseminated and developed more healthily and smoothly. Here are some examples.

Table 1. Soil erosion and economic losses in Guangdong province (1986-1992)

	Ero area (km <sup>2</sup> )	Ero amount (x 10000 m <sup>3</sup> )	Farm influenced (x 10000 hm <sup>2</sup> )	Sedi. in ditches (x 10000 m <sup>3</sup> )	Sedi in res No. of res	Economic loss (x 104 Yuan RMB) Sedi amount (x 104 m <sup>3</sup> )	Items Direct	Non-direct
Steep farm	811.30	2 171.61	1.290	153.50	537	1633.86		4309.30
	5537.54							
Defor.	229.20	239.58	0.255	29.89	55	89.55	1787.81	5200.72
Mining	510.69	7 908.32	2.27	269.63	329	2272.26		6824.81
	13522.98							
Kiln	413.22	538.03	0.311	23.00	77	148.50	5097.46	3000.95
Railway	26.76	195.03	0.249	11.89	34	40.30	366.72	1058.67
Highway	344.85	3039.18	1.207	158.41	208	177.89	4297.02	4557.34
Indu. buil.	190.62	1043.39	0.623	19.34	21	5.39	5200.47	2579.53
Civ. buil.	101.34	1186.75	0.502	54.43	139	65.69	2409.94	2383.02
Water. con.	29.11	376.70	0.211	27.80	39	58.56	1007.16	1131.74
Power eng.	24.97	700.67	0.123	19.84	14	3.63	593.83	538.22
Earth	32.04	338.57	0.115	13.62	36	34.07	653.87	1008.94
Quarry	115.50	2093.93	0.369	74.71	1265	261.86	5201.92	7288.29
Other infr.	12.93	24.62	0.008	4.95	11	7.61	277.89	213.84
Other	55.90	627.41	0.205	33.92	42	1812.02	2991.22	1798.34
<b>Total</b>	<b>2898.43</b>	<b>20483.79</b>	<b>7.705</b>	<b>894.93</b>	<b>2817</b>	<b>6620.19</b>		<b>41019.42</b>
	<b>49865.12</b>							

Based on Li Zhiguang

**Legend:** sedi. = sediments, res. = reservoirs, ero. = eroded, Steep farm = new cultivated farm land on slope of over 25°, Indu. buil. = Industrial building & development, Civ. buil. = civil building, Power eng. = power engineering (stations), Earth = place for taking earth off (for building, etc.), Oth. infr. = other infrastructure, Defor. = deforestation and depasture for infrastructure purpose

**NB.** The figures in the table do not include the following five cities: Shenzhen, Zhongshan, Dongguan, Fushan and Yangjia

## **Application Models**

Although VGT is easy to grasp, it may fail if the technology cannot be properly used. The technology was introduced into China years ago. However, due to the language problem, much experience obtained from foreign countries was not fully transferred into China. Improperly used, technology acts as a negative example showing people that VGT is not as successful as expected. To solve this problem, CVN established some demonstrations in different provinces to show people how to use the grass under different conditions and for different uses. For example, during the very hot and dry season we demonstrated to farmers how to use vetiver pruning as mulch to reduce evaporation and protect crops.

## **Keeping VGT out of the Closet**

Reversely, when people use VGT successfully and profit from selling planting material, contracting projects with highway bureaus or cultivating mushrooms, they may want to keep it a secret, in order to make more profit without competition. As a result, the dissemination of technology is again influenced. To solve this problem, CVN disseminated the basic knowledge and successful experiences via its publications with a large circulation in order to break through possible blockades.

## **Quality Control**

Given the growing enthusiasm for using vetiver for highway stabilization, CVN established a bridge between highway institutions and farmers who produce planting materials so that the former received plenty of planting materials to start their protection job and the latter made considerable profit selling seedlings. Unfortunately, another problem occurred. Some farmers sold low-quality planting material planted many years ago and inflated the number of tillers to earn more money, which was detrimental to the highway application. To solve this problem, CVN prepared a paper on the quality of planting material and distributed it to highway institutions, telling them how to select high-quality planting material.

## **International Exchange**

VGT is a technology without borders. In the last two years CVN has invited international experts from various countries to visit China introducing their experience. Many Chinese highway institutions became interested in vetiver applications because vetiver can save up to 90 % of the costs compared with traditional concrete protection. They established demonstrations themselves or they contracted the projects with agronomists. However, they could not each arrange demonstrations as was done by Diti Henchaovanich in Thailand. Therefore, we organized an international conference and invited Mr Diti and other international experts to give lectures and to give in situ comments to both engineers and agronomists. We encouraged our scientists and engineers to study foreign experience, to learn from one another and to co-establish demonstrations. Besides, we organized Chinese engineers' visits to Thailand and the Philippines.

## **Inviting Partners from Various Disciplines**

Since many disciplines are involved in VGT and each discipline acts as an independent kingdom, we had to invite people from different disciplines to study and disseminate VGT. During the workshop in Fuzhou in 1997, which was organized jointly with the Fujian Provincial Soil and Water Conservation Office, there were no engineers to attend because engineers might consider it to be none of their business. To solve this problem, we invited chief engineers from highway constructions to visit foreign countries and then we invited them to co-organize the Conference on Vetiver Bio-engineering Technology for Erosion and Sediment Control and Civil Construction Stabilization held in Nanchang in October 1999. Most of the conference participants were engineers. The method proved to be very successful. For the same reason we invited engineers to co-prepare articles for various engineering publications.

To sum up, VGT has developed and disseminated very quickly in recent years through national networking. There will be a great jump in the 21st century.

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