

REPORT ON THE VISITS TO VIETNAM AND CHINA DECEMBER 2000 - JANUARY 2001

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VIETNAM

THE MEKONG DELTA

In response to the request from both public and private sectors and Universities following the series of seminar on the potential application of VGT in Vietnam in Hanoi and Saigon in January 1999, a visit was made to southern Vietnam in December 2000- January 2001. The main focus of this visit was in the Mekong Delta and the southern part of the central highland.

The Mekong River

The Mekong or Cuu Long River, which means 'Nine Dragons' in Vietnamese, indicates its size and power over the lands and peoples along its course. The Mekong is 4 350 km long, starting in Tibet and finishing in the South China sea. The Mekong has a catchment of over 810 600 km², it flows through six China, Myanmar, Laos, Thailand, Cambodia and finally Vietnam where the Mekong splits into two main rivers: the Mekong in the north and the Bassac in the south

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

The Main Transport Corridor

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

Riverbank Stability in the Past

Historically erosion on the banks of rivers in the delta has been an on going process caused by the siltation of its channels resulting in changes in river hydrology and occasional floods. The erosion was confined mainly to the banks of the Mekong itself

On the other hand erosion of the banks of both large and smaller tributaries and canals rarely occurred in the delta. Although these watercourses were used then, as they are

used now, as the main transport corridor, the sampans and smaller boats of the past were mostly manually powered



Traffic on the Mekong



Erosion on the bank of the Mekong

Present Riverbank Erosion

Things have changed, due to the fast economic development in recent years, almost all boats travelling on the rivers and canals now are motorised. These boats produce waves, which relentlessly pounded the banks of these watercourses day and night, causing massive erosion. As the texture of these alluvial soil ranges from silt to loam, these riverbanks are extremely erodible when wet. The problem has been intensified in recent years with the introduction of more powerful engines, such as old car and truck V6 and V8 engines. Boats fitted with these engines produce huge waves and the severity of the problems is worse in remote areas as they need faster means of transportation. For example the erosion rate in canal banks in the southern end of the delta, the Ca Mau province, caused by these powerful boats, is a lot worse than that in the area around Cantho City, the capital of the Mekong delta.



Traffic on a tributary of the Mekong



Erosion on the bank of a tributary

Case Study

The water supply of Cantho City is in jeopardy as active erosion threatens the stability of the intake structure built on the bank of the Bassac river. Despite continuous effort and several major attempts to stabilise the site, erosion continues. In the past 3 years more than 10m of bank have been eroded. It is predicted that at the current rate of erosion, the intake pipe will collapse in less than two years unless the authority takes very costly measures.

Local Measures

Vegetative method: Water hyacinth and a local water plants (*Phragmites vallatoria* L.) are commonly used to combat the erosion.

Water hyacinth is a floating weed, which can choke up rivers and canals.

Phragmites vallatoria L is a perennial grass up to 3m high, with erect, stout and hollow stem of about 1-1.5cm in diameter. The stems are not flexible and break easily under pressure. It has a relatively shallow root system of about 0.5m depth. But due to various reasons, the vegetative means of bank stabilisation used locally are not effective or at best provide only temporary relief.

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

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

The Vetiver Solution

The Vetiver System is an effective, practical and low cost method of riverbank stabilisation for low lying, tropical and alluvial flood lands, it is particularly suited for the Mekong delta because:

- The Mekong delta is a “Meander Plains” changing its course once it has silted up its present ‘bed’.
- Static engineering solutions have been tried and failed in many countries, including the U.S.
- It is simple, low cost, low-tech, labour intensive and low maintenance
- The Vetiver System can be applied to all rivers and canals from fresh to brackish water zones and acid sulfate soils of the delta
- For the Mekong river itself, as the river moves its course, the low cost and fast growing VS moves with it.
- For the less erodible tributaries and canals the VS will provide a long term erosion control measure
- VS has been used successfully to stabilise highly erodible riverbanks in Australia, Asia and Africa.

Alternative to this new bioengineering technology are very costly:

- Rock walls, rock baskets or rock rip rap are traditional methods used for riverbank stabilisation in Asia, particularly in China and Vietnam.
- These methods are high-tech engineering structures, requiring special skill and high maintenance costs
- These methods are much more expensive, may be several thousand times more in the case of the Mekong delta as rock is not available locally and some imported materials are required
- But most importantly they are not effective as they are not stable themselves on the alluvial plains of Asia as their foundation is highly erodible

The *Vanishing Delta* CD ROM under preparation will give more details of the above.

THE CENTRAL HIGHLAND

The Problem

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

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

The newly cleared forest areas are used by million of farmers who migrate from lowland area and from the North. These farmers having very little or no knowledge of cultivating on the sloping land and slash and burn is the standard practice and this newly cleared land is kept clean of weeds. The bare soil on these steep slopes is exposed to heavy rain, between 2000 and 3500 mm falling mainly over the period of 6 months in the rainy season.

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

The Vetiver Solution

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

The problem is no longer confined to land degradation and erosion control, recently it has become a political issue as the government is now trying to stop the slash and burn practice to save the little forestry resource left. This ban has resulted in riots in the central highland, a revolt from peasant farmers, unprecedented in the communist Vietnam, which troops and helicopters were used to control the riots.



A recently cleared forest area.



An eroded coffee patch

SOUTHERN CHINA

A short visit to Guangdong was organised by Dr Xia Hanping to review his research and various joint projects with private companies. I also had the opportunity to discuss the possibility of having ICV3 in Guangzhou and to seek support for from various level of government during the visit.

Research Projects and Seminar

Seminar on Phytoremediation at South China Institute of Botany: A seminar entitled Recent European and Australian Research in Phytoremediation was presented to the Institute staff and students. The seminar summarised highlights of the recent Phytoremediation Conference I attended in Australia and the paper I presented there. Although vetiver is strictly not defined as a super-accumulator plant (more than 50% of the absorbed metal is translocated to the shoot), due to its high biomass production vetiver can remove more heavy metals than most super-accumulator plants. In addition vetiver can tolerate growing conditions that other species used in phytoremediation could not survive.

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

DNA screening trial: Observation was made on growth and behaviour of the 13 genotypes being tested by Dr. Adams. According to Dr. Xia the Kanartaka genotype so far performed best under south China conditions.

Reviewing of applications for Donner Foundation grant: Discussion was held to review the applications for Donner Foundation grant prepared by Dr. W.S. Shu of Zhongshan University on acid drain from mines and Dr. Xia on the use of vetiver in wetlands to treat water contaminated with petroleum products.

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

Native vetiver natural habitat: I also had the opportunity to visit Wu Chun, the home of ‘native vetiver’ according to Xia. In this county, vetiver can be found in most low-lying area with high water table and often inundated in the rain season. According to the local people, vetiver has been growing in this area for hundreds of years, it is confined to this habitat and exists nowhere else in China. From its growth pattern and leaf structure, I believe it is *V. zizanioides*, not *V. nemoralis* and from its widely scattered clumps and self-propagated, it must be a seeded genotype. Although Xia strongly believes that it is ‘native’ I think that it was introduced to China centuries ago for essential oil production and has spread from the farms to the wetland by seeds. I was told that in the past vetiver was harvested as fuel for brick production.



“Native vetiver” in Wu Chun, Guangdong

Despite the fact that vetiver is grazed heavily by water buffalo and farmers harvested, what is left after the buffalo, for fuel, the vetiver area is reducing rapidly as people

clear the land for cultivation. As Xia has convinced the local official of its uniqueness, Mr. Li, the County Vice Chief of the Scientific Department has promised to do all he can to preserve its stand.

I also saw here a perfect example of the effectiveness of vetiver in riverbank stabilisation, as shown below.



While vetiver protects the right bank, the left bank is badly eroded

Hong Kong Baptist University and Melbourne University, Australia: I met Prof. Ming Wong in December last year at the Phytoremediation Conference in Australia. Prof Wong is Chairman and Head of the Department of Biology and Institute for Natural Resources and Waste Management at Hong Kong Baptist University, he is the leading expert in the use of vegetation in mine land rehabilitation in Hong Kong and China. In fact he was the supervisor of Dr. WS Shu's project and co-author of the paper on mine rehabilitation that won the King of Thailand Award at ICV2. His interest in vetiver was further enhanced after discussing the tolerance mechanism of vetiver with me at the conference.

I was also introduced to Prof Alan Baker, a colleague of Prof Wong. Prof Baker is currently Head Department of Botany Melbourne University, Australia, and he is an authority on phytoremediation in Europe (Rothampstead group) specialising in the tolerance mechanism of super-accumulator plants before coming to Australia.

Both Prof Wong and Baker have now started research projects to identify anatomical and physiological mechanisms of heavy metal tolerance of vetiver grass. They will cooperate to avoid duplication and I will coordinate their effort to keep them up to date with any relevant information. I don't want to repeat again that to make a greater impact on the scientific and engineering fields we need to know these HOW and WHY questions, so I suggest that TVN should encourage them with a small contribution, may be in the next round of grant from the Wallace Genetic Foundation.

Projects

Quarry Rehabilitation: To provide rocks for infrastructure and housing constructions in addition to the Chinese people love of rock structures, quarries are a big industry in

China. In fact I was never out of sight of some quarries during the 2.5 hour drive from Shenzheng to Guangzhou.

The trial conducted by Mrs Xu's Garden Engineering Co. at the Shenou quarry near Shenzheng is highly successful, this very difficult and steep site has been completely stabilised. But the vetiver growth and vigour would be much improved if they had fertilised them at planting and in the following spring, the company normal practice is to fertilise vetiver only when they pot them, never at planting nor any follow up applications. Due to this success, the company has won a very large contract to rehabilitate a number of quarries with the Hongling Quarries.

The manager of Garden Engineering company told me that they were not as successful with the Highway Department of Shenzeng as they are concerned with the fire hazard along the highway due to dry vetiver biomass in winter. As the following picture shows, vetiver was very dry and poor at the Shenou site, this was due to the lack of fertilisers and but not by the low temperature and moisture. Vetiver plants still go to the dormant mode in the nursery where water is not limited at the same temperature. This is in sharp contrast with Monto vetiver in Australia, which only becomes dormant after frost damage. Because of this I think the genotype they have in Guangdong is different from Monto. I am sending some Monto over to Mr Hong's nursery (via Xia's) for testing.



Shenou quarry near Shenzheng

Pearl River bank stabilisation at San Shui



Stabilisation of the Pearl River bank at San Shui

A very expensive trial is being carried out at San Shui to protect the levee bank of the Pearl River. The combination of massive rock groynes, rock rip rap, rock wall (as I mentioned, the Chinese love playing with rocks!), reinforced turf and vetiver were used at this site. If successful they will have at least another 30km to go (and another 30 quarries to go with it). As Xia was not able to convince the government project engineer, vetiver was only planted on the top of the wall (brown coloured strip on RHS) instead of on the slope joining the rock wall (green turf in the middle).

After showing the General Manager of the contracting Co., Hareor Construction Engineering Corp. the effectiveness of VS in riverbank stabilisation in Australia and elsewhere, he was very interested in using vetiver but he wishes to set up a trial first. In this regard, I mentioned to him the possibility of setting up a trial with his company to test the design developed by the University of South Queensland University under the Wallace Genetic Foundation grant. He has accepted the offer and we are working on it now.

Oil shale rehabilitation: To my great surprise, Xia took me to Maoming to see his oil shale rehabilitation project with the Maoming Petrochemical Corp. This company was a major oil producer, from oil shale, in China in the 1950s and only in the last few years that the company has started the rehabilitation work on the waste rock dumps. In collaboration with Mr Deng Zhaoping of the company Environmental Section, Xia established 2 trial sites, one on the flat and one on the very steep slope, both sites are very successful and the company is now ready to extend their planting to cover all their old dumps. As the oil extraction method was not very efficient then, at least 10-15% of the oil-bearing rock was wasted, giving a very high oil content in the waste rocks.



Vetiver trial on oil shale dump

I am particularly pleased to see the good outcome of this work, as to me this is the first evidence that vetiver can be used for the rehabilitation of petroleum contaminated sites. The company is extremely pleased with the work and has applied for a Donner Foundation grant to work on a wetland system to purify their excess process water before discharging it to the Maoming River.

In addition, on behalf of the management, the Vice Chief Engineer, Madame Q M Zheng invited delegates from ICV3 to visit the site and promised to give full support to ICV3 if it were to be held in Guangzhou.

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

Lake side stabilisation: Xingfengjiang (Evergreen) Lake near Heyuan City, is the largest lake (360Km²) in southern China which supplies water to Guangzhou, Shenzeng and Hong Kong. However its capacity and water quality is threatened by the massive erosion of its banks and the surrounding hills. Hongri started planting vetiver on the lakeshore and a very steep and badly eroded hill near the lake last year to demonstrate the effectiveness of Vs in stabilising erodible slopes. The results were so spectacular that the Deputy Governor of Guangdong paid a visit to the site last year and Heyuan city has now used VS to stabilise farm roads in the city.

The Vice Mayor and the Chief Scientist of the City suggested that this site is a good field trip for the delegates of ICV3 and have pledged full support for such a trip.



Badly eroded shoreline of the Evergreen Lake in Heyuan



Vetiver planting has effectively stopped this erosion

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

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

Dr. Xia also told me that there are at least 2 more nurseries operated by other contractors; he knows one of them but not the other.

Planting materials are used mostly by the companies but they are also available for other users at the cost of 1Yuan /tiller (\$US 0.10 to 0.15). Guangdong therefore I think has the largest vetiver supply in China and VS is an accepted technology for erosion control in the province.

At the nurseries visited I noted that all plants were dormant in winter, irrespective of their age (as early as less than 6 month after planting), temperature, nutrition and water supply. The dormancy was further exacerbated by the lack of soil moisture on steep slopes in winter. Because of this I suspect that the Guangdong genotype is not a Sunshine-Monto kind.

THIRD INTERNATIONAL VETIVER CONFERENCE

During my visit I had several opportunities discussing the possibility of having ICV3 in Guangzhou with government leaders as well as Universities, Scientific Societies and private enterprises. All of them have pledged strong support for the conference if held in Guangzhou and they are very eager to participate in the organization of the conference once it is formally decided.

As for myself I strongly favoured Guangzhou as the host city for the following reasons:

- **A wide range of research and demonstration sites for field trips:** As mentioned above, the wide variety of vetiver applications are in the vicinity of Guangzhou, including steep slope bioengineering, rehabilitation of quarry and mine, pollution control, riverbank and lakeshore stabilisation, nurseries etc
- **Strong support from all levels of government and enterprises:** In separate meetings with Professor Luo Fuhe, Deputy Director General of the Guangdong Provincial Department of Science and Technology, Prof. Xie Xiande, President of the Science and Technology Association of Guangdong Province, Prof. Luo Shi Ming, President of the South China Agricultural University, Mr. Wu You Bi, Vice Mayor of Heyuan City, Vice Mayor of Zhongshan City and Wu Chun County, Maoming Petroleum Corporation, and importantly Mr Hong Hao, Chairman of the Hongri group of companies, have pledged strong support and contribution to the organization of the Conference.

It should be considered that all the contributions are not necessary in monetary form but in kind contribution (manpower and facilities) is equally important as an international conference needs a lot of people and facilities.

- **Excellent facilities and experience**

Guangzhou, the third largest city in China (after Shanghai and Beijing) has all the facilities needed for an international conference as the city has an International Trade Fair every six months.

- **Close to South East Asia**

Guangzhou international airport is the hub of air service in southern China, it provides easy and direct service to many SEA countries where most of the delegates are expected to come from.

- **Easy access to Hong Kong international gateway**

Easy and fast access to Guangzhou from Hong Kong by plane, bus or train for delegates from other countries.

- **Nice climate and culinary delight**

Autumn weather in sub tropical Guangzhou is very nice and being fully biased Cantonese food in Guangzhou is the best there is!

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