VST IN RIVER AND CANAL BANK STABILISATION IN CENTRAL VIETNAM: SUCCESSES AND FAILURES TEN YEARS LATER

Tran Van Man, Huynh Van Thang**, and Paul Truong****

*** Coordinator Vietnam Vetiver Network, CEO SBTV Co., Da Nang, Vietnam**

**** Deputy Vice Director of Agriculture and Rural Development Department, Danang, Vietnam**

**** TVNI Director for Asia and Oceania, Brisbane, Australia**

Abstract

Hundreds of hectares of land on riverbank have been lost annually and thousands of kilometres of dikes are threatened by wave erosion and the strong current in the flood season. These figures tend to go up exponentially due to lack of effective erosion controls and increased usage of modern means of water transport and climate changes. To protect the fertile agricultural land, local people are using traditional methods such as wooden, cement, or rock walls; planting wetlands species and water hyacinth. However these methods are either ineffective or too costly to implement. Literature shows that the Vetiver System is a new and effective method of stream bank erosion control, which has been proved successful in Australia and in a number of Asian and African countries. Vetiver system is low cost and labour intensive, which is highly suitable for a developing economy like Vietnam.

Following a series of successful trials, in October 2002 the local Dike Department also decided to mass plant the grass on more bank sections of several rivers and subsequently, Vetiver grass was recommended for use in another natural disaster mitigation project in Quang Ngai province, which was funded by AusAid for protection of dikes and irrigation canals in several districts against flash flood and sea water intrusion. Some design modifications have been introduced to better adapt Vetiver grass to the local conditions. For example, mangrove fern and more salt tolerant grasses are planted on the lowest row to better withstand the high level of saline water and effectively protect the embankment toe.

One year later, 2003, Danang was the next city adopting Vetiver system in erosion control and riverbank stabilization. The excellent result of vetiver projects in Danang has been recognized by the Ministry of Science and Technology as an effective solution for landslide and erosion.

However, disadvantages and limitations are always present. So that this paper discusses the successes and failures following recent assessment of the projects and lesson learnt.

1. INTRODUCTION

1.1 Overview on flood season, damages to infrastructure

Quang Ngai and Danang are located in the Central of Viet Nam where tropical climate is the dominant weather condition. The wet season starts from September to December, with a peak rainfall recorded in October and November. Part of the water go underground, while the other part flows on the surface then gathering up to become stream and river to or storing in lakes. However, climate change combined with human activities has broken this nature which sustained for millions of years. A vast increase in rainfall makes the soil become saturated then the rest of water flow on the surface. In addition, deforesting is a significant factor that contributing to the formation of high speed water flows, which known as flash flood in mountain areas and general flooding in low-lying. As a result, this leads to the loss of many lives and causing serious damage to infrastructure as well as surrounding environment.

Annual flash floods cause several damages to dikes and rural roads

Conventional vegetation such as wild pineapple (left) and reeds are ineffective in protecting these infrastructures against Annual general and flash floods

1.2 Natural Disaster Mitigation Project in Quang Ngai

The Quang Ngai Natural Disaster Mitigation Project (QNNDMP) arose out of the disastrous events of late 1999, when nearly a thousand people died and damages exceeded US$340 million caused by a typhoon crossed the central coast of Vietnam. The damage was a result of a combination of 'storm' (waves, higher tides) and flood.

Following these events, initiatives by the donor community and the Government of Viet Nam resulted in the formulation of a partnership with a focus on an integrated approach to mitigation of the natural disasters. In 2001 Halliburton KBR Pty Ltd were commissioned by AusAID to prepare a Project Design Document for a project to be based in the central provinces and to act as a demonstration project for the concept of an integrated approach to the mitigation of natural disasters.

The goal of the QNNDMP is to mitigate the impact of natural disasters in the central provinces of Vietnam in accordance with the Natural Disaster Mitigation Partnership objectives.

The specific objective of the project is to implement appropriate and effective management and infrastructure solutions for the mitigation of disasters and to strengthen community based disaster management in the Quang Ngai Province.

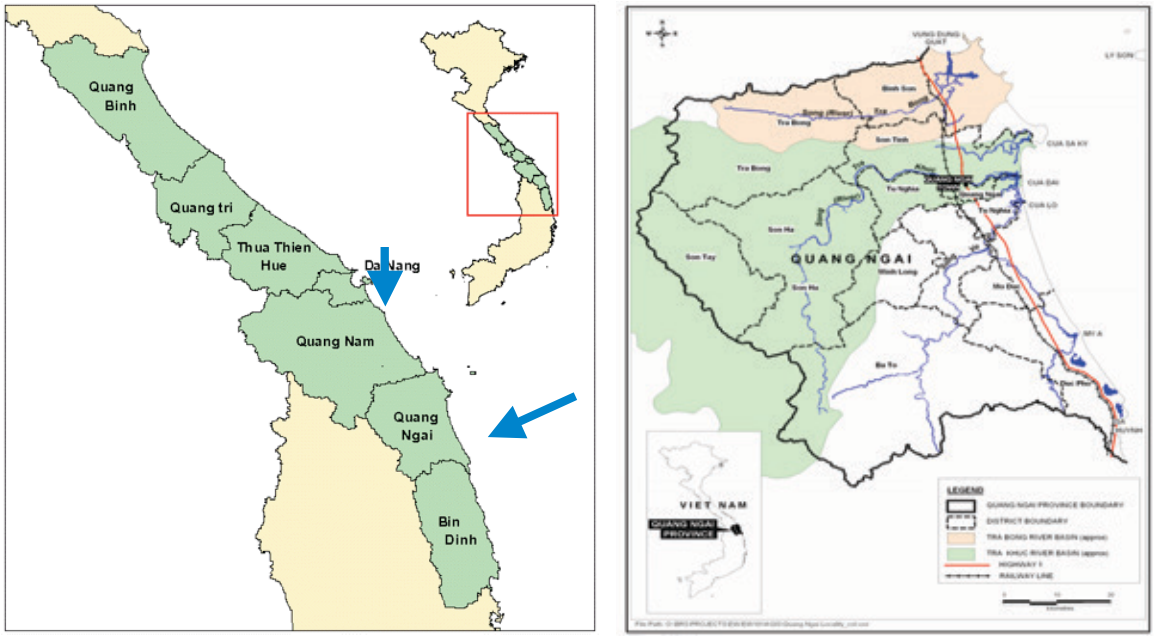

Figure 1: Danang and Quang Ngai are prone to flash floods and typhoons

2 PROJECT IMPLEMENTATION

2.1 Brief Evaluation of Vetiver Growth in Quang Ngai Province

Although vetiver has been grown in Quang Ngai for several years for erosion control on sloping agricultural land, it has not been used for infrastructure protection. The following are brief evaluation of its performance in local environment:

- Broad adaptability to various kinds of soil in Quang Ngai

- Can survive in drought and inundation
- Can restore strongly after cutting, drought and inundation
- Blossom early in wet season, slow growth in cold season; root strongly penetrate vertically
- Rat, snake habitat not yet found
- Parasite not found on Vetiver stem (stem borer and brown spot are minor)

2.2 Introducing Vetiver Grass

The Environmental Assessment in particular, recognised that there were opportunities to utilise Vetiver grass system as an alternative to conventional engineering measures for the anti-salinity dike and riverbank protection work activities of the project. However, there is still limited experience and knowledge in the use of Vetiver grass in Vietnam and in particular in the central provinces. In this situation, demonstration trials were needed to verify the suitability of the grass for various uses in the central provinces of Vietnam. This will be the first step to improve the awareness of the local government as well as community about climate change and then promote bio-engineering solution to reduce the effects of natural disaster.

Vetiver is tolerant to flooding in low land and drought in mountainous region

Vetiver can be grown on brackish water and coastal sand dunes

At the time of project commencement vetiver grass was an unproven technology for the proposed uses, so it was expected that there would be a natural reluctance by responsible agencies to promote its application. The protection offered by concrete structures is well understood and for this reason is regarded as the optimal solution. This factor is particularly relevant for natural disaster mitigation projects where quick, but effective solutions are required for the future protection of local communities, particularly in the short term. It was therefore expected that there would be some institutional reluctance to adapt an alternative vetiver based system.

Because the use of vetiver was a relatively unknown procedure in the local area, trials of its use were carried out as part of the overall implementation phase of this project.

2.3 Advantages of Vetiver Grass over Concrete

The main advantages of Vetiver grass over concrete are the considerable saving in construction costs and the lower maintenance requirements in the longer term. It is thus possible to construct significantly longer sections of bank protection for the same cost in the same area for a given budget.

In addition, the inevitable involvement of local communities in the propagation, planting and maintenance of the grass following the adoption of Vetiver grass technology may in the future require less demands for major inputs from governmental agencies as the communities adopt a self-help approach using their skills and knowledge of vetiver to carry out their own protection projects.

As noted earlier, there was a need for demonstration trials to be conducted on vetiver in the local area. Initially planting trials were planned on three sections of the existing Binh Chanh estuary dike exposed to differing flood and salinity regimes. The program was expanded to include a section of an irrigation canal in a cutting where exposed slopes were being eroded and a section of an existing riverbank flood protection dyke where attempts at establishing suitable ground cover had failed.

2.4 Outcome of Vetiver Trials

The followings are summary of the initial trials' outcome:

- Vetiver can be established in a wide variety of soil conditions from loose sand to compacted laterite fill.
- Vetiver adapts well with the climatic conditions in the central regions of Vietnam and is tolerant to the dry season.
- Vetiver is not suitable for all conditions. It was found that the roots did not penetrate sandy soil with saline ground water.
- Local salt tolerant species may be planted at the toe of slopes in saline conditions to provide toe protection allowing vetiver to be planted on the higher slopes for scour protection.
- In reasonable growing conditions vetiver can be established to resist flood flows within three months of planting.
- Even young beds of vetiver encourage silt deposition from flood flows.

- Vetiver should be cut to approximately 100 mm above the ground to encourage fresh growth. Care needs to be taken in the timing of the cutting to ensure adequate regrowth prior to the expected flood season.
- Vetiver can be used as a fodder crop particularly while young.
- Livestock will graze on vetiver if other food supply is limited.
- Other fodder crops may be inter-planted with vetiver to maximise the utilisation of the protected ground.

The highly successful outcome of the initial trials resulted in provincial authorities agreeing to a further demonstration where vetiver would be used to provide additional protection at the upstream and downstream ends of the first project construction of conventional rigid riverbank protection.

2.5 Incorporation of Vetiver in the Design of Works

From the outset of the project, counterpart agencies were resistant to widespread use of vetiver for riverbank and dyke erosion control. While recognising that vetiver was effective in slope stabilisation for roadwork and for river bank protection in the northern and southern river deltas of Vietnam, they considered that the flood characteristics of the major rivers in the central provinces were significantly different with higher velocity flows and rapid rise of flood levels. On this basis these agencies firmly believed that experience in the northern and southern deltas was not transferable to the central provinces therefore there was no technical basis for the design of significant hydraulic structures incorporating vetiver as the principal stabilising factor and erosion protection. Counterpart agencies were prepared to accept the use of vetiver on a trial basis at low risk areas of one of the anti-salinity estuary dykes as this was specifically provided for in the project design document. They were not prepared to consider it for “permanent” structures.

3 RESULTS FROM TRIALS

3.1 Outstanding Successes

Trials through the first flood season clearly demonstrated vetiver could provide protection under severe flood conditions even at only three months after planting. However this did not change the official position of the counterparts. The results of the early trials however encouraged the project to continue to actively promote the incorporation of vetiver protection into the design of the subsequent project funded works. The dyke and canal demonstrations clearly showed that the use of vetiver was an economical and environmental friendly treatment that would give an equivalent degree of protection for significantly less capital expenditure. Given that the project has a fixed areas where such treatment was appropriate would have allowed a greater area to budget, adoption of vetiver protection for benefit from the same quantum of external funding.

Through a project initiated workshop on vetiver, local agencies gained a greater understanding of the benefits in using vetiver system. As a result, this enables further trials on the sections of riverbank upstream and downstream of the My Phuoc revetment

which was constructed by the project using typical rock and concrete techniques. These trials have proved equally successful in protecting loose bank material and promoting sedimentation from flood flows within three months of planting.

Counterpart agencies now accept the suitability of this technique for several situations. Specifically they have recommended the use of a vetiver slope protection system for a section of riverbank that could not be protected economically using conventional rock and concrete systems. This change in attitude has come about through the impact of the trials and the continued advocacy of project personnel and visiting specialists.

The followings are a snapshot of the 'before and after' of vetiver planting, which clearly show the effectiveness of VS in stream bank stabilisation under extreme conditions.

Small river bank stabilisation (brackish water)

Large river bank stabilisation (fresh water)


Canal bank stabilisation (fresh water)

Rural road batter stabilisation (brackish water)


Prawn farm dike batter stabilisation (brackish water)

To protect the toe of the batter from brackish water inundation, planting of mangrove fern or local salt tolerant plants is recommended

3.2 Vetiver Projects in Danang

Follow the success of the trial in Quang Ngai, Vetiver System was first planted in Danang in 2003. The first trial of Vetiver application in erosion mitigation on Bana road was supported by The Department of Science & Technology and was implemented by The Department of Irrigation & Flood control. This project shows an excellent result and proves that vetiver system has ability to mitigate landslide and erosion as well as the adaption of this technology to Central region of Vietnam.

The result of this project has been officially certificated by National Agency for Science and Technology Information of the Ministry of Science and Technology. This nationally recognized certificate is an important official foundation for VS to be implemented widely not only in Danang, but also over the whole nation. In order to encourage the application of vetiver in Danang, the local government has issued the official "vetiver rate" to give the costing information for the other projects to consider VS as an available solution.

Since 2004, Counterpart agencies have accepted that Vetiver system is an effective solution for infrastructure protection. As a result, VS has been widely used in erosion and landslide control for both agriculture and infrastructure. This shows that VS is step by step gaining the trust of local government and private sectors about its effectiveness in term of cost and benefit.

A few projects using vetiver as erosion and landslide control in Danang such as slope on 14B National Highway in Son Tra (nearby Tien Sa port), protecting the dam of Dong Truoc lake, preventing landslide, and stabilizing river embankment such as: Giang Nam, Binh Ky, Co Man on Vinh Dien river, etc.


Slope stabilization at Ba Na road


Vetiver protects An Luu Embankment

However, disadvantages and limitations are always present. Some places have obtained ineffective results of VS because of the following reasons:

- People remove the grass because they are afraid that VS can be the hiding place for snakes and mice.
- People replace VS for crop production.
- The negative effects of over-shading tree on VS.
- Lack of maintenance of VS leads to the invasion of weed, especially in the initial stage when VS has not covered the ground.
- Vetiver Grass growth slowly on the hard soil and water shortage conditions, for example, on the slope which were formed by weathered-rock.

3.3 Uptake of Vetiver by Community Groups

Contrary to slow movement from government, local community groups have quickly grasped the idea of using Vetiver grass. Even more, they show great willingness to adapt the Vetiver system by using their own funds and resources to build up riverbank protection.

A particular example of this occurred at An Chau village, where the Tra Bong riverbank was vertical and actively eroding and a low level earth filled flood protection dyke on the top of the riverbank was at risk. Through a local initiative, the community adopted vetiver as a new approach to address the issue and protect their agricultural land.

The commune planned, developed and executed a scheme that included trimming the riverbank to a slope of approximately 1V: 2H and the reconstruction of the dike with laterite fill. The slopes and crest were then planted with vetiver on a 1m rectangular grid. The space between the vetiver rows was planted with guinea grass that the people could harvest for stock feed. Woven bamboo matting and mini timber stake groynes were used as initial toe protection at the normal river level. Ultimately after the bamboo has decayed, it is expected that the deep rooting characteristics of the vetiver will provide protection to this zone.

This project was entirely community driven with only a minimal contribution from the project to finance some materials and provide technical assistance for the planting and maintenance of the vetiver from the AEC in full. The success of the project clearly demonstrates what can be achieved at a local level using minimal resources and appropriate technology.

In addition to the above scheme that has been successfully implemented, there are many other communities within the project area that have expressed interest in implementing their own schemes. As a result of the interest expressed by the community groups, a workshop was conducted specifically to inform these groups about the potential advantages of using vetiver for small-scale community erosion control initiatives. Following this workshop the community mass organisations such as the Women's Union and the Red Cross have expressed great interest in taking up community vetiver projects.

Local community groups show great willingness to adopt the system and to use their own funds and resources to develop riverbank protection works.

Before and 10 years after

3.4 Conclusion

These projects have promoted the utilisation of vetiver as an economical and environmental friendly method for slope protection and erosion control on hydraulic structures. The projects have supported this view through the implementation of demonstration trials funded by the project.

Through these trials and the continued advocacy of national and international specialists, the advantages of using the vetiver system as an economic and environmentally friendly solution for slope protection and erosion control on hydraulic structures has been recognised by concerned agencies in Quang Ngai.

As an important milestone, Vetiver has been certified as an official solution for erosion and landslide control in Danang. This also confirms the adaption of vetiver in central region condition and encourages bioengineering development in Vietnam.

At the community level, there has been strong interest generated and a high degree of willingness to adopt the technology as an economic solution to many community problems.

Limitations to the wider uptake of these techniques appear to be the absence of any nationally recognised standard guidelines that a project designer can use as a basis for design.

4 EVALUATION TEN YEARS LATER

4.1 Results

There are no significant failures noted 10 years after planting and the overall results are very good, the degree of success depends greatly on:

- The degree of awareness of the local communities on the role of vetiver on this site, it is not just another grass
- The maintenance of the planting: weeding and fertilisation

Most of the failures can be attributed to:

- Overshading
- Removal or destruction of the planting for crop production

A highly effective & successful section of a freshwater river where is was properly maintained

A highly effective and successful section of a brackish river where is was properly maintained

Invasion of weeds due to lack of maintenance causing over shading

Note moderate shading is quite acceptable (left) as compare with no shading.

The poor growth at these two sites can be attributed to low fertility of the soil. Occasional fertilisation on poor soils is essential to maintain good growth

4.2 Impact on local communities

Recognising the effectiveness and significance of vetiver planting, local communities continue to adopt and initiate their own planting

Figure 2: Community initiated their own planting on this eroded bank of this brackish river

4.3 Conclusion and Recommendations

- From the above it can be concluded that VS is very effective and highly successful in protecting river and canal banks from flash flood and salt water intrusion on the low lying area of coastal central Vietnam
- Continuously education is essential to keep up community awareness of the important role of vetiver grass so that proper maintenance is implemented.

5. OVERALL CONCLUSION AND RECOMMENDATIONS

The result of this project overwhelming demonstrates the significance of the Vetiver System in protecting infrastructure under extreme conditions. These results can only be achieved when VS is properly designed and applied correctly.

Most importantly continuing education/ awareness program is needed to ensure long term success.