Coastal Dune Stabilisation in Central Vietnam

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The Vetiver Network Award Winner

Abstract: Farmers in Central Coastal Vietnam are regularly confronted with flood or storm related damage, and have to spend much of their time and money to restore badly damaged structures. The measures they have used include stabilisation of dykes by local grass, which are easily uprooted by flood, or small waves, hence are not effective, or short-term measures such as blocking sand dune flow by sand dykes, which themselves are poorly stabilised due to lack of vegetation cover.

Technical support, when available, has its own problems. Local civil engineers are used to more expensive hard solutions such as rocks and cement, even these solutions are not always effective or durable. Agro-forestry projects focus on tree planting but it is expensive to implement and slow in growth. Trees are effective for wind erosion control but they give little protection against neither water erosion nor trapping sand eroded by heavy rainfall.

With a small grant from the Netherlands Embassy, a vetiver trial and demonstration project was initiated in 2001. The results were outstanding and both local farmers and engineers now adopted VS as their preferred option for sand dune and road batter stabilisation, stream bank erosion control and fishpond stabilisation.

Key Words: Sand dune, stream erosion, dykes, flood, wave erosion.
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1. INTRODUCTION

The ‘Geological Hazard Assessment for Coastal Provinces of Central Vietnam' study conducted by the Research Institute of Geology and Mineral Resources (RIGMR), has identified flood damage to coastal zone and farmland is one of the major hazards of the region and recommended the use of Vetiver Systems (VS) for the reduction of flood damage to farmland, particularly the stabilisation of dikes, riverbanks and coastal dunes.

Through her relentless effort Elise Pinners succeeded in obtaining $US15 000 grant from the Netherlands Embassy SEP (Small Embassy Projects) funds allocated for the poverty reduction program.

2. THE PROBLEM

Farmers in Central Coastal Vietnam are regularly confronted with flood or storm related damage to their farmland, and have to spend much of their time and money to restore badly damaged structures. The measures they used are not effective enough (e.g. stabilisation of dykes by local grass, which are easily uprooted by flood, or small waves) or of short-term measures such as blocking sand dune flow by sand dikes, which themselves are poorly stabilised due to lack of vegetation cover (Photo 1).

In this project area, local farmers have to spend much time and resources to maintain and repair the dikes and dams in their irrigated land. In Quang Binh Province, those farmers who had their land invaded by sand dunes are now facing starvation, and have nowhere to go. In Da Nang during the last flood, farmers feared drowning if the dams breached.

Photo1: Typical coastal dunes with planted Casuarina in Central Vietnam

3. CURRENT EFFORTS

Technical support, when available, has its own problems. Local civil engineers are used to more expensive hard solutions such as rocks and cement (even these solutions are not always effective or durable), they are not familiar with 'green' and soft methods, and the requirements that go along with these methods: timely planting, involvement of local population at planning, implementation and maintenance stages.

Agro-forestry projects focus on tree planting but it is expensive to implement and slow in growth. Trees are effective for wind erosion control but they give little protection against neither water erosion nor trapping sand eroded by heavy rainfall.

4. CURRENT PROJECT

This project has three sites:

1. Dune and related dike stabilisation in Quang Binh province.
2. Riverbank stabilisation – cum – roadside near Da Nang city
3. Stabilisation of banks of shrimp ponds and nearby gully along the bank, near Da Nang city.

This project was carried out in two stages:

- Establishment of plant nurseries and small demonstration trials
- Large scale planting

5. ESTABLISHMENT OF NURSERIES AND DEMONSTRATION TRIALS

5.1 Site description

This paper reports only the coastal dune stabilisation work in Quang Binh province, Le Thuy district. The site is a few hundreds meters from a group of sand dunes bordering a small river. The local authority has built a number of sand dikes to protect farmland from floodwater but these dikes are very unstable and mostly barren, only some *Casuarina spp* and wild pineapples are found on these dikes. Farmers have to protect their farmland against sand intrusion from the dunes and the dikes. The erosion was so bad that when it rains they even had to get up at night to guard the dikes (Photo 2).

Photo 2: Overview of the riverbank on the left and the sand dike on the right before planting

5.2 Planting

The initial planting started early in March 2 002, during the driest and hottest part of the year so it had to be watered until rain. Three rows 60m each were divided in two trials, on one side (30m) only bare root slips were used ; on the other side (30m) potted plants were used in the upper line, and 5m on the 2nd line. Planting density was at 10 plants/m and cross rows at 1m above the wet sand (Photo 3).

5.3 Fertiliser Application

Different rates of farm manure and chemical fertilisers were trialled. In each trial three fertiliser treatments were used:

- 3 kg manure per meter;
- 3kg black soil + 3kg manure per meter;

- 6 kg manure per meter.

The application of manure was to encourage fast growth as planting was done at sub-optimal time of March (best time is in October/November). A general impression is that farmers in Quang Binh are very serious with the trials, they are very experienced and creative. Their experiences could be very useful for future planting. But ahead were 2-4 months of very hot and dry weather, with the so called “Laos wind” that would dry up the sand very quickly.

Photo 3: Planting during the dry season and watering is needed until rain

5.4 Results

5.4.1 One month after planting

Vetiver grass established and survived in sand dunes, but whether it can survive the hot and dry summer that is unbearable even for people (Photo 4). Plants in the nursery also grew well (Photo 5).

Fig.4: Shifting sand buried vetiver 200mm deep in 4 weeks

5.4.2 Two months after planting

The unfertilised grasses survived but did not grow or multiply vigorously. On contrary, vetiver grew well producing strong and healthy growth. A fence from dry Casuarinas branches was installed to prevent the sand from sliding, this promoted better growth. Evidence of small sand slips are very clear, with the grass row becoming pushed out of line. Some whole individual clumps

even slid down a little bit, showing their root system is not yet deep enough. It might have also taken time for them to re-establish which explains why they look smaller and lower than other unaffected plants (Photo 6).

The nursery plants are very good, green, strong and straight, no dry leaf. Fertilizer was applied once (NPK + manure mix). Clumps have maximum up to 30 tillers, usually 10-20 tillers (Photo 7).

Fig.5: Very healthy nursery next to the dune

Photo 6: *Left,* Unfertilised plant and *Right,* fertilised plants

Photo 7: Excellent growth after 4 months, during the rainy season

5.4.3 Four months after planting

All three rows are very good, up to 1.5 m high. Digging to a depth of 0.5 m showed very good root system development, likely to continue well below the observed range. The clumps now had 30-40 tillers, which differ from each other only by their height and healthy.

The nursery looks very good, green, strong and straight, no dry leaf. All are up to 1.5-1.7 m high. Many tillers have become mature with a lot of nodded culms (Photo 8).

Photo 8: Excellent growth in nursery after 4 months,

5.4.4 Seven months after planting

- The Vetiver hedgerows become so dense. All gaps in between (especially in the two upper rows) are closed. All farmers, including directors and technicians of the Forestry Enterprise, are now convinced that the hedgerows could stop the sand dune from moving (Photo 9).
- Even the young Casuarinas and wild pineapple planted before, in between the grass, looks fresh and green, probably due to moisture that the grass helps to retain in the sand;
- A hole was dug to see how deep the root system could reach. The hole was almost 1m deep but the roots still continued, the wall started collapsing so it was not sure how deep the roots grow (Photo 10).

Photo 9: Seven months after planting,
note other plants grew between and below vetiver hedges.

Fig.10: Thick growth and roots was much deeper than 1m

6. A SUCCESS STORY

The results to date have surprised both local authorities and farmers, they were so convinced on the effectiveness of VS that they have initiated their own projects at the expense of the nursery materials. The following incidents illustrated the success of this project.

- The first incident involved the local authority, the provincial Enterprise director, who was very impressed and completely convinced about the effectiveness of the VS. When a new bridge on Highway 1, which passes by his headquarter office, was completed there was no protection for the bridge abutment against the coming flood season. Concerned about the weather and the threat of floods, he made an executive decision of 'commandeering' some vetiver grass (2 rows) from the nursery and planted on the bridge abutment. Although he did not follow the manual he planted correctly the grass, all survived this transplantation and successfully stabilised the bridge abutment (Photo 11).

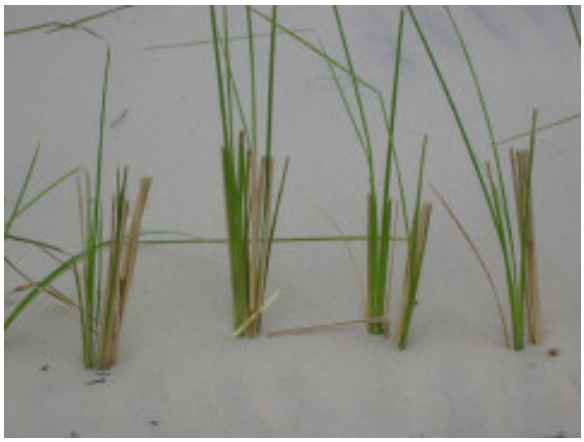
- The second incident (or series of small incidents) was that other farmers, for their own use, took grass secretly from the nursery. In total we lost 2 more rows. However experience elsewhere shows that theft of material is a good sign.

Photo 11: A well-stabilised bridge abutment on Highway 1 in Quang Binh province

7. LARGE SCALE PLANTING

Initially the nursery had 14 rows, giving in total about 30,000 slips, sufficient for about 1.5-2 km planting. But due to the two incidents mentioned above 1000m were planted in October 2002 at three sites. This was at the beginning of the rainy season, one month later all the grasses established well (Photo 12).

Photo 12: One month after planting



8. FIELD VISIT

A field visit was organised to invite (potential) partners to observe results of the demonstrations project, and discuss future opportunities for application of Vetiver Systems in central Vietnam provinces. The participants were very varied: NGOs, provincial authorities from all provinces in central Vietnam, local authorities and private companies (Phto13).

The aim of the project was to investigate whether vetiver hedges could stop the stream from undermining the foot of dunes, which collapsed under heavy rains. The demonstration site was 11 months old and the large scale planting was 4 month. Participants observed that the planting of three horizontal hedges and some vertical ones, were effective in reducing the speed of water and stop erosion at the foot of the dune. Vetiver hedges were dense, closing all the gaps and that other vegetation established well between the rows. However, more research is needed to find out the optimal planting time, hence whether it may be possible to establish hedges without any watering.

This in contrast with unprotected dunes, where heavy rains caused streams to swell up and undermine dune slopes, thus transporting a lot of sand to irrigated areas downstream. This problem is of major concern not only to farmers, but also to road authorities, as the sand quickly fills up drains under the national highway. An IFAD/MOSTE project tries to stabilize dunes with Casuarinas and helped farmers to construct sand-dikes (with heavy equipment) to avoid sand deposition on farms. However, the effectiveness of Casuarinas is limited, and from time to time the highly instable and barely vegetated sand-dikes surrender to sand invasion.

The participants concluded that there is a lot of opportunity to use VS for dune sand fixation in coastal Vietnam, as it is a very promising technique. Several participants intend to apply VS on larger scale, for dunes in their own province, for example authority in Quang Binh Province now plans to control sand dune erosion in 22.000 ha of land south of Dong Hoi, to protect about 10 local roads that often fill up with sand.

Photo 13: Participants inspected the new planting

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Questions of particular interest were:

- ***Planting time***: more research is needed on the right planting time. Planting in March (just before the hot dry period) is possible but then watering is needed, which increases costs and risk. These plantings have survived well the summer storms in August through November. Planting in October is also possible, the plants survived the winter without any watering, but the critical question is: will they be able to survive the hot dry season equally without watering? The expectation is they will, but observations need to continue on this. If they do survive, then planting in October is much more practical (also cheaper).
- ***Design***: planting more rows, above the three already established, is only possible once the plants are big enough to withstand sand flow caused by planting above; however, it seemed hardly necessary to continue planting more rows above, because the major cause for the dune to collapse is the water flow eroding the foot of the dune; this erosion has now been reduced considerably, according to farmers there is much less sand flow downstream of the site, and thus their problem of sand invading the farm is much reduced.

Most participants found the demonstrations very interesting, and several intended to try themselves; particularly authorities (DARD/DOSTE) from Quang Binh, Quang Tri, Thua Thien-Hue, Quang Nam and Quang Ngai expressed their intentions to set up more demonstrations in dunes. In Quang Binh there are plans to control dune sand erosion in 22.000 ha south of Dong Hoi, to protect about 10 local roads that often fill up with sand.

9. CONCLUSION

- Vetiver can be established and is effective in stabilising drifting sand dunes in coastal central Vietnam.
- Application of farm manure or chemical fertiliser is recommended.
- Watering is needed when planting during the dry season

10. ACKNOWLEDGMENTS

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A Brief Introduction to the First Author

Dr. Tran Tan Van is a geologist and geotechnical engineer. He is currently working as a Geologist-Geotechnical Engineer at the Research Institute of Geology and Mineral Resources, Vietnam. He is currently the Coordinator of the Vietnam Vetiver Network and advising several Departments on the use VS for land stabilisation.