

**REPORT ON BIOENGINEERING WORKSHOP FOR POST-HURRICANE MITCH CONSTRUCTION -
EXPERIENCES WITH THE USE OF VETIVER FOR THE
PROTECTION AND STABILIZATION OF INFRASTRUCTURE
SAN SALVADOR - EL SALVADOR, 4-6 MAY 1999**

Introduction

A two and one-half day workshop in El Salvador for 40 to 45 participants from Central America was held in El Salvador from 4-6 May, 1999. The purpose of the workshop was to educate key actors and decisionmakers in the post-Mitch reconstruction (government, donors, and private sector) as to the potential, the benefits and the means to go about incorporating vetiver grass technology as a low cost, proven, bio-engineering approach for infrastructure and watershed stabilization. Invitees included: (i) Government personnel - senior engineers and upper-level decisionmakers from public works and agricultural ministries; (ii) Private sector - senior technical personnel and executives from construction companies active within Central America; and (iii) key resource persons with knowledge and experience with application of vetiver.

Background

Of all the countries in Latin America, El Salvador is the most advanced in the use of vetiver grass for bioengineering. This is due to the efforts of a private company, NOBS ANTI-EROSION, based in El Salvador which works to promote vetiver for soil erosion control in the agricultural and construction sectors of the country. NOBS ANTI-EROSION was created in 1994 as a subsidiary of NOBS HIDROFUSION, Inc. which was established during the mid 1980s as a producer of essential oils for the perfume industry. NOBS has made a commercial success of vetiver, not only through its sales of oils, but also from contracts for highway and construction site stabilization using the grass. On a yearly basis the company has about 80 hectares of vetiver grass available for sale as planting stock; produced by contract farmers in the coastal plains south of Volcan Chinchontepec in San Vicente. Government and private construction companies are currently NOBS' main clients. As a subcontractor to road construction companies, NOBS has planted more than 300 km of vetiver hedges for roadcut, roadside and fill bank stabilization. In 1997, the company earned over \$350,000 from the sale of vetiver grass for highway and construction site stabilization.

Following Hurricane Mitch, NOBS carried out an evaluation of damages to areas which the company had stabilized with vetiver; with greatest attention paid to those zones which had suffered the worst hurricane damage. The evaluation included not only road and infrastructure works, but also agricultural fields. The evaluation concluded that:

- the only damages observed were in three (3) fill banks, where subsequent laboratory analysis showed that they had been inadequately compacted (less than 90% compaction);
- the vetiver barriers demonstrated complete resistance to direct damage from heavy rainfalls and flooding;
- correct formation and compaction of soils guarantees that vetiver barriers can subsequently provide adequate protection; and
- vetiver proved to be a good alternative for erosion control and stabilization of fill banks during extreme events.

NOBS has also donated significant amounts of vetiver and technical assistance to local communities for soil and moisture conservation; subsidized by their commercial operations. In order to work with communities, NOBS networks through NGOs and employs five extensionists who carry out demonstrations, training and provide technical advice to community projects. They have also developed promotional and extension materials, including flyers and a comic booklet. As a result of their work, the government's small farmer credit program (through BFA - Banco de Fomento Agropecuario), now includes vetiver as an eligible soil conservation technology credit; proof of adequate soil conservation in the farmer's plot is a pre-requisite for credit eligibility. In addition, NOBS has trained over 200 agronomists from BFA in vetiver technology.

Participants:

Approximately 43 individuals (including conference organizers) attended the workshop. Participants came from Panama, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Mexico, Venezuela and Chile and represented a range of interests and backgrounds from Government Ministries (transportation, infrastructure, public works, agriculture, irrigation, natural resources and environment, petroleum, emergency relief), NGOs (CARE International {rural roads, hillslope agriculture}, ARDAO {organic agriculture}, ERA & LASOS {soil & moisture conservation}, etc), Projects (El Cajón/Honduras and Chixoy/Guatemala hydropower dam watershed management project), Universities (Guatemala, Venezuela, Chile), and Private sector companies (construction firms, and Chiquita banana).

Workshop:

The workshop started on Tuesday evening with opening words by Ernesto López Zepeda, a representative of the Director of the Ministry of Environment and Natural Resources in El Salvador; and short presentations by Jim Smyle, Director of the LAVN and Specialist in Natural Resources of RUTA; and Aldo Miranda, General Manager of NOBS.

Wednesday, the first full day of the workshop was spent on an all day field trip (see below).

Thursday included the following activities:

Presentation and round table discussion of "Experiences of the public and private sectors in the use of vetiver as an alternative technology for protection and stabilization of infrastructure"; participants and presenters in this discussion included William Ibarra of the Ministry of Public Works in El Salvador; Luis Rivera Ponce of Jose Cartellone Civil Construction Company; and Ronaldo Chávez of NOBS ANTI-EROSION.

Some of the main points brought up were:

- (i) that opposition to vetiver for road stabilization and protection has come from failure to see the technology as something which is integrated into an overall approach to protection and stabilization where vetiver is combined with other plants and traditional engineering solutions to enhance their utility in some cases and to replace traditional engineering approaches in others;

- (ii) Initially, in El Salvador, there was concern with using vetiver since it wasn't widely tested or known. However, it was finally given a chance in a road project in an area with very loose volcanic ash soils, which was also subject to flooding. Two major concerns of the project were, 1) that the entire roadbed would occasionally be saturated, so if a plant were used to stabilize the berms, it would have to survive underwater for a time; and 2) that when the water receded, the plant would need to remain in place and retain the roadbed's extremely light soil so that it would not wash away. Given that no one could offer any potential solutions except for vetiver, the vetiver was given a chance, and proving successful, this opened up subsequent opportunities.
- (iii) The success of the introduction of the vetiver technology for infrastructure stabilization (i.e., the initial acceptance by government and construction firms to give it a try) was based on three key factors: (1) the availability of information and photos from other parts of the world showing vetiver being used for roads, (2) the strict, professional approach of NOBS Anti-erosion with their insistence on maintaining technical standards, and (3) the provision of a guarantee with a value 10 times the value of the initial contract in case of failure.
- (iv) One of the main concerns expressed about roadside hedges was that they limit driver visibility of the road shoulder and of pedestrians "jumping out" on to the road. It was mentioned also that some families living near highways where vetiver is planted worry that they provide places for thieves to hide, thus they burn the hedges or herbicide them. Though such cases were in the minority, all agreed that it is important that local people be made aware of the importance of the hedges in protecting the roads, which are of such great importance to their lives and livelihoods. It was mentioned by the construction firm engineer that in areas where local people had been hired to plant the vetiver hedges, one did not encounter such problems as these people in turn protected them and told their neighbors why they should not abuse the hedges

Specific Presentations

- "Worldwide experience with the use of vetiver for infrastructure, watersheds and agriculture", by James Smyle, Director/LVN and Natural Resources Specialist/RUTA, San José, Costa Rica.
- "Live hedges with cover crops for erosion control and environmental protection. Research and recommendations for its application in Venezuela"; and "Recent experience with the application of vetiver for bioengineering internationally", by Prof. Oscar S. Rodríguez P., Central University of Venezuela, Faculty of Agronomy, Maracay. (This second presentation was an excellent summary of much of the works presented in a conference in the Philippines).
- "Development and management of large-scale vetiver nurseries", Ronaldo Chávez, Soil Conservation Division, NOBS ANTI-EROSION, El Salvador.

- "Promotion and expansion of vetiver programs: The experience of PCERS with the work of networks for the training and development of municipal and community nurseries", Carlos Vilchis Bizarro, PCERS/ERA, Oaxaca, México.
- Panel presentation by participants with comments and conclusions of workshop

Field Tour

See Power Point Presentation

General Comments and Conclusions

The most interesting outcomes of the workshop were what were learned from NOBS and their experiences. They are very careful and consciencious with their projects. For example, they will not accept a contract to plant vetiver for site stabilization if in their technical judgement the site engineering is below standard (e.g., fill slopes not adequately compacted). They do this in order to maintain their reputation and to avoid the technology being blamed for failures caused by shoddy construction practices.

It is more and more obvious that vetiver hedges need maintenance and care. Gaps must be filled soon after planting, as well as annually in the first couple of years. Gaps are caused by many reasons, principal among them the human factors. For example, gaps in the hedge may be caused by paths cut by people walking through the area, new construction work being carried out after hedge planting (e.g., new drains being installed, road bed being re-leveled), road maintenance (construction or other debris being thrown on top of hedges; etc. This shows a need for maintenance and cooperation between those responsible for the hedges and the road contractors. NOBS generally will continue watering newly planted hedges during the dry season at their own cost to ensure its survival. On one large road rehabilitation project, NOBS had offered to gapfill and maintain the hedges at cost; but Government refused. All construction sector participants (government and private) agreed that maintenance is always a problem as there are no budgets assigned for maintenance. The government representative informed the attendees that his strategy is "to lose fingers, not the hand", therefore he looks for approaches to build into the construction phase which are going to give him long term, very low maintenance protection in critical areas. He counts vetiver as one of those approaches. Several attendees pointed out that while 'agronomists' look to see beautiful hedges and plants above ground, engineers want to see the fill bank stabilized and not collapsing; therefore, that from a maintenance perspective efforts should be targeted at keeping enough healthy plants with good roots in the ground and acceptable levels of protection against concentrated flows versus ensuring 'pretty' hedges.

All of NOBS' planting material is grown in one of 3 large nurseries (the smallest is about 9 hectares; plant densities are 40,000 plants/ha). Plants are allowed to grow in the nursery for generally 9 months to 1 year. One nursery we visited was in a clay loam soil. Their experience has been that for infrastructure stabilization projects, nurseries in clay loam to loamy clay soils are best. The reason for this is that at lifting, some of the clayey soil is retained on the plants' roots, helping to protect them from drying out during transport as well as giving the plant a much better start once planted since they still have some of good soil associated with them. Proper soil preparation of prior to planting the nursery was stressed as critical for ensuring good growth.

They prune 3 times during the 9-month to 1-year period. At harvest, each clump has about 80 to 100 tillers (in fertilized and irrigated nurseries) yielding an average of 340,000 planting units per hectare. The nurseries are fertilized twice during the growing cycle.

NOBS uses an unusually large planting unit, which they refer to as an "haz enraizado" or "rooted clump", consisting of 8 to 10 tillers. The 'standard' which they use, however, is not based on the number of tillers in the clump, it is based on the clump's diameter. Their standard is a clump that measures 8-10 cm in diameter. As a rule they plant 7 plants/meter for agricultural erosion control and 10 plants/meter for infrastructure stabilization. Given the planting units' diameter, there is only 4 cm to 6 cm between plants for agriculture and maximum 2 cm for infrastructure. Using this system (large planting units with some viable roots protected by nursery soil), NOBS reports that they have not needed to use containerized material (they have made some trials with containerized stock).

A long stretch of road (CA-12 to CA-4) has been protected with vetiver for going on 3 years. The hedges are nicely closed and maintained primarily by fire, pruning and grazing by wandering livestock. Root mats are visible in some places forming a very dense protective cover holding the soil in place. When the hedges were installed it was almost impossible to walk parallel to the highway between hedges because the soil on the slope was so unstable, but now it is very stable and makes a nice solid path for walking alongside the road.

One interesting point brought up was the fact that during construction or road rehabilitation, the concrete curbs on the side of the road are no longer needed because the vetiver hedge protects the edge of the road and controls water flow from the road's edge. What has happened though is that a contractor will build the curb anyway because he can get paid for it - vetiver doesn't save him money in fact he would make less money if vetiver were used in place of a curb.

To date NOBS has executed well over 500 projects of all sizes with vetiver and established over 2,000 km of hedgerows.

Participants from Guatemala, Honduras, Cost Rica and Panama expressed a great deal of enthusiasm for applying the technology in their countries and specific opportunities created by the workshop include: Guatemala - integration of vetiver into a US\$7 million river training and protection program; Honduras - CARE's rural roads program and government's Emergency Social Fund (the largest financier of public, rural infrastructure and potable water systems) adopting the vetiver technology for road and infrastructure protection; Panama - increased application (with better technical standards) of vetiver for road stabilization and protection by CUSA Construction Co. and dissemination of the technology into the Panama Canal Zone and Canal watersheds through ARI (Autoridad de la Region Interoceanico or Inter-Oceanic Region Authority). The LAVN, RUTA and NOBS will by providing immediate follow up on these opportunities. In addition, a bioengineering discussion group (by e-mail) is being set up by LAVN with the workshop participants; the group will include all other LAVN members (with e-mail access) who are interested. One of the first topics for the group will be the development of interim technical standards for application of the vetiver technology in infrastructure stabilization. This step is seen as an essential first step to dissemination as, among others, design and contracting cannot be done in the absence of some concrete standards.