THE VETIVER SYSTEM FOR SAND DUNE STABILISATION
&
POVERTY ALLEVIATION IN MADAGASCAR

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1. INTRODUCTION

QIT Madagascar Minerals (QMM), a company jointly owned by Rio Tinto and the Malagasy State has since 1986 conducted an extensive exploration program in the Tolagnaro region (Fort Dauphin) along the eastern coast of Madagascar for heavy mineral sands, which lead to the mining of titanium dioxide in 2008.

Madagascar, the fourth largest island in the world is one of the poorest countries on earth with approximately 80% of the population being engaged in subsistence farming where only 4% have access to potable water. Life expectancy is 52 years and the infant mortality rate is 89 per 1,000.

Economic isolation of many communities resulted from the deterioration over the past 25 years of the regional road network and in 2004 80% was then impassable for 12 months per year. This is however slowly improving but the roads are still in a serious state of disrepair with transportation still remaining excessively expensive reducing the movement of people & essential goods.

Hydromulch (Pty) Ltd, a vegetation restoration & environmental contracting company from the Republic of South Africa was invited by Rio Tinto/QMM to submit a turnkey solution for the rehabilitation and vegetation restoration of approximately 40 hectares of exposed side

slopes on the newly constructed access roads between the quarry, the new Ehola Port, MSP plant site and the construction villages on the Ilmenite project in Fort Dauphin, Madagascar. The contract was awarded to Hydromulch in May 2006. The project necessitated the propagation of approximately 4,000,000 Vetiver plants which was to be used in sand fixing, erosion control and slope stabilization in addition to hydroSeeding and the implementation of other erosion control techniques.

The haul road from the quarry to the new harbour site involved major earthworks through the primary dune between the coastline and the quarry.

Sand deposition carried by prevailing north-easterly winds averaging 26 km/hr from September to October impacted on local fishing villagers near the dune cut. These areas were stabilised by the implementation of wind control barrier netting and sand fixing techniques using vegetation. Vetiver Grass (*Chrysopogon zizanioides*) was to be planted as the primary "soil fixing" mechanism as it was capable of withstanding the impact of wind borne sand particles and would easily be able to migrate through layers of deposited dune sand.

2. COASTAL DUNE STABILISATION

Difficult construction activity along the full extent of the service roads leading to the new Port, the quarry and the MSP plant site exposed vast areas which were subjected to erosion resulting from adverse climatic conditions in particular to intense wind erosion damage.

Initially, trials using potted and established Vetiver grass plants, were carried out on the dune cut to determine its effectiveness. This proved to be very successful as it was found that the windblown sand (26Km/hr) did little or no damage to the Vetiver plant but did effect other vegetation. The force of the prevailing winds blew away the sandy topsoil surrounding the planted Vetiver. The Vetiver plants survived only because of its root system penetration into the soil profile.

The Vetiver was planted as an erosion control mechanism and not as a means of replacing or substituting vegetation. It was interesting to observe that the Vetiver had receded after a period of 3 years on the sections where the topsoil layer on the dunes had been preserved or not covered by a layer of windblown dune sand.

A visit to site during August 2010 showed that the Vetiver grass rows had remained intact on areas exposed to heavy sand deposition caused by the prevailing winds particular through the dune cut corridor, where the sand build-up had exceeded 700mm meter in height. This can be seen by the remaining section (± 500mm) of the wind barrier netting that was initially 1.2 metre in height.

November 2006
Ehola dune cut during construction phase – An area of 5 hectare in extent had to be stabilized.

April 2007
Wind Barrier Netting erected and Vetiver grass planting completed

August 2010
Stabilised dune cutting showing native specie diversity

The Vetiver grass rows had receded in the sections where the Ehola Dune cut was protected from the impact of the prevailing winds and deposition and was replaced by native grass and shrub species. In places little or no Vetiver grass could be found.

The Vetiver grass rows were almost totally destroyed in areas where control of domestic animal grazing was virtually impossible. It was noted that even mature plants were grazed by the animals indicating the lack of suitable pastures. The impact of the continuous trampling during grazing dislodged and damaged the crown of many plants. Attempts by local farmers to establish crop planting areas on the side slopes could also be found.

The planting of Vetiver grass on the project not only stabilised drift sand on the dunes but also created a "micro-climate" where native vegetation was able to establish.

The Vetiver plants receded as the native species through succession developed a strong canopy cover.

It was noticed that some of the Vetiver plants were turning yellow rather quickly and decided to send in leaf & root samples for analysis to determine what was happening. The samples were to sent the SGS laboratory in Midrand, South Africa. Interesting results showed that the plant absorbed large amounts of Iron (Fe) and Magnesium (Mn) from the mineral rich contaminated sands.

Mineral	Leaf Analysis	Root Analysis
Cu	1.10 mg/kg	3.20 mg/kg
Fe	398 mg/kg	381 mg/kg
Mn	174 mg/kg	40 mg/kg
N	1.36 %	1.05 %
P	0.43%	0.22 %

3. VETIVER SUPPLY

HYDROMULCH (Pty) Ltd in conjunction with QMM Environmental initiated a Vetiver nursery program utilising members of the local community surrounding the entire project, who would be able to "sell" their production crop.

Fifteen communities were initially approached during December 2006, which expanded to 32 communities by August 2008. These communities had been involved in the propagation of Vetiver plants at their respective villages, where one hundred & thirty three families (133) jointly became involved in these programs.

It was important to first establish the Vetiver source such that progressive stabilisation of the civil works on the construction site could take place.

3.1 Vetiver Sources

The Vetiver plants were found growing in abandoned fields, along watercourses and in rural pasturelands in close proximity to site, where it is sometimes used for grazing. The villagers were briefed by Hydromulch on the soil conservation properties of Vetiver, the correct cropping and trimming procedures and were shown how to remove plant material without causing damage to the parent plant. They were further encouraged to preserve existing Vetiver bushes and to replant additional material to areas with high erosion potential.

The Vetiver planting material were purchased from the different farmers or communities from the Manisy Village, Mahasidi district approximately 50 kilometres from Fort Dauphin and transported to a holding nursery from where it was distributed to the community farmers.

The Vetiver supply process involved all members of the community who collected viable and strong plant material from various sources often travelling great distances to obtain suitable material. Collection areas were predetermined by both supplier and consumer.

3.2 Community Participation

The Vetiver farmers (growers) received potting bags, NPK fertiliser, spades, rakes, plastic watering cans, wheelbarrows and the plant material (Vetiver slips) from HYDROMULCH. Communities in close proximity to water sources were approached to set up "Vetiver" nurseries. Basic on-site propagation training was given to these farmers and they were guided through the initial process.

Payment to the farmers was structured as follows:

- First payment once Vetiver slips planted into potting bags and well watered.
- Second payment once the plants are satisfactorily established with evidence of a developed root system – 3 to 6 weeks.
- Third payment when plants were ready for collection by Hydromulch – 10 to 12 weeks.

Madagascar's own Vetiver "Rastafarian" carrying his crop to the local collection point.

The table below reflects the number of farmers/communities and the number of plants that were grown up from May 2006 up to October 2008.

Nursery	Name of Source	Location	No. Vetiver Plants Supplied
P1	Garry I	Beloto	**320,000**
P2/P3	André/ Auguste	Mangaiky	**1,080,000**
P4	Marie-Agnès	Mandromo-Dromotra	**250,000**
P5	Antahova	Mangarivotra	**250,000**
P6	School	Morafeno	**35,000**
P7	Jean Marie	Montifeno	**20,000**
P8	Arthur	Ampasy	**300,000**
P9	Marie Mariette	Ambaniala	**120,000**
10	Claudia	Andrakaraka	**30,000**
P11	Cascade	Manantantely	**210,000**
P12	Hydromulch	Beloto	**55,000**
P13	Guillaume	Andramaka	**24,000**
P14/P15	Razafy/Jonesy	Analabendra	**410,000**

P16	Garry II	Andranara	**200,000**
P17	Bari	Belavenoka	**10,000**
P18	TomTom	Manambaro	**20,000**
P19/P26	Masy Flomene	Befeno	**555,000**
P27/P28	Pelakoa Julienne	Manantantely	**60,000**
P29	Doda Mbola	Manambaro	**40,000**
P30	Pelavao	Befeno	**30,000**
P31/P32	Rakotonirina Berton	Manantantely	**80,000**
	TOTAL		**4,099,000**

3.2 Employees of the Company

Hydromulch employed 52 people from the local community on the project. They were trained in various skills ranging from seed collection, Vetiver propagation & planting techniques on contours, maintenance of vegetation, placing barrier netting, soil preparation and hydroseeding.

A recent visit to the mine site was carried out where it was found that many of these people had now been employed there in a permanent capacity for the rehabilitation of the mined dune sand.

Some of the ex-Hydromulch staff from Fort Dauphin, are now employed on the Ambatovy Nickel Slurry Pipeline, between Moramanga and the Malagasy port town of Tamatave. They are engaged in the hydroseeding operation of approximately 360 hectares along the right of way (ROW).

4.0 CONCLUSION

Environmental restoration should and must be a top priority for all of us, irrespective of the background or discipline we come from.

Just think about it:

THERE IS ALWAYS A PLAN B BUT THERE IS NO PLANET B