rehabilitation

Erosion control and environ mental restoration

Simandou Range iron ore project, Guinea

The southern part of the Simandou Range in Guinea has high quality deposits of iron ore at places along its length and it is being surveyed by Rio Tinto Guinea. The company was granted the licence to mine the deposits in March 2006. A section of the range rich in iron ore comprises the Pic de Fon/Oueleba ridge which is about 110km in length. This ridge is situated above some of the forest patches that serve as habitat for the West African Chimpanzee – a conservation priority species.

The construction of service roads and drill pad bases for Rio Tinto's exploratory phase resulted in disturbance along this ridge with its steep gradients, and Hydromulch (Pty) Ltd was called in to assess the erosion potential of and vegetation restoration requirements for the damaged areas. These disturbed areas are located above the chimpanzee habitat, which is in forest pockets on the slopes of Pic de Fon and in the valley below. Uncontrolled surface water run-off from these disturbed areas was considered the highest environmental risk on the project. It was vitally necessary to prevent sediment from washing into the waterways of the chimpanzee habitat. Roley Nöffke of Hydromulch observed that during their rehabilitation operations, the calls of chimpanzees could be heard from the valley below.

Rio Tinto's environmental manager Leon Payne comments that according to his company's Biodiversity Strategy every effort will be made to ensure that "biodiversity conservation ultimately benefits from our presence in the region".

Nöffke explained that there were in excess of 2 000 exploratory drill pads on the range and this meant the need for numerous service roads, some at a 17 degree gradient with fill side slopes of between 45-60 degrees and cut slopes of between 70-100 degrees. On his first site visit in January 2008, accompanied by Rio Tinto's environmental staff, he observed that construction had resulted in an abundant surplus of excavated material, which had been deposited over the drill pad bases and along the road embankments. These areas were susceptible to increasing erosion and the subsequent deposition of sediment into the sensitive wetland and forest areas below. The containment of this spoil material was the primary objective, prior to vegetation establishment.

OPPOSITE PAGE LEFT: The Pic de Fon/ Queleba ridge in the Simandou Range is rich in iron ore and is being surveyed by Rio Tinto Guinea. There are over 2 000 exploratory drill pads on the range as a whole.

OPPOSITE PAGE BELOW LEFT: Travelling through the forests to the Simandou Range.

LEFT: Uncontrolled surface water run-off from such disturbed areas was considered the highest environmental risk on the project. It was vitally necessary to prevent sediment from washing into the chimpanzee habitat below.

BELOW LEFT: After erosion control measures such as BioJute, silt fences and gabion structures had been put in place.

BELOW: Hydroseeding at Beyla airport.

BOTTOM LEFT: Laying Biojute to stop 'splash erosion' and create a microclimate for revegetation.

BOTTOM RIGHT: Indigenous grasses coming through in the same area after hydroseeding.

Hydromulch collected seven soil samples from locations in need of immediate action and submitted these for laboratory testing to soil scientist Dr Ari van Vuuren in South Africa. A detailed proposal of erosion control measures and rehabilitation work was presented to the client and Hydromulch started work in May 2008, with two of its own employees in a supervisory capacity and a team of local labourers provided with the necessary skills training on site. A member of the Rio Tinto environmental team, botanist Thomas Williams, served as the project manager, while Jabulani Dlongolo and Daniel Nel of Hydromulch managed the rehabilitation site. The team was operational on site for a period of 16 weeks during which 5ha in the mountain range were

rehabilitated with erosion control netting, 'trash bunds', silt fences, rock gabions, Vetiver plantings and hydroseeding with indigenous species, along with 20ha of hydroseeding done at Beyla airport, the nearest town to the Pic de Fon area.

The vegetation in the disturbed mountain areas is montane or submontane grassland and wooded grassland. Rio Tinto had commissioned a botanical survey by the Royal Botanical Gardens at Kew to provide vegetation mapping and identify plant species with conservation priority on the Simandou range. The information gathered will be instrumental in assisting Rio Tinto to minimise its impacts on the environment and to meet the objectives of the company's Biodiversity Strategy. The surveys done in 2005 and 2006 were conducted by a team of botanists from Guinea, Cameroon and Britain.

Nöffke described the problems initially experienced with travelling to the remote site in the Simandou range, saying that it had originally taken three days to get to site from Johannesburg. He had flown to France and then to the capital of Guinea, Conakry, and from there by means of a chartered flight to Nzérékoré. The road trip through the forest from Nzérékoré to the Pic De Fon area is 143 km and took between 6-12 hours to negotiate, depending on conditions. Once Beyla airport had been completed, the road trip only took one and a half hours. En route from Nzérékoré, Nöffke spotted clumps of Vetiver growing in villages. He has used this grass for soil stabilisation in numerous rehabilitation projects, prior to hydroseeding with locally collected indigenous species (*see article on rehabilitation in Madagascar page 20 Jul/Aug 2008* EM). The Vetiver is shaded out, once the local species are established.

He spoke about the good quality roads that had been constructed to the exploration sites – drill pad bases – saying that the erosion had resulted largely from the degree of steepness along the ridge. He commented on Rio Tinto's high standard of safety on site, saying that every driver had to complete a 4x4 course prior to being allowed on site, and that 4x4 and 4x6 vehicles were specifically equipped for the steepness of the gradients on site with features such as roll bars.

After the results of the detailed chemical analysis of the various soils on site had been received, decisions were made on how to deal with the problem sites and soil erosion control methods were put in place. The product BioJute, a fabric which biodegrades with time, was chosen to stop 'splash erosion' and to create a microclimate for revegetation. It also serves to retain surface moisture. Six metre wide strips were fixed in place on the slopes below the platforms of drill pad bases. Several grades of this material were trialled for suitability. A bag stitcher was used to stitch the widths of BioJute together to form continuous 6m wide mats, so as to preclude separation at the edges of rolls. The mat was pegged into the ground with stakes. Wire mesh netting at a width of 2, 8m was used in areas where extra reinforcement was needed.

Where necessary, 6m wide 'trash bunds' constructed from locally collected palm fronds were erected at 20m intervals as an interim measure for soil retention below the Biojute netting – and, according to Nöffke, some of these filled up completely with silt. Lower down the slopes, the additional protection of 20m wide silt fences was required in some areas to contain sediment deposition. Sandbag walls were positioned and secured in side slope gullies and at other sensitive areas of the terrain, such as above the wetlands and on the edges of forest patches, to serve as further retention of sediment deposition. The sandbags were staked with 500mm long steel pegs to reduce slippage. Rock gabions were utilised for stabilisation in certain areas.

ABOVE: An almost vertical slope being clad with Biojute. Safety is always meticulously taken into account on Rio Tinto's projects.

ABOVE CENTRE: Vetiver planted in the BioJute on the same slope.

ABOVE RIGHT: Indigenous grass species establishing after hydroseeding on the same steep slope.

ABOVE: Palm fronds were collected to build 'trash bunds' for soil retention on the steep slopes.

RIGHT: On the left is the project manager for the rehabilitation, Rio Tinto'sThomas Williams, with a clump of Vetiver and villagers involved in the collecting of the grass.

BELOW: Villagers on the outskirts of Nzérékoré being taught the art of trimming and splitting Vetiver clumps.

Families from the local communities were involved in the collection of Vetiver grass for reinforcement on the steep slopes. Hydromulch set up co-operatives with the villagers as trading partners and harvested material was purchased from these locals, as part of Rio Tinto's poverty alleviation programme. Nöffke commented that at least two of the suppliers that he knew of had been able to build new houses with the proceeds. He said that about 500 000 Vetiver plants had been used in the rehabilitation on the mountain range.

The outskirts of some of the neighbouring villages proved to be a good source of this plant material which had, historically, been used for the stabilisation of agricultural soils. Although the indigenous West African species, *Chrysopogon* (previously *Vetiveria*) *nigritana*, is found in the area, *C. zizanioides* was approved by Kew because it is sterile. Locals were trained in the sourcing of the best Vetiver material and trimming and collecting techniques, along with methods of splitting the clumps ready for planting. The Vetiver was planted into the BioJute on the slopes of the service roads, behind culvert head walls, at drain outlets and along the breakpoint of fill slopes for additional stabilisation. Nöffke said that Vetiver was used because of its ability to cope with the severe angle of the side slopes and its ability to retain sediment deposition. He commented that hydroseeding with the veldgrass seeds without this additional precaution would not have resulted in successful grass establishment on the extreme slopes. The Vetiver also served to further anchor the BioJute on the uncompacted fill slopes and steep in-situ cut slopes.

Once the erosion control measures had been installed, Vetiver grass hedgerows were planted and the hydroseeding applications for revegetation were carried out, using hydraulic seeding equipment with a built-in agitation system and a specialised centrifugal pump for handling various viscous and slurry formulations. A 6x6 truck was equipped with a Finn Hydroseeder for this project. In the sensitive mountain areas, locally indigenous grass seed was collected for the seed mix. According to Williams, seeds from grasses found in the Pic de Fon and Oueleba areas of the mountain range that were used on the project were largely *Pennisetum purpureum*, *P. hordeoides*, *Melinis minutiflora* and *Hyparrhenia* species. A commercial seed mix was used for the hydroseeding at Beyla airport.

The seed is combined with a soil binding agent in order to bind the loose soil particles when the mix makes contact with the surface, and along with the mulch and additives to create a suitable microclimate for the germination of the grasses on the steep slopes. Organic matter and fertilisers were added to the hydroseeding mix at application rates determined by the soil analysis. Work was completed by November 2008, and the 6x6 truck and hydroseeding unit was purchased by the mine after the completion of the initial work.

Nöffke returned during May 2009 to continue training the environmental workforce in all aspects of its work, with major emphasis on the technique of hydroseeding. This two-week course was followed up by a four-week practical course given by Daniel Nel of Hydromulch.

LEFT: The Vetiver planting team.

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