Road rehabilitation in 2000 (Kirsten Mahood)

Strip mine rehabilitation (南非)

描述

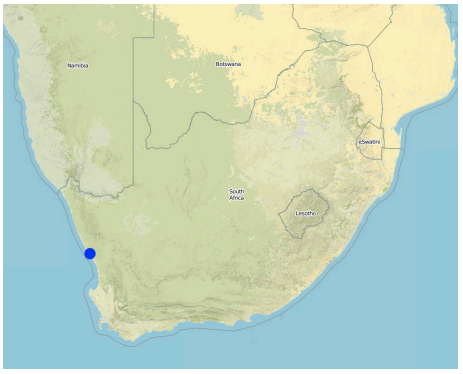
Rehabilitation of areas degraded by strip mining, through returning stockpiled topsoil and transplanting of indigenous species, to promote revegetation.

In contrast to the land degradation commonly caused when 'strip mining' is carried out, a land rehabilitation technology, which was first developed experimentally, is now routinely applied by mining companies on the west coast of South Africa. Indeed it is now a legal requirement in South Africa for mining companies to rehabilitate mined areas to a condition and productivity equivalent to the pre-mining situation.
The primary purpose of the technology described here is to achieve this result – thus allowing the site to be used again for extensive grazing by sheep and wild animals. Revegetation also reduces wind erosion. The technology further contributes to increasing biodiversity, as particular attention is given to planting a range of locally endemic and other indigenous species.
The sequence of operations is as follows: during strip mining operations the topsoil is pushed to one side by bulldozer, and stockpiled. The substrata is then excavated mechanically, removed by tipper truck, and processed to extract the heavy metals. The tailings (waste materials) are returned by tipper truck to the area from which they were mined, and then levelled by bulldozer. The stockpiled topsoil is returned and spread by bulldozer over the levelled tailings. Indigenous succulents and other plant species are dug out by hand, with a spade, from either the surrounding areas of natural vegetation, or from the piles of topsoil (where plants may have naturally established) and transplanted manually into the newly spread topsoil. The planted areas are protected from wind erosion by erecting fine mesh nylon netting as windbreaks. These are 0.8 metre high and 5 metres apart. The nets are usually installed for a period of up to 2-3 years. Subsequently they are removed, once the vegetation has successfully become re-established, and they may be re-used at the next rehabilitation site. Maintenance activities continue for a few years – until the site is rehabilitated. An individual mine strip is usually about 1 km long and some 100 m wide.
This form of strip mine rehabilitation has been in operation since 1990, and costs on average just over US$ 200 per hectare, with all expenses met by the mining company. This particular approach was developed for the Anglo-American subsidiary – 'Namaqua Sands'. A similar approach was adopted by 'PBGypsum Mines' located further inland, where rehabilitation is also conducted on several hundreds hectares of mined land. Not all mining companies use the same technology, however.

Purpose of the Technology: Establishment activities:
Mining activities (not part of technology)
1.Removal and stock piling of topsoil
2.Excavation, removal and processing of substrata to extract heavy minerals
3.Return and levelling of the mine tailings
4.Return and spreading of topsoil Technology activities
5.Collection/digging up of indigenous plants
6.Transplanting into returned topsoil
7.Erection of fine mesh nylon net windbreaks Activities 1-4 are a continuous process associated with the speed of mining activities and involve the use of heavy earth moving machinery (bulldozers, front end loaders, tipper trucks). Activities 5&6 take place immediately prior to the onset of the rainy season and involve hand labour for collection and transplanting and tractor and trailer for transporting collected plants. Activity 7 can take place at any time of the year involving hand labour for erection of the nets and tractor and trailer for transport.

Maintenance / recurrent activities per year:
Maintenance activities restricted to:
1.Ensuring the nylon nets remain upright
2.Supplementary watering during the winter months, when rainfall inadequate, to support plant growth

地点



地点: Brand-se-Baai, Western Cape, Western Cape, 南非

分析的技术场所数量:

选定地点的地理参考
- 17.9128, -31.2736

技术传播: 均匀地分布在一个区域 (approx. 1-10 平方千米)

在永久保护区？:

实施日期: 不到10年前 最近

介绍类型
- 通过土地使用者的创新
- 作为传统系统的一部分 > 50 年
- ☑ 在实 /研究期间
- 通过 外部干

Rehabilitation in 2000 (Kirsten Mahood)

Rehabilitation in 2002 (Kirsten Mahood)

技术分类

主要目的

- [ ] 改良生产
- [ ] 减少、 防、恢复土地退化
- [ ] 保护生态系统
- [ ] 结合其他技术保护流域/下游区域
- [ ] 保持/提 生物多样性
- [ ] 降低灾害 险
- [ ] 适应气候变化/极端天气及其影响
- [ ] 减缓气候变化及其影响
- [ ] 创造有益的经济影响
- [ ] 创造有益的社会影响

土地利用

牧场

- 经营牧场

矿山、采掘业 - 具体说明: Stockpiling of topsoil; processing of subsoil

供水

- [x] 雨养
- [ ] 混合雨水灌溉
- [ ] 充分灌溉

土地退化相关的目的

- [ ] 防止土地退化
- [ ] 减少土地退化
- [x] 修复/恢复严重退化的土地
- [ ] 适应土地退化
- [ ] 不适用

解决的退化问题

土壤水蚀 - Wt 表土流失地表侵蚀

土壤风蚀 - Et 表土流失

物理性土壤退化 - Pu 由于其他活动而导致生物生产功能的丧失

SLM组

- 不适用

SLM措施

农艺措施 - A3 土壤表 处理.1 免耕

植物措施 - V5 其它

结构措施 - S11 其它

技术图纸

技术规范

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: moderate

Main technical functions: reduction in wind speed

Secondary technical functions: improvement of ground cover, increase in organic matter, increase of infiltration, increase in soil fertility

Scattered / dispersed
Vegetative material: O : other
Number of plants per (ha): 2000
Vertical interval within rows / strips / blocks (m): 5

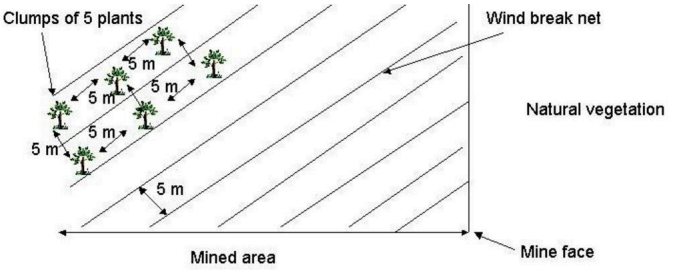
Other species: Succulent plants

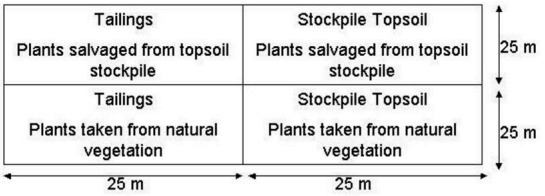
Slope (which determines the spacing indicated above): 4.00%

Structural measure: silt fence
Spacing between structures (m): 5
Height of bunds/banks/others (m): 0.8

Construction material (other): nylon net - small grid size

Silt fence: all 5m and height of 0.8m





Author: Kirsten Mahood

技术建立与维护 活动、投入和费用

投入和成本的计算
- 计算的成本为
- 成本计算使用的货币 **Rand**
- 汇率 换算为美元 1 美元 = 9.07 Rand
- 雇用劳工的每日平均工资成本 12.00

影响成本的最重要因素
Labour costs

技术建立活动
1. Collection of plants from natural vegetation (时间/ 率Pre-rainy season)
2. Collection of plants from topsoil stockpiles (时间/ 率Pre-rainy season)
3. Transport plants to rehabilitation area (时间/ 率Pre-rainy season)
4. Plant all plants (时间/ 率Pre-rainy season)
5. Insert droppers into net pockets (时间/ 率all year)
6. Spread nets over topsoil areas (时间/ 率all year)
7. Erect nets and hammer in droppers (时间/ 率all year)

技术建立的投入和成本

对投入进行具体说明	单位	数量	单位成本 (Rand)	每项投入的总成本 (Rand)	土地使用者承担的成本%
劳动力					
Labour	hectare	1.0	75.0	75.0	100.0
设备					
Machine use	machine hours	0.5	134.0	67.0	100.0
植物材料					
Seedlings	ha	1.0			100.0
施工材料					
Nylon net	ha	1.0	70.0	70.0	100.0
技术建立所需总成本				**212.0**	
技术建立总成本 美元				*23.37*	

技术维护活动
1. Topsoil pushed into stockpile (时间/ 率all seasons / continuous)
2. Subsoil removed and processed (时间/ 率all seasons / continuous)
3. Processed subsoil returned to mined area and levelled (时间/ 率all seasons / continuous)
4. Stockpiled topsoil spread over processed subsoil (时间/ 率all seasons / continuous)
5. Plants transplanted onto spread topsoil (时间/ 率just before rainy season / late autumn/winter)
6. Ensure nets remain upright (时间/ 率all year/continuous)

技术维护的投入和成本

对投入进行具体说明	单位	数量	单位成本 (Rand)	每项投入的总成本 (Rand)	土地使用者承担的成本%
劳动力					
Labour	ha	1.0	37.0	37.0	
技术维护所需总成本				**37.0**	
技术维护总成本 美元				*4.08*	

自然环境

年平均降雨量
- [x] < 250毫米
- [ ] 251-500毫米
- [ ] 501-750毫米
- [ ] 751-1,000毫米
- [ ] 1,001-1,500毫米
- [ ] 1,501-2,000毫米
- [ ] 2,001-3,000毫米
- [ ] 3,001-4,000毫米
- [ ] > 4,000毫米

农业气候带
- [ ] 潮湿的
- [ ] 半湿润
- [ ] 半干旱
- [x] 干旱

关于气候的规范
不适用

斜坡
- [ ] 水平（ 0-2%）
- [x] 缓降（ 3-5%）
- [ ] 平缓（ 6-10%）
- [ ] 滚坡（ 11-15%）
- [ ] 崎岖（ 16-30%）
- [ ] 陡峭（ 31-60%）
- [ ] 非常陡峭（ >60%）

地形
- [x] （ 平原
- [ ] 山脊
- [ ] 山坡
- [ ] 山地斜坡
- [ ] （ 坡
- [x] 谷底

海拔
- [x] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

.....应用的技术
- [ ] 凸形情况
- [ ] 凹陷情况
- [ ] 不相关

土壤深度
- [ ] 非常浅（ 0-20厘米）
- [ ] 浅（ 21-50厘米）
- [ ] 中等深度（ 51-80厘米）
- [ ] 深（ 81-120厘米）
- [x] 非常深（ > 120厘米）

土壤质地（表土）
- [x] 粗粒/轻（ 砂质）
- [ ] 中粒（ 壤土、粉土）
- [ ] 细粒/重质（ 粘土）

土壤质地（地表以下>20厘米）
- [ ] 粗粒/轻（ 砂质）
- [ ] 中粒（ 壤土、粉土）
- [ ] 细粒/重质（ 粘土）

表土有机质含量
- [ ] （ >3%）
- [ ] 中（ 1-3%）
- [x] 低（ <1%）

地下水位
- [ ] 表（ 上
- [ ] < 5米
- [ ] 5-50米
- [ ] > 50米

地表水的可用性
- [ ] 过量
- [ ] 好
- [ ] 中等
- [ ] 匮乏/没有

水质（未处理）
- [ ] 良好（ 用水
- [ ] 不良（ 用水（ 需要处理）
- [ ] 仅供农业使用（ 灌溉）
- [ ] 不可用

盐度是个问题吗？
- [ ] 是
- [ ] 否

洪水发生
- [ ] 是
- [ ] 否

物种多样性
- [ ]
- [ ] 中等
- [ ] 低

栖息地多样性
- [ ]
- [ ] 中等
- [ ] 低

应用该技术的土地使用者的特征

市场定位
- [ ] 生计（ 自给）
- [ ] 混合（ 生计/商业）
- [x] 商业/市场

非农收入
- [x] 低于全部收入的10%
- [ ] 收入的10-50%
- [ ] > 收入的50%

相对财富水平
- [ ] 非常贫瘠
- [x] 贫瘠
- [x] 平均水平
- [ ] 丰富
- [ ] 非常丰富

机械化水平
- [ ] 手工作业
- [ ] 畜力牵引
- [ ] 机械化/电动

定栖或游牧
- [ ] 定栖的
- [ ] 半游牧的
- [ ] 游牧的

个人或集体
- [ ] 个人/家庭
- [ ] 团体/社区
- [ ] 合作社
- [ ] 员工（ 公司、政府）

性别
- [ ] 女人
- [ ] 男人

年龄
- [ ] 儿童
- [ ] 青年人
- [ ] 中年人
- [ ] 老年人

每户使用面积
- [ ] < 0.5 公
- [ ] 0.5-1 公
- [ ] 1-2 公
- [ ] 2-5公
- [ ] 5-15公
- [ ] 15-50公
- [ ] 50-100公
- [ ] 100-500公
- [ ] 500-1,000公
- [x] 1,000-10,000公
- [ ] > 10,000公

规模
- [ ] 小规模的
- [ ] 中等规模的
- [ ] 大规模的

土地所有权
- [x] 州
- [ ] 公司
- [ ] 社区/村庄
- [ ] 团体
- [ ] 个人（ 未命名
- [x] 个人（ 有命名

土地使用权
- [ ] 自由进入（ 无组织）
- [ ] 社区（ 有组织）
- [x] 租赁
- [ ] 个人

用水权
- [ ] 自由进入（ 无组织）
- [ ] 社区（ 有组织）
- [ ] 租赁
- [ ] 个人

进入服务和基础设施的通道

影响

社会经济影响

料生产	降低	增加	
料质量	降低	增加	vegetation, establishment
畜牧生产	降低	增加	Land can be used again for extensive grazing after mining

社会文化影响

社区机构	削弱	加强	
国家机构	削弱	加强	
None	None	None	improved conservation / erosion knowledge

生态影响

土壤覆盖层	减少	改良	
生物量/地上C	降低	增加	restoration of bio-productive function
栖息地多样性	降低	增加	biodiversity enhancement
速	增加	降低	reduced wind velocity

场外影响

力搬运沉积物	增加	减少	

成本效益分析

与技术建立成本相比的效益

短期回报	非常消极	非常积极
长期回报	非常消极	非常积极

与技术维护成本相比的效益

短期回报	非常消极	非常积极
长期回报	非常消极	非常积极

气候变化

-

采用和适应

采用该技术的地区内土地使用者的百分比

- 单例/实
- 1-10%
- 11-50%
- > 50%

在所有采用这种技术的人当中，有多少人在没有获得物质奖励的情况下采用了这种技术?

- 0-10%
- 11-50%
- 51-90%
- 91-100%

最近是否对该技术进行了修改以适应不断变化的条件？

- 是
- 否

什么样的变化条件？

- 气候变化/极端气候
- 不断变化的市场
- 劳动力可用性 例如 由于迁移

结论和吸取的教训

长处: 土地使用者的观点

长处: 编制者或其他关键资源人员的观点

- Low establishment costs and very low maintenance costs

  How can they be sustained / enhanced? Make use of whatever resources and potentials are naturally available (such as micro-catchments to trap rainwater and improve soil moisture conditions for plants) to lower establishment costs.
- Costs are met by the mining company – no costs are transferred to those who subsequently use the land for grazing

  How can they be sustained / enhanced? Regular monitoring of soil and vegetation conditions.

弱点/缺点/风险: 土地使用者的观点如何克服

弱点/缺点/风险: 编制者或其他关键资源人员的观点如何克服

- Rehabilitation is an extra cost for the mining company. Ensure mining company meets the costs through enforcing legislation.

- Land productivity is restored and biodiversity increased

  How can they be sustained / enhanced? Seeding as well as transplanting.
- Wind erosion minimized.

参考文献

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WOCAT数据库中的完整描述
https://qcat.wocat.net/zh/wocat/technologies/view/technologies_970/

链接的SLM数据
不适用

文件编制者

机构
- University of Stellenbosch (University of Stellenbosch) - 南非

目
- Book project: where the land is greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide (where the land is greener)