

# CONCEPTS FOR MINING LANDSCAPE DEVELOPMENT IN EASTERN GERMANY WITH GRAZING ANIMALS AND AGROFORESTRY

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## ABSTRACT

Leipzig South (Saxony) has been heavily transformed by open cast lignite mining. Alternative forms of land use are sought which contribute to an increase of biodiversity and an improvement of soil quality. This could be achieved by the selective introduction of grazing animals and perennials. Specific scenarios for open pits, dumping areas, open pits' slopes and land reclaimed for agriculture are proposed. Socio-economic drawbacks are outlined.

## KEYWORDS

Reclamation, habitat management, silvopastoralism, ecological infrastructure, animal-environment-interactions

## INTRODUCTION

The Convention on Biological Diversity, signed in Rio de Janeiro in 1992, aims at the protection of biological diversity and the sustainable use of natural resources. The importance of preventing degradation and the loss of soils is emphasized, among others, by the German Advisory Council on Global Change (WBGU, 1997). In surface mining landscapes, the contrary has happened. In consequence, the principle goals of rehabilitation must be to increase biodiversity and to recultivate soils sustainability.

In the region south of Leipzig, several near-surface lignite seams are subject to intensive mining operations. In the past, this region was characterized by agriculture on fertile soils, interspersed with small rivers and accompanying meadows and flood plain forests. From the beginning of this century onwards, surface mining and subsequent industrial development have heavily transformed an area of about 600 km<sup>2</sup>. Today, alternative forms of land use are needed to revitalize this region.

## METHODS

This study is based on literature, statistics, interviews and the digital analyses of aerial photographs, topographic and thematic maps of an area from 51°02' - 51°18' latitude north and 45°17' - 45°36' altitude east by using a geographical information system.

## RESULTS AND DISCUSSION

In the years to come, land use changes will occur on almost one third of the total area under consideration (Table 1). Open pits and dumping areas will be reclaimed, at least partially. For slopes and recultivated agricultural land, land use alternatives are sought which allow achievement of the objectives of an increase in biodiversity and the preservation or improvement of soil quality. Possible avenues to achieve these goals are:

**Landscapes management with grazing animals.** This is a proven technique which allows control of the vegetation by means of a well-directed introduction of different animal species in specific grazing systems. It needs to be adapted to the local conditions and purposes. There is a close interaction between animals (browse, trampling, nutrient input and output) and local conditions (climate, topography, vegetation, parasites). Sheep are thought to adapt better than cattle to the greatly varying feeding value of the vegetation on reclaimed soils. In certain areas, also suckler cows and game husbandry may be appropriate. The most important problem is to be seen in the adaptation of the stocking density.

**Agroforestry.** The introduction of perennials into agricultural landscapes creates wildlife habitats for birds, arthropods and small mammals reducing at the same time fallows of arable land, diversifying farmers' income and improving the visual quality of these monotonous landscapes. Fast growing trees should be used for wood production, such as *Populus* sp., *Prunus avium*, *Gleditsia triacanthos*, *Betula pendula*, etc. Tree densities can vary between 50 and 400 stems per hectare; the distance between tree rows must be adapted to the farming equipment. Agricultural use between the tree lines can be arable crops (alley cropping) or grassland (silvopastoralism). The latter requires less mechanic labor and is advantageous for reclaimed soils; it should therefore be preferred.

These approaches can improve the environmental quality in the areas where landscape change will mainly occur (Table 1):

**Open pits.** They will be reclaimed predominantly for forestry. Still, for diversified land use, patches of open land must be retained. They can be grazed, the choice of the animal species depending on the soil and vegetation quality which will be achieved. Game husbandry can enhance the attractiveness for recreation.

**Dumping areas.** They are yet to be reclaimed but on most of them, spontaneous vegetation has established. Valuable biotopes have developed which are worth protecting because of their high species diversity and/or because they host endangered species. By introducing grazing animals at appropriate stocking densities, the stages of succession can be preserved which are of interest for nature protection. Table 2 shows the plant richness of a typical site. 44 % of the herbaceous plant species are accepted by cattle. Other animals, namely sheep, may be more appropriate in many places, but, as there are important differences between the sites, generalized recommendations cannot be made.

**Slopes of pits.** On slopes, the rapid installation of a vegetation cover is essential to prevent erosion. The plant species used for this purpose are accepted by the cattle to 91 % (Table 2). However, due to the gradient, most slopes are herded with sheep. The introduction of perennials along contour lines would further reduce erosion.

**Land reclaimed for agriculture.** These areas form a coarse grain landscape with little ecological infrastructure. This is mainly due to a purely technically motivated design of the recultivated sectors. With an average size of 50.8 hectares, the field plots of the Leipzig district were the largest in eastern Germany (Dittrich, 1989). Almost half of these soils are laid fallow in the set aside program of the EU (Götze and Stahl, 1996). Silvopastoral agroforestry would be a pragmatic land use alternative for these sites. Grassland management on reclaimed soils should be rather intensive to continue the building up of organic matter and soil structure. It could include fodder production for the winter. Trees would provide shelter for cattle, namely suckling cows.

Diversified land use systems have the potential to yield more environmental benefits than monocultures. The introduction of perennials and grazing animals into the reclaimed parts of the mining landscapes south of Leipzig would help to preserve and improve

both soil qualities and biological diversity. In the parts yet to be reclaimed, ruminants can play an important role in managing semi-natural ecosystems. Experiments must be designed to optimize their use and adapt the concepts to local conditions. However, the actual laws and regulations impede the implementation of alternative forms of land use. Economic pressure on agriculture and forestry leaves relatively little room for novel, non-conventional solutions. In regions such as the one examined here, which have so much suffered from human intervention into biotic and abiotic systems, economic and juridical considerations should step back behind the necessity to stabilize and revitalize the natural balance.

## REFERENCES

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**Table 1**

Land use in Leipzig South on natural soils and in former and present mining areas (based on Berkner, 1991)

	Natural soils		Mining areas	
	km <sup>2</sup>	%	km <sup>2</sup>	%
Open pits			22.9	3.9
Dumping areas (spontaneous vegetation)			42.4	7.3
Slopes of pits			29.0	5.0
Agriculture	222.1	38.1	71.7	12.3
Forestry	24.7	4.2	38.8	6.7
Water	3.0	0.5	6.0	1.0
Future mining areas, fallows	22.1	3.8		
Urban & residential areas, recreation	66.9	7.6		
Mining, industry & traffic	21.2	3.6		
Other uses	1.0	0.2	10.6	1.8
total	361.0	62.0	221.4	38.0

**Table 2**

Occurrence of plant species and palatability for cattle on dumping areas and on slopes of pits in Leipzig South (based on Durka et al., 1996 and König, 1994)

	Spontaneous vegetation on dumping areas		Slopes of pits	
	number	%	number	%
Plant species	238		24	
Fodder plants	82	34.4	22	91.7
Preferences:				
- preferred	7	8.5	3	13.6
- well taken	11	13.4	11	50.0
- taken	18	22.0	6	27.3
- reluctantly taken	15	18.3	2	9.1
- avoided	20	24.4	-	-
- refused	11	13.4	-	-
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