the uppermost soil horizons and is harmful to the superficial root systems. Management strategies play a key role in sustaining soil nutrient budgets. Litter raking has to be abolished because the impact of litter raking on soil impoverishment and acidification by far exceeds that of wood harvesting in eucalyptus plantations.

All over summary

Even when we assume that eucalyptus plantations will have some negative long term effects on physical and chemical soil properties and on the hydrology of a site and that eucalyptus is highly competitive to other types of vegetation, the importance of expanding eucalyptus plantations is recognisable beyond any doubt in order to narrow the gap between demand and supply of fuel wood and to replace dung, crop residues, and forest litter as fuel sources. Concerning the hydrological rationale, our research could not provide answers to all the questions. *Eucalyptus camaldulensis* is able to enlarge the water and nutrient cycle down to soil depths that are not accessible for other tree species or agricultural crops. The planting or preservation of indigenous species should be supported and extended. For the moment, well-managed eucalyptus plantations, apart from plantations of other fast growing species, are one of the measures that help to cover the demand for construction and fuel wood and may help to protect the small number of remnant indigenous forest patches. The tradition of free grazing livestock is counter-productive to the natural regrowth of indigenous trees, shrubs, herbs and grasses that are protecting the soil and the seed beds from erosion. With these common land use traditions eucalyptus plantations that are not browsed by animals are a suitable alternative for soil protection. The harvest of eucalyptus should include only stem-wood and branches and should leave the compartments with high nutrient contents like leaves and bark on site. This would help to minimize the nutrient export and to reduce soil impoverishment. Changes in management strategies such as using cow dung for fertilization and leaving tree litter on site increase the sustainability of both agricultural and forest production and therefore should be encouraged through information campaigns for the village communities.

Foto 32: Farmers on degraded lands (© Gerhard Glatzel).

Further activities – partnerships

- *Memorandum of Understanding between the following partner organizations:* Faculty of Forestry of the University of Natural Resources and Applied Life Sciences, Vienna; Ethiopian Agricultural Research organization; Amhara Region Agricultural Research Institute; Amhara Region Bureau of Agriculture; Austrian Embassy Development Cooperation, Addis Ababa
- *Research cooperation implementation plan:* Initiation and prioritization of collaborative research on development, sustainable utilization and conservation of natural resources in Ethiopia.
- *Human capacity building:* Agreement between the respective Ethiopian counterparts, Austrian donors and the University of Natural Resources and Applied Life Sciences, Vienna, concerning PhD-students, MSc-students in mountain forestry, and short term training for scientists.

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Hailu, T. (2004) *Root biomass and nutrient distribution study in a* Eucalyptus camaldulensis *plantation in Ethiopia*. Diplomarbeit, Universität für Bodenkultur Wien. 106 p.

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Hailu, Z. (2002) Dung or forest biomass as fuel – even plantation trees with a bad reputation help conserve soil fertility. *ETFRN News 37,* pp. 5–8, Wageningen.

Hailu, Z., Sieghardt, M., Glatzel, G. (2002) Acknowledging farmers' choice of tree species: a reasonable approach for sustainable development and utilization of natural resources in the Highlands of Ethiopia. *Proceedings Environmental Research for Sustainable Development: a Review and Outlook on Austrian Co-operations with (sub)tropical and Mediterranean partners*. November 22–23, 2002 at BOKU, Vienna.
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Ingenieurbiologische Uferschutzmaßnahmen an Bächen und Flüssen in Südbrasilien (KEF Projekt 121)

Fabrício J. Sutili, Miguel A. Durlo und Florin Florineth

Projektpartnerschaft:

BOKU: Universität für Bodenkultur, Wien/ Österreich (Institut für Ingenieurbiologie und Landschaftsbau)

UFSM: Universidade Federal de Santa Maria, Rio Grande do Sul/Brasil (Departamento de Ciências Florestais)

Projektdauer:

2003–2006

Projektbeschreibung und Ziele

Ingenieurbiologische Bauweisen zur Sicherung von Fluss- und Bachufern haben sich in Europa und Nordamerika durchgesetzt, weil sie dauerhaft funktionieren, primär aus nachwachsenden Ressourcen hergestellt werden und – richtig eingesetzt – ökologisch wertvoll sind.

Damit diese landschafts- und ressourcenschonenden Maßnahmen auch in Brasilien durchgeführt werden können, müssen die geeigneten Gehölze gesucht und getestet werden, sowie verschiedene Bauweisen den dortigen Klima- und Arbeitsbedingungen angepasst werden.

Foto 33: Erodiertes Flussufer des Arroio Guarda-mor (2003) (© Fabrício J. Sutili).

Foto 34: Ufer des Arroio Guarda-mor zwei Jahre nach Bepflanzung (2005) (© Fabrício J. Sutili).

In diesem Zusammenhang bestehen für dieses Forschungsprojekt in Südbrasilien folgende Ziele:

- Erkundung der ingenieurbiologischen Eigenschaften der Ufervegetation an Flüssen und Bächen.
- Verschiedene Pflanzenarten auf ihre ingenieurbiologische Eignung und ihr Verhalten in verschiedenen Jahreszeiten zu testen. Auch die Biegefestigkeit und der Auszugwiderstand der Pflanzenarten soll untersucht werden.
- Exemplarische Anlage einiger ingenieurbiologischer Bauten mit nachfolgenden Pflegemaßnahmen zur Stabilisierung von Gewässerufern.
- Kostenanalyse dieser Bauweisen zur Flussufersicherung.

Erreichte Ergebnisse

Nach Untersuchungen der regionalen Vegetation wurden neun Ufergehölzarten (strauch- oder baumförmig) ausgewählt, die als potenziell geeignet erschienen. Auch je eine Gras- und eine Krautart wurden als geeignet erachtet, bei den Bauwerken eingesetzt zu werden, sie wurden aber nicht ins Testprogramm einbezogen. Für die Untersuchung der Sprosswurzelbildung wurde die Entwicklung der Pflanzen übererdet (Pflanzhügel) beziehungsweise in Wasser eingelegt beobachtet. Für die überer-

deten Pflanzen wurden drei Beobachtungszyklen an zwei Pflanzhügeln untersucht, die Variante der in Wasser eingelegten Pflanzen ist ein ganzes Jahr lang beobachtet worden. Auch die Biegefestigkeit der Pflanzen und ihr Auszugwiderstand wurden bereits untersucht.

Mit den Pflanzenarten, die sich am besten geeignet zeigten (in abnehmender Reihenfolge: *Salix x rubens, Sebastiana schottiana, Hedychium coronarium, Phyllanthus sellowianus* und *Salix humboldtiana),* wurden fünf ingenieurbiologische Bauwerke an den Flüssen Arroio Guardamor, Arroio Vale Vêneto und Rio Soturno errichtet.

Foto 35: Eingebrochenes Ufer des Rio Soturno, August 2005 (© Fabrício J. Sutili).

Umsetzung der Ergebnisse

Zwar zeigten sich *Phyllanthus sellowianus, Hedychium coronarium* und *Salix humboldtiana* ebenfalls zur Verwendung geeignet, konnten aber bis jetzt wenig in unseren ingenieurbiologischen Baumaßnahmen verwendet werden; daher kommen heuer diese Arten in neuen Bauwerken zum Einsatz.

Obwohl bereits mehrere Hochwässer über die errichteten Bauten drüber flossen, ohne sie zu beschädigen, bedarf es noch weiterer Erfahrungen mit derartigen Extrembeanspruchungen, um endgültige Schlüsse betreffend der Stabilität der verschiedenen Bauweisen zu ziehen.

In Abhängigkeit von den lokalen Gegebenheiten können sich verschiedene Pflegearbeiten in den angelegten Ufergehölzen als notwendig erweisen.

Foto 36: Bepflanztes Ufer des Rio Soturno, November 2005 (© Fabrício J. Sutili).

LPCC-Guineé: Recirculation of local organic wastes in peri-urban and rural agriculture and their effect on the soil functions in Guinea/West Africa (KEF Projekt 139)

Roland Linzner and Momo Soumah

Project partners:

BOKU – University of Natural Resources and Applied Life Sciences, Vienna

Institute of Waste Management (Department of Water, Atmosphere and Environment)

Institute of Soil Science (Department of Forest and Soil Sciences)

Ministère de l'Agriculture, des Eaux et Forêts – Institut de Recherche Agronomique de Guinée

Service National des Sols (SENASOL), Conakry, Guinée

Project duration:

2005–2006

Introduction and Goals

In the course of ongoing urbanisation and changing living conditions, organic waste lost its link to the traditional reuse practices in rural agriculture. Instead, it became a health hazard for cities and an environmental burden due to the lack of appropriate management. In development cooperation of the 1970s it was believed that large-scale and highly mechanised composting plants could solve the problems in urban areas. Most of these composting plants turned out to be failures with serious economic consequences. Since the 1990s, a new approach of initiating small-scale composting projects has been set up by NGOs and community groups.

One of the challenges of rapid urbanisation is to make sufficient food available on a sustainable basis for the increasing urban population. In West Africa, it has been estimated that within 20 years, two out of three West Africans will live in urban centres partly due to rural-urban migration. The related increase in urban food demand is responsible for the establishment of intensive food production systems in and around cities, often specialised in perishable crops or poultry, and also of export-oriented agriculture which takes advantage of urban infrastructure. These types of agriculture require large amounts of input, including plant nutrients. Once the food is consumed or processed in the city, related market and household refuse as well as human excreta contribute to urban pollution, due to the common lack of adequate sanitation services, or they end in landfills. In both cases large amounts of nutrients are simply 'wasted'. This leads to a lack of nutrients and humus in the soils, as well as to related problems such as soil degradation and erosion. Converting urban wastes or a substantial portion of it into organic manures is an adequate way of closing the nutrient cycle by means of natural methods.

Based on the previous project *'The assessment of the sustainable productivity potential of important agriculturally exploited soils in West Africa as exemplified by Guinea'* (1998 to 2000 and 2001 to 2003), funded by the Commission for Development Studies, the existing partnership between SENASOL and BOKU-University was intensified by proposing a project that also includes waste management topics. In addition to the previous project it was intended to research the possibility of producing organic fertiliser (compost) in order to use an adapted low-technology approach for sustainable urban agriculture.

The goals of this project are:

- the installation and operation of an adapted, small-scale and decentralised composting facility in the capital Conakry;
- the application of good quality compost on test plots in Conakry with different application rates and the analysis of the impact on the maize yields in peri-urban agriculture;
- the transfer of an adapted technology and of knowledge concerning the production and application of compost including the motivation for a self-dependent implementation of the collection and composting of biogenic market waste.

Foto 37: Turnover of the windrows (© Erwin Binner).

Within the framework of this project it was necessary to develop locally adapted knowledge of the biological processes involved in composting as well as the technical skills required to carry out composting. The development of sustainable knowledge supported by the application of an adapted low budget technology is crucial in view of the fact that the parties involved should in the future be in a position to carry out compost production and application independently.

Overview of the achieved progress

Based on a literature research to determine the factors which constrain or promote compost as a technology within the development cooperation framework, a first workshop was carried out in Vienna in order to train project partners in the basic biological degradation processes and composting technology. Besides providing theoretical information, practical experience formed part of this introductory training. Furthermore, the compost facility was designed jointly, and a work plan and a bill of material were set up. After the installation of the compost plant and the initiation of the collection of market waste, the composting process started at the beginning of December 2005. In January 2006 two technicians from the Institute of Waste Management joined the project partners in Conakry in order to supervise and, if necessary, improve the collection of market waste and bulk material as well as the composting process. The goal of their first visit to Conakry was to learn about the progress of the work and to jointly initiate possible improvements. Addi-

Foto 38: Examples of sorted out residues in the market waste (© Erwin Binner).

tionally, it was necessary to carry out networking activities to consolidate the contacts with representatives of the concerned political decision makers. Therefore, the main topics of the visit to Conakry were the completion of the technical design of the composting plant; the improvement of the composting process (including input material); sampling procedure; visits to different markets in Conakry; networking activities.

Lessons learned

The basic idea of the project was to use market waste as input material for composting. At the proposal stage of this project it was assumed that market waste might be mostly source separated biogenous waste without contaminants and residues. But the situation turned out to be a bit different. The delivered market waste was not the separated organic fraction that was expected, but rather mixed market waste. In the project it was planned to use separated organic waste. However, at the markets hardly any separation takes place. Therefore, a time-consuming manual sorting process had to be conducted. The materials that were separated from the organic fraction were plastics (beverage packaging, detergents, food packaging, packaging tapes); textiles (tailors at the market) and shoes; hazardous waste (batteries, pharmaceuticals and the corresponding packaging material); cardboard (cigarette and fruit packaging) and metal scrap (cans and scrap from car repair shops).

Outlook

The project lasts until the end of 2006 and the following measurements have to be undertaken according to the project plan: analysis of the compost samples in order to compare the results with EU quality standards; preparation of the field trials and of compost application; soil analysis and soil characterisation; execution of the field trials; preparation and execution of the second workshop in Conakry; harvest on test plots and analysis of the results of the field trials; dissemination activities. Based on this project, a follow up project with a focus on disseminating the results is planned.

Publications

Linzner, R. (2005) Recirculation of local organic waste in (peri-)urban agriculture – the impact on soil functions in Guinea/West Africa. *Proceedings of A critical look at the role of research in achieving the Millennium Development Goals',* KEF MDG+5 Workshop at ÖAW; Nov.29,2005. [INTERNET] http://www.oeaw.ac.at/kef/workshop_MDG2005.htm.

Linzner R. and Soumah, M. (forthcoming) *"Factors constraining and promoting the implementation of small-scale composting in West African Countries"* to be presented at the ORBIT 2006, Fifth International Conference on Biological Waste Management in Weimar, Germany (13.9. to 15.9.06).