Silviculture Contributions Towards Sustainable Management of Plantation Forests in the Highlands of Ethiopia

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Introduction

Remaining forest resources of Ethiopia are affected by an ongoing destruction and degradation process of high rates. The forest cover was estimated to be 40 % a century ago, reduced to less then 3 % at present time. An ever-increasing population growth linked with high demands of agriculture land as well as wood as energy source (fuelwood and charcoal) and construction material enforces the negative trend of deforestation.

Starting from the late 19th century plantation forests of exotic tree species had been introduced in Ethiopia. There is no doubt, that these fast growing plantation forests mitigate the pressure on the remaining natural forest resources by at least partly satisfying the demands of timber and fuelwood. However defined thinning concepts are neglected within forest management plans and scientific knowledge about thinning effects on plantation stands are missing. Therefore a silviculture experiment was implemented in plantation stands of *Cupressus lusitanica*, *Pinus patula* and *Eucalyptus saligna* in the Munessa Shashemene Forest in the highlands of Ethiopia. The following hypothesis were formulated:

1) Appropriate silviculture treatments of plantation forests enable to increase the productivity of the harvestable stand in terms of mass and value.

2) Appropriate silviculture treatments of plantation forests enable to convert plantation forests of exotic tree species into natural forests.

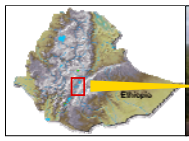


Fig. 1: Map of Ethiopia

Fig. 2: The study area, Munessa Forest

Experimental Design

Tree Species (3):	Treatments (3): *)
Cupressus lusitanica	Control
Pinus patula	Intense Promotion
Eucalyptus saligna	Conversion
Age Classes (4):	**Protection Level (2):**
(I) < 8 years	fenced
(II) 9 – 16 years	unfenced
(III) 17 – 24 years	
(IV) 24 years	

Factor combination

Tree species	Age class (years)	Control (0) fencing (+)	Control (0) no fencing (-)	Intense promotion (1) fencing (+)	Intense promotion (1) no fencing (-)	Conversion (2) fencing (+)	Conversion (2) no fencing (-)
Pinus (A)	I (2-8)	A I 0 +	A I 0 -	A I 1 +	A I 1 -		
	II (9-16)	A II 0 +	A II 0 -	A II 1 +	A II 1 -		
	III (17-24)	A III 0 +	A III 0 -	A III 1 +	A III 1 -	A III 2 +	A III 2 -
	IV (≥ 25)	A IV 0 +	A IV 0 -	A IV 1 +	A IV 1 -	A IV 2 +	A IV 2 -
Cupressus (B)	I (2-8)	B I 0 +	B I 0 -	B I 1 +	B I 1 -		
	II (9-16)	B II 0 +	B II 0 -	B II 1 +	B II 1 -		
	III (17-24)	B III 0 +	B III 0 -	B III 1 +	B III 1 -	B III 2 +	B III 2 -
	IV (≥ 25)	B IV 0 +	B IV 0 -	B IV 1 +	B IV 1 -	B IV 2 +	B IV 2 -
Eucalyptus (C)	III (17-24)	C III 0 +	C III 0 -	C III 1 +	C III 1 -	C III 2 +	C III 2 -

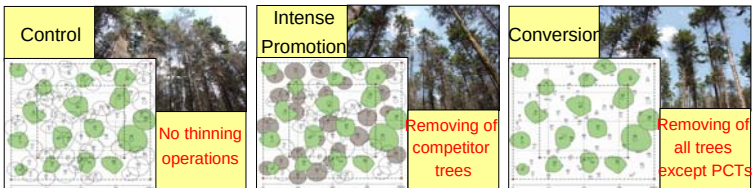
Fig. 3: Experimental design

For each *Cupressus* and *Pinus* four stands of different age classes were selected. For *Eucalyptus* just one appropriate stand age class III was available.

Age Class I and II comprise 4 plots receiving the silviculture treatments **Control** and **Intense Promotion**. Age Class III and IV comprise 6 plots receiving additionally the treatment **Conversion.** Investigating the impact of livestock on ground vegetation and regeneration, each silviculture treatment receives a fenced and unfenced variant. In total 46 research plots were established in the study area.

The "Generalised Randomised Block Design" is used for the simultaneous analysis of Pinus and Cupressus over all four age classes. For the analysis of age class III for all three plantation species the appropriate design is the "Completely Randomised Design"

*) *Further explanation of the silviculture treatments*



Selection of 17 Potential Crop Trees (PCTs/green) per plot (110 PCTs/ha).

Promoting the PCTs by removing the next competitor trees (grey)

Providing growth condition for nativ species by removing all trees except the 17 PCTs.

Fig. 4: Silviculture treatments

Data collection

Main objective of the present study is to gain information how plantation forests, different in age and species, respond to silviculture measures (treatment / protection). Mature stand, regeneration and ground vegetation are studied in detail and data is collected repeatedly

Plot layout

Each plot is 40 x 40 m in size with a core zone of 25 x 25m. For regeneration records 49 circular units (1-3m²) are distributed systematically in the middle of the core zone surrounded by 4 rectangular units (45m²) for plant sociological records.

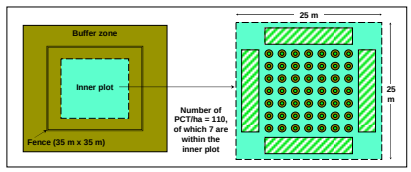
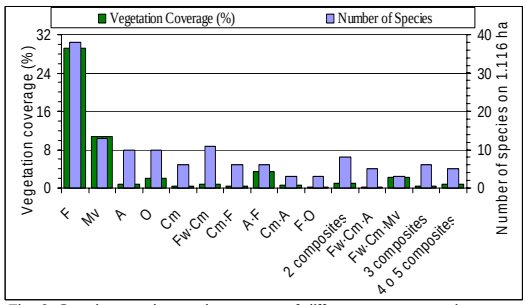


Fig. 5: Plot layout

Results

1) Plant usage by the local people



Use-categories:
F = forage
Mv = medicinal value
A = alimentation
O = other uses
Cm = construction material
Fw = firewood

Fig. 6: Species number and coverage of different use-categories (Master Thesis, Thea-Katharina Wiesinger)

2) Growth reactions of the PCTs (Basal area cm² y^{-1}) one year after thinning

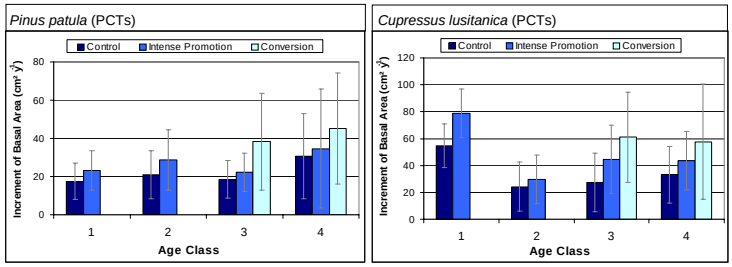


Fig. 7: Basal area (cm²) increment of *Pinus* and *Cupressus*.

3) Treatment effects on woody regeneration

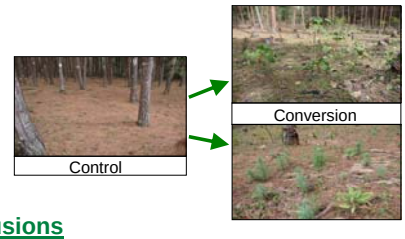


Fig. 8: Regeneration in comparison to control and conversion treatment. Under the conversion treatment rich regeneration of native and exotic tree species could be found.

Conclusions

1) Ethnobotanical importance of understorey plant species:

- A significant number of woody and herbaceous species of the studied plantation forests are useful to the local people living in the surrounding of the Munessa-Shashemene Forest. The ethnobotanical approach gives evidence that ground vegetation should be considered as an important economic resource for the local population within management strategies .

2) Growth reactions PCTs:

- All tree species respond to the different thinning regimes according to the intensity of intervention one year after implementation. Thinning can be considered as an appropriate silvicultural tool to manage plantation stands in order to regulate rotation age (time), diameter growth (dimension) and quality for all three tree species.
- Even older plantation stands can be thinned, because PCTs are able to respond to liberation.
- To achieve growth effects thinning in *Pinus patula* and *Eucalyptus saligna* stands has to be more pronounced than in *Cupressus lusitanica* stands.

3) Woody regeneration:

- Conversion seems to be a very promising option to restore biodiversity

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www.soils.uni-hannover.de/forschung/munessa.htm

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