Sino German cooperation on new land use systems

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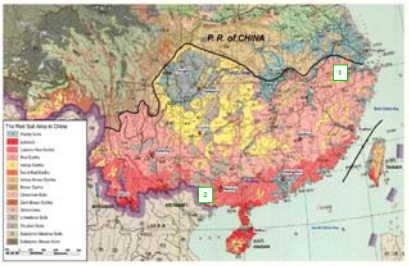
Introduction

In China soils of tropical and subtropical regions cover an area of 215 Mha with an ability to store around 30 Pg of soil organic carbon (SOC) and therefore should be considered more intensively in the global C budget. Under different land–uses these SOC stocks and fluxes can vary immensely. Well managed forestry systems not only contribute to restoration efforts of degraded subtropical and tropical ecosystems but also can play a major role in carbon sequestration. New forestry systems, characterised by the combination of biomass, bamboo and timber production and there influence on soil conditions as well as the Carbon dynamics in comparison with other traditional forest systems will be assessed.

Study area

The study sites are located in the red soil region of China (Fig.1). The red soil region of China covers an area of 2.6 Mio km² and is distributed in the subtropical and tropical region of South China including 15 provinces and autonomous regions.

According to the Chinese soil classification there are 4 major red soil types: latosols, lateritic red earths, red earths, and yellow earths.



site	province	location	major soil types	land use systems
1	Zhejiang	Fuyang, Lin An	Red Earths, Yellow Earths	Bamboo plantation, Chinese fir plantation Secondary forest
2	Guangxi	Pingxiang	Lateritic Red Earths, Latosols, Purplish Soils	Masson Pine plantation, Mixed forests, Pure broadleaved forest

Fig.1: location of study sites.

Methods

Soil fertility of different forest-ecosystems was assessed by analysing stocks and contents of nutrients, C mineralisation rates and microbial biomass C and N (Fig. 3 brown boxes).

pure coniferous plantation | **pure broadleaved stand (valuable wood)** | **pure broadleaved stand (fast growing)** | **pure bamboo stand** | **close to nature mixed forest** | **new land use systems**

Fig.2: investigated forest types.

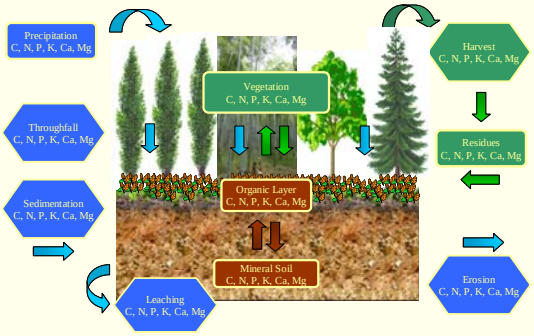


Fig.3: relevant nutrient pools and pathways in different forest types.

Results of soil inventory

Soil characteristics: acidic soils with low base saturation and low content of potentially available nutrients (Tab. 1).

Tab.1: Soil characteristics.

stand	depth	BD [g cm^{-3}]	pH	CEC [cmol$_c$ kg^{-1}]	BS [%]	PO_4-P [mg kg^{-1}]	K_{exch} [mg kg^{-1}]
broadleaved	0-10	1.3 (0.2)	4.2 (0.1)	6.2 (0.5)	5.3 (1.2)	2.3 (0.3)	40.9 (12.9)
	10-20	1.7 (0.1)	4.4 (0.0)	5.2 (0.3)	3.6 (0.8)	1.0 (0.1)	19.5 (8.13)
mixed	0-10	1.2 (0.2)	4.1 (0.1)	6.1 (0.6)	7.0 (0.9)	3.7 (0.9)	44.5 (9.5)
	10-20	1.7 (0.1)	4.3 (0.1)	4.6 (0.3)	5.0 (0.6)	1.6 (0.4)	19.8 (4.3)
coniferous	0-10	1.4 (0.1)	4.0 (0.0)	4.5 (0.5)	4.9 (1.1)	2.8 (0.4)	27.8 (5.7)
	10-20	1.7 (0.1)	4.1 (0.0)	6.6 (0.4)	3.5 (0.3)	1.0 (0.3)	15.7 (4.4)

Soil fertility:

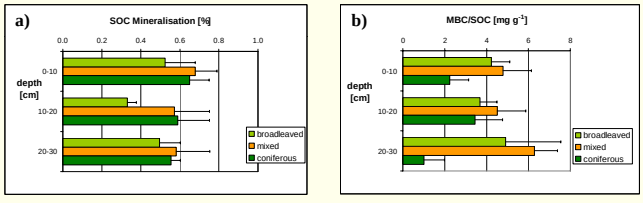


Fig.5: (a) SOC mineralisation after 14 days of incubation and (b) MBC/SOC ratio (n=5, bars=SD).

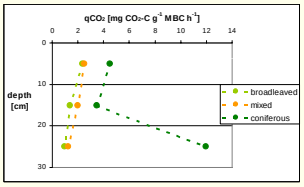


Fig.6: mean respiratory quotient of different soil depths.

The combination of coniferous and broadleaved tree species shows better soil fertility conditions. Therefore the new management system should be highly suitable.

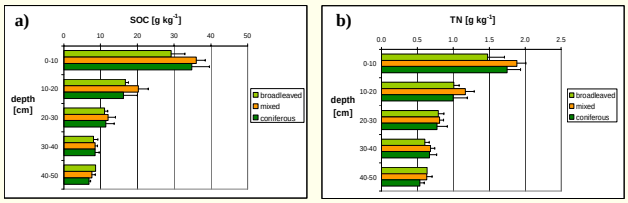


Fig.4: SOC (a) and TN (b) contents of different soil depths (n=5, bars=SD).

TOC and TN show significant ($p<0.05$) differences between the forest types in the first two depths (Fig. 4). SOM contents of top soils between 25 to 65 g kg^{-1} are within the range of values reported for Chinese red soils. (He et al. 2004)

SOC mineralisation was relatively (not significant) higher under coniferous stands (Fig. 5a). Mean basal respiration had values between 6 and 10 mg CO_2-C kg^{-1} d^{-1}.

Respiratory quotient decreases with increasing depth and was generally lowest under broadleaved forest showing a more efficient microbial use of the substrate than under the coniferous stand (Fig. 6). The higher MBC/SOC ratio under broadleaved forest supports the result for the comparison of these both forest types (Fig. 5b).

Further steps

A broadleaved (fast growing) forest system will be harvested in order to achieve data on nutrients fluxes due to management practices. Plant tissue analysis will complete the picture (see Fig.3 green boxes).

Establishment of the new management system on the harvested area.

Finally all assessed parameters will be integrated into a soil organic matter model to evaluate effects of forest management systems on productivity and sustainability of different forest-ecosystems.

References: He et al. (2004): Distribution and Classification of Red Soils in China. In Wilson et al. (2004): The red Soils of China: 29-35

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