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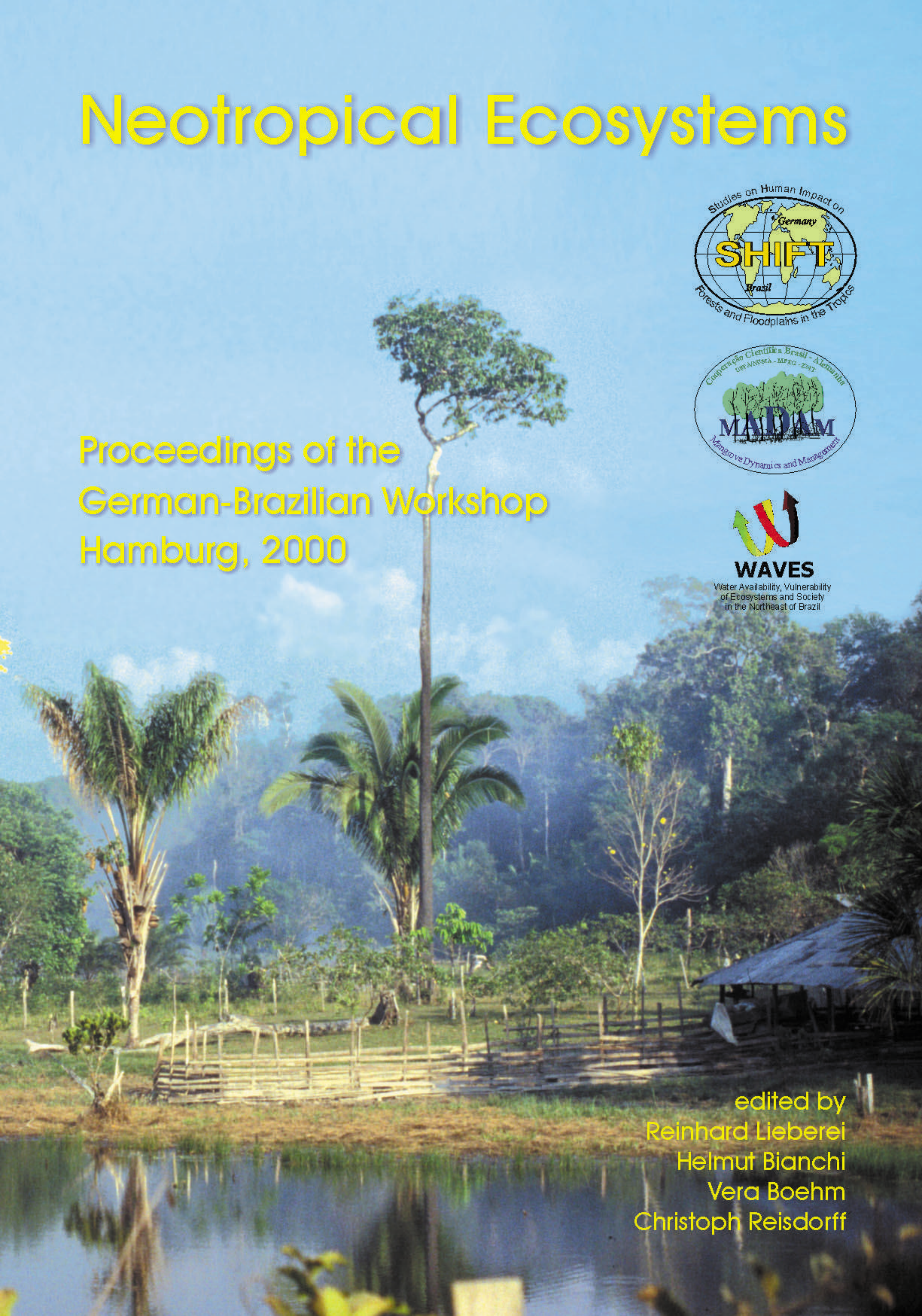

Studies on Human Impact on Forests and Floodplains in the Tropics

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Water Availability, Vulnerability of Ecosystems and Society in the Northeast of Brazil

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Fallow Vegetation Enrichment with Leguminous Trees in the Eastern Amazon of Brazil: Trees Performance

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The fallow periods used in slash-and-burn agriculture in the Eastern Amazon of Brazil are being shortened. As a consequence, there is insufficient time for the fallow vegetation recover vitality and build up a biogeochemical nutrient cycle. Planting trees as an enrichment of fallow vegetation can aid biomass accumulation and using leguminous trees might be advantageous due to the benefits of nitrogen fixation.

To study the capability of improvement of fallow biomass, the leguminous trees *Acacia angustissima* Kuntze, *Clitoria racemosa* G. Don, *Sclerolobium paniculatum* Vogel, *Inga edulis* Mart. and *Acacia mangium* Willd. were planted during the agricultural period at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m, with the exception of *S. paniculatum* which was planted only in 2 m x 1 m to enrich the later fallow. The trees were planted replacing maize (June 1995) and four months after cassava had been planted (February 1995). Trees and cassava grew together for eight months until the cassava be harvested (February 1996). After the last cassava weeding (between October-November 1996) the fallow vegetation started to grow as an enriched fallow. To evaluated the silvicultural performance of trees, the height was measured every 2 months up to 12 months of age and again after 18 and 24 months. The diameter at breast height at 1.3 m (Dbh) was taken only when the trees had a diameter of at least 1 cm.

The values of tree survival at 24 months of age were as follows: *C. racemosa* (99%), *A. angustissima* (98%), *I. edulis* (97%), *A. mangium* (91%) and *S. paniculatum* (90%). At 24 months of age trees planted to enrich fallow vegetation showed different behaviors relating to height- and Dbh growth. *A. mangium* presented the best performance (7.1 m height and 5.6 cm Dbh) followed by I. edulis (4.7 m and 3.5 cm), *A. angustissima* (4.5 m and 3.2 cm) and *C. racemosa* (3.4 m and 3.0 cm). Plant spacing did not influence growth in height, but caused significant impacts on growth in Dbh. The lowest value was observed at the spacing of 1 m x 1 m (3.2 cm) followed by 2 m x 1 m (3.9 cm) and 2 m x 2 m (4.3 cm). The monthly dynamics of tree growth, evaluated by average height increment - MHI during the study period, showed the same tendency for species planted and for studied spacing. The interpretation of these growth dynamics demonstrates the existence of the following phases of tree development: "adaptation", "growth explosion", "competition" and "stability". Based on the average of monthly growth in height the trees studied were ranked as: *A. mangium* was considered as of fast growth (32 cm $month^{-1}$), followed by *S. paniculatum* (22 cm $month^{-1}$), *I. edulis* (22 cm month-1), and *A. angustissima* (17 cm $month^{-1}$) were classified as of intermediary growth and *C. racemosa* (11 cm $month^{-1}$) as of slow growth.

Litterfall and Litter in Enriched Fallow Vegetation with Fast Growing Trees in the Eastern Amazon of Brazil

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Litterfall is the main process of transferring organic matter and nutrients accumulated from standing aboveground tree biomass to the soil. Therefore, its quantification can aid in understanding the biomass dynamics of an ecosystem. In the present study, this parameter was estimated in improved fallow vegetation biomass with the leguminous trees *Acacia angustissima* Kuntze, *Clitoria racemosa* G. Don, *Inga edulis* Mart. and *Acacia mangium* Willd. All trees were planted during the agricultural period at spacing of 1m x 1m, 2m x 1m and 2m x 2m. The trees replaced maize (June 1995) four months after cassava had been planted (February 1995). Trees and cassava grew together for eight months until the cassava be harvested (February 1996). The litterfall were studied from April 1996 to April 1997 considering planted trees and natural fallow. The existing litter biomass at the beginning and end of the period of litterfall collection was also estimated.

A clear seasonal pattern of litterfall was observed for all species and spacing of planting. The greatest intensity of litterfall was registered during the period of lowest precipitation and the lowest litterfall values coincided with the rainy period. Annual accumulated litterfall biomass was dependent of species and spacement. The largest accumulation provided by I. edulis planted at the spacing 1m x 1m was 2.3 times larger than the control, whereas the lowest (*C. racemosa* planted at 2m x 1m) production was only 1.15 times more than the control. The litter biomass ratio between planted leguminous trees and the associated fallow vegetation varied from 3:1 for systems with *A. angustissima, I. edulis* and *A. mangium*, and 1:1 for *C. racemosa*. Two distinct patterns of litter decomposition could be identified. *A. angustissima* and *I. edulis* showed a decrease of litter decomposition with increase of planting density, whereas *C. racemosa* and *A. mangium* presented an increase of litter decomposition increasing planting density.

Fallow Vegetation Enrichment with Leguminous Trees in the Eastern Amazon of Brazil: A Comparative Analysis of Cost with Traditional System

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In the Eastern Amazon of Brazil the fallow periods after slash-and-burn agriculture are being shortened. As a consequence, there is insufficient time for the fallow vegetation recover. Planting trees as an enrichment of fallow vegetation can improve biomass accumulation and using leguminous trees might be advantageous due to the benefits of nitrogen fixation. But the main points for enrichment of fallow vegetation are: a) what is the cost to small-holders of planting trees? and b) could the wood produced in enriched fallow represent a cash income?

The presented questions were evaluated experimentally when the leguminous trees *Acacia angustissima* Kuntze, *Clitoria racemosa* G. Don, *Inga edulis* Mart. and *Acacia mangium* Willd. were planted during the agricultural period at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m to enrich the following fallow. The trees were planted after harvesting of maize (June 1995) and four months after cassava had been planted. Trees and cassava grew together for 8 months until the cassava harvest (February 1996). After the last cassava weeding (between October-November 1996) the fallow vegetation started to grow as an enriched fallow. In November 1997, the trees were cut and their biomass and volume estimated.

The economic aspect of fallow vegetation enrichment depends on the production and planting cost of leguminous trees seedlings and the income from the wood produced. A density of 10000 trees ha^{-1} produced the largest biomass, but involves the highest planting cost. According to a preliminary estimates, tree seedlings production and planting of 2500 (2 m x 2 m), 5000 (2 m x 1 m) and 10000 trees ha^{-1} (1 m x 1 m) would represent additional costs per hectare of approximately US$ 520, US$ 980 and US$ 2090, respectively, compared to the traditional system. The extend to which these costs can be lowered is difficult to envisage. Compensation may be feasible at the end if the produced wood could be sold as firewood or charcoal. A. mangium, yielded 34 t ha^{-1}, 28 t ha^{-1} and 25 t ha^{-1} of wood with diameter of more than 5 cm at the densities of 10000, 5000 and 2500 trees ha^{-1}, respectively. The thicker fraction of the wood can be utilized as construction material and for poles (fences for passion fruits or pepper). The other hand, the thinner fraction is an excellent material to be transformed to charcoal. Under these cost aspects, one might consider the alternative of choosing even wider spacing of the trees planted.