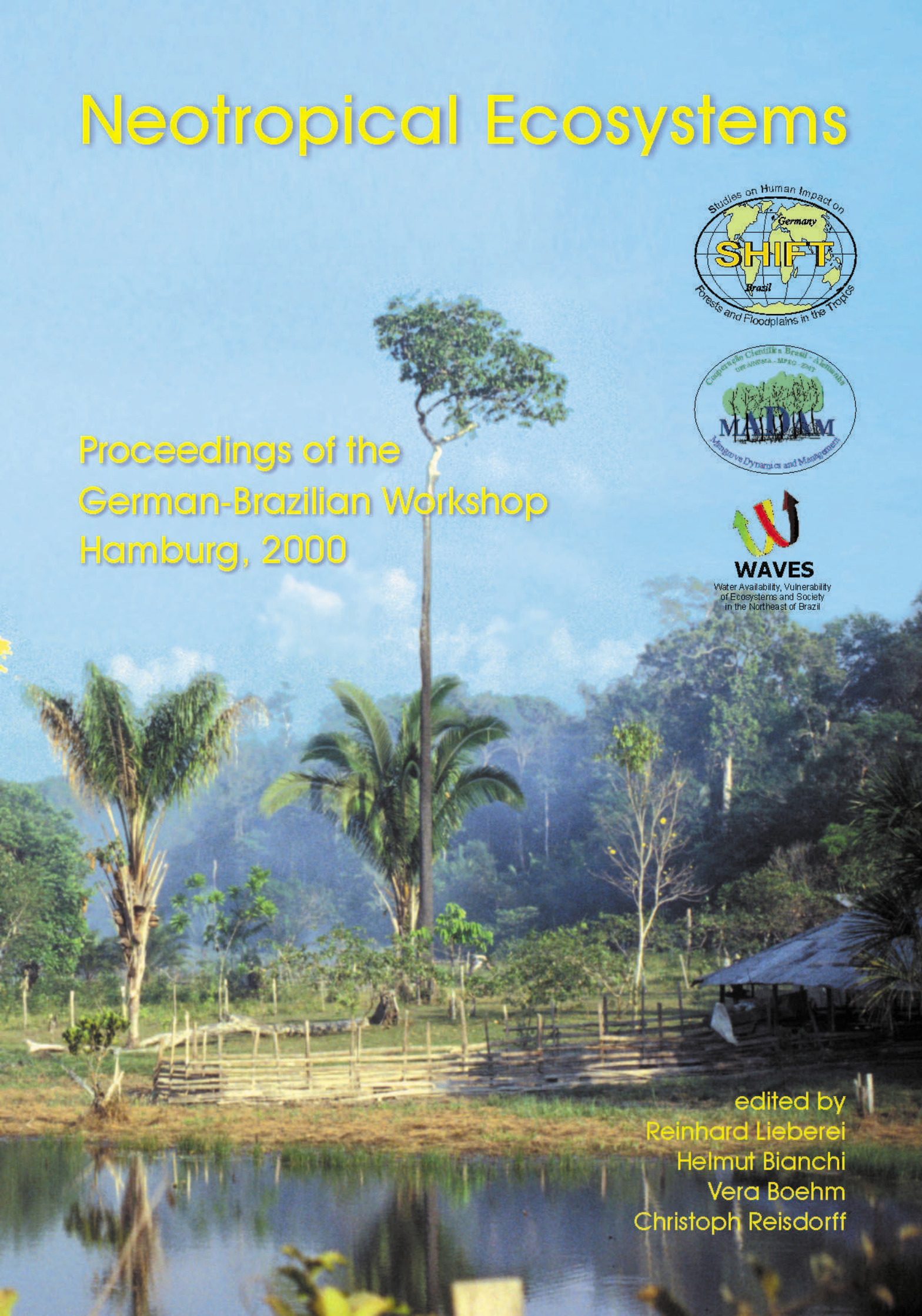
Neotropical Ecosystems



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

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

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Abstract

Litterfall is the main process of transferring organic matter and nutrients accumulated in primary production, from standing aboveground tree biomass to the soil. Its quantification can aid in understanding the nutrient and biomass dynamics of an ecosystem. The present study shows litterfall data estimated from enriched fallow vegetation with five leguminous trees (*Acacia angustissima* Kuntze, *Clitoria racemosa* G. Don, *Inga edulis* Mart., *Acacia mangium* Willd. and *Sclerolobium paniculatum* Vogel) in the Eastern Amazon of Brazil. A clear seasonal pattern of litterfall was observed during the period studied. For all species, the greatest intensity of litterfall was registered during the period of lowest precipitation. The greatest fall intensity occurs at the spacing of 1 m x 1 m, followed by 2 m x 1 m, 2 m x 2 m and the control, and the annual accumulated litterfall biomass was dependent of species and spacement.

Keywords

Fallow vegetation, Leguminous trees, Amazon region, Fallow enrichment, Litterfall.

1 Introduction

In a forest ecosystem, the returns of organic matter and nutrients from vegetation to the soil can occur in the following manner: i) litterfall (leaves, branches and logs); ii) decomposition and root nutrient exudation; and iii) rain wash from standing vegetation (NYE, 1961). Litterfall is the main process of transferring organic matter and nutrients accumulated in primary production, from standing aboveground tree biomass to the soil (VITOUSEK, 1984; SZOTT et al., 1991). Therefore, its quantification can aid in understanding the nutrient and biomass dynamics of an ecosystem. In the present study, the litterfall was estimated in enriched fallow vegetation in the Eastern Amazon of Brazil.

2 Material and Methods

The enrichment of fallow biomass, conserving the fallow vegetation as a base for biodiversity and keeping the short fallow time, was studied in the Eastern Amazon of Brazilian based on a traditional slash-and-burn system of maize (cultivar BR 106, planted in January 1995 at 1.0 m x 0.5 m; SOUZA et al., 1999) and cassava (cultivar "olho verde", planted in February 1995 at 1 m x 1 m). Using experimental plots of 10 m x 8 m in four randomized blocks, the leguminous trees *Acacia angustissima Kuntze, Clitoria racemosa* G. Don*, Inga edulis Mart.* and *Acacia mangium Willd.* were planted after maize harvest (June 1995) and four months after cassava had been planted (February 1995) at spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m. 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. The litterfall were studied from April 1996 to April 1997 considering planted trees and natural fallow. Biomass of leaves, branches, flowers and fruits collected inside the boxes (50 cm x 50 cm) placed 10 cm of above the soil surface, was considered litterfall.

3 Results/Discussion/Conclusions

A clear seasonal pattern of litterfall was observed during the period studied. For all species, the greatest intensity of litterfall was registered during the period of lowest precipitation (from September to December) and the lowest values coincided with the rainy period (from January to August). Under the conditions of the present study, the following phenological characteristics of trees planted for fallow vegetation enrichment were observed during the period of low precipitation:

a) *Acacia angustissima*: among the species studied, it is the one that possesses the smallest leaflet size. From the beginning to the end of the period of low rainfall, this species exhibited a gradually of decreasing litterfall until the complete absence of leaves. Its branches were visible at the end of the dry season. At the first rain, its leaves quickly started to re-growth. This species was in its flowering

process at 12 months of age (July-96) and fructification ended in December-96;

b) *Clitoria racemosa*: under isolated conditions it shows a large canopy. However, in the present study this species did not develop a dense canopy, even with the spacing of 2 m x 2 m, where theoretically it would better be able to express its natural form. This species also gradually lost all its leaves during the driest period. Fast new leave development was observed after the first rainfall;

c) *Inga edulis*: this species has large leaves. Its canopy is generally ramified and broad under natural conditions. In the experiment, planting in open spaces and in lines with in the fallow vegetation stimulated its apical development. This species also lost its leaves gradually until its complete absence during the driest period. Fast leave growths occurred after the first rainfall; and

d) *Acacia mangium*: this species has a typical forest form and strong apical dominance. Unlike the other species studied, it did not completely lose its leaves during the dry period. Its canopy always remained green.

Thus, besides precipitation, litterfall also reflected different physiological characteristics of the species studied (deciduous or semi-deciduous species).

The greatest fall intensity occurs at the spacing of 1 m x 1 m, followed by 2 m x 1 m, 2 m x 2 m and the control, and the annual accumulated litterfall biomass was dependent of species and spacement (Fig. 1). The largest litter accumulation provided by I. edulis (5037 kg ha^{-1}) planted at the spacing 1 m x 1 m was 2.3 times larger than the control (2190 kg ha^{-1}), whereas the lowest (*C. racemosa* planted at 2 m x 1 m) production was only 1.2 times more than the control.

Planting a larger number of trees per hectare implied a larger accumulated biomass of litter. But the litter biomass ratio between planted leguminous trees and the associated fallow vegetation varied between species and planting density (Tab. 1). Litter biomass of the planted trees predominated except for *C. racemosa* (45%). The species *I. edulis* and *A. mangium* were the greatest litter biomass contributors (74%). 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*. Considering only the average values of each spacing studied, regardless of leguminous trees, the result showed that as the number of trees planted per hectare decreased, the litter biomass of planted trees and fallow vegetation became similar. The biomass rates of planted trees and fallow vegetation was 4.6-to-1, 2.3-to-1 and 1-to-1 respectively at the densities of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m (Tab. 1).

The observation that at a planting density of 2 m x 2 m (2500 trees ha^{-1}), practically 50% of produced biomass came from planted trees, is important information in the search for enrichment systems that minimize possible negative impacts on fallow vegetation biodiversity.

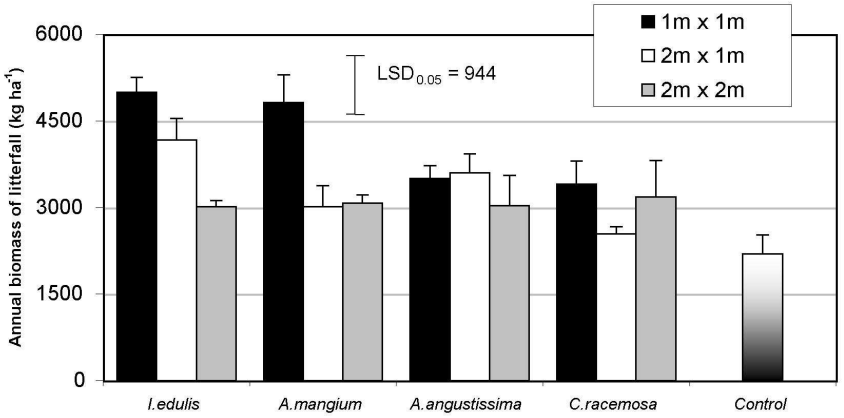

Fig. 1: Annual accumulated litterfall and standard errors of control and leguminous trees *A. angustissima, C. racemosa, I. edulis* and *A. mangium* planted at the spacing 1m x 1m, 2m x 1m and 2m x 2m (n=4)

Enriched	Plant Density			Trees Species			
System	(trees ha^{-1})			*Acacia*	*Clitoria*	*Inga*	*Acacia*
Component	10000	5000	2500	*angustissima*	*racemosa*	*edulis*	*mangium*
Natural Fallow	17.2 c	29.1 b	47.3 a	22.4 b	50.6 a	25.9 b	25.9 b
SE	(± 2.4)	(± 3.4)	(± 4.9)	(± 3.1)	(± 5.8)	(± 4.7)	(± 4.5)
CV (%)	56.8	47.3	42.2	47.5	40.2	63.1	61.4
Legume	79.7 a	66.7 b	47.1 c	63.9 b	44.5 c	73.9 a	73.7 a
SE	(± 3.5)	(± 3.8)	(± 4.9)	(± 2.9)	(± 6.2)	(± 5.3)	(± 5.1)
CV (%)	18.0	22.8	41.7	16.0	48.9	24.9	23.5
Others	3.1	4.2	5.6	13.7	4.9	0.2	0.4

Data followed by the same letter and located in the same group (natural fallow and legume) are not statistically different ($p<0.0001$)

Tab. 1: Percentage of total accumulated litterfall biomass (kg ha-1) fractionated in fallow vegetation; planted trees (*A. angustissima, C. racemosa, I. edulis* and *A. mangium*; spacing of 1 m x 1 m, 2 m x 1 m and 2 m x 2 m) and others (flowers, fruits, seeds and branches) (SE = standard error and CV = coefficient of variation). Data followed by the same letter and located in the same group (natural fallow and legume) are not statistically different ($p<0.0001$)

4 References

SOUZA, F.R.S. DE; VELOSO, C.A.C.; POLTRONIERI, L.S.; ARAÚJO, S.M.B. DE. 1999: Recomendações básicas para o cultivo de milho no Estado do Pará. Belém: Embrapa Amazônia Oriental, 20 p. (Embrapa Amazônia Oriental. Circular Técnica, 2).