

## CANOPY OPENNESS AND PHOTOSYNTHETIC ACTIVE RADIATION IN DIFFERENT COCOA PRODUCTION SYSTEMS IN ALTO BENI, BOLIVIA

Wiebke Niether<sup>1</sup>, Consuelo Campos<sup>3</sup>, Monika Schneider<sup>2</sup>, Gerhard Gerold<sup>1</sup>

<sup>1</sup>Department of Landscape Ecology, University of Göttingen, Göttingen, DE

<sup>2</sup>FiBL, Frick, CH

<sup>3</sup>Universidad Internacional de Andalucía, Cordoba y Sevilla, ES

Agroforestry systems are characterized by their different strata and at least one agronomic used species that grows in the shadow of one or several tree species. In this kind of systems light is usually a limiting factor. Cocoa as a tropical perennial tree species produces well under shaded and non-shaded conditions, both having their advantages and disadvantages in terms of production, ecology, and system sustainability. Shaded cocoa agroforestry systems are often described and discussed, but the fact that shade is not a steady-state but a dynamic process in natural and especially in anthropogenic systems is rarely mentioned.

The canopy above the cocoa is influenced by the selection of shade tree species and tree spacing but also by management just as pruning. Pruning is an agronomic tool for tree maintenance, flower and fruit development, and disease control. While a term of "less than 50%" of shade for cocoa is recommended in farmers manuals, this study shows that the canopy openness above the cocoa in agroforestry systems estimated by hemispherical photography with an angle of 180° varies from 24% openness before intervention to 56% openness after a drastic pruning event. Therefore, recommendations have to be interpreted within a broad range depending also on the viewpoint and methodology of estimation. Furthermore, shade trees and cocoa themselves permit growth of vegetation such as leguminous herbs depending from light input. Photosynthetic active radiation was measured below the cocoa layer before and after the pruning showing variations for possible photosynthetic activity of soil covering vegetation in cocoa monocultures and agroforestry systems.

Species selection influences shading since some tropical species are leaf shedding during dry seasons, or have different shape of crown and canopy density. Description of the shading properties of seven shade tree species show the different shading characteristics within the genus *Inga*, used as shade trees in tropical America.