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“Development on the margin”

Four-dimensional Agriculture: Successional Agroforestry for Ecological and Socio-economic Resilience Building

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Abstract

Successional agroforestry systems have proved to recover soil fertility and to enhance adaptation to difficult climate conditions in highly vulnerable tropical regions. This study introduces the principles of successional agroforestry and reviews surveys and ongoing research. In the humid tropics, annual cultures in slash-and-burn cultivation are one of the main reasons for deforestation and soil degradation. Annual crops in association with permanent cultures such as cocoa, coffee, fruit and timber trees are more resilient to stress factors such as heavy rains or droughts than mono-cultures. Successional agroforestry is characterised by a diversity of crops (horizontal and vertical), trees, shrubs and other naturally regenerating species of the local ecosystem taking into account the dynamic of successional processes and making use of all storeys occupying as much ecological niches as possible, similar to the natural vegetation (spatial and temporal). The combination of a high plant density and diversity provides a wide range of ecosystem services and self regulation processes. An important management aspect is pruning of the accompanying species and those who completed their production or life cycle. The pruned branches and leaves cover the soil protecting it from intense solar radiation, erosion due to heavy rainfalls and increase soil organic matter and metabolic rate of energy as well as the availability of organically bonded water. Recent research from Bolivia indicates less abundance of fruit flies (*Anastrepha* spp. and *Ceratitis capitata*) in orange production in successional agroforestry with significantly higher yields and the same sugar content, significantly more humus in soils and a deeper Ah-horizon than in comparable monocultures. A study on economic viability showed that successional agroforestry competes with monocultures with regard to the area equivalent of the respective crops, whereas the high diversity of crops decelerate economic risks and diversifies the diets of local small scale farmers. In the region Alto Beni, a long-term field trial was established in 2008 to compare organic and conventional cocoa cultivation which also includes successional agroforestry with cocoa as a primary forests' species. This is combined with on-farm research to link the biophysical research questions with farmers' perceptions and needs to implement this practice.

Keywords: Biodiversity, cocoa, organic agriculture, resilience, soil fertility