University. Although, agroforestry education is expanding very rapidly, qualitative improvement cannot be attained because of the shortage of specialists and research findings. However, it is expected that collaborative work with competent universities and research organizations across the world would help a lot to achieve the desired goal.

Shade trees and income diversification from coffee agroforestry farms: field evidence from Kodagu district, South India

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Preferred session ***A1. Multistrata agroforestry systems with perennial crops***

Abstract India contributes to 5% of the world coffee production; 80% of this is Robusta *(Coffea canephora)* and 20% is Arabica *(Coffea arabica)* grown under the shade of multi-strata systems. These coffee agroforestry systems (CAFS) are located in the Western Ghats, one of the world hotspots of biodiversity. In 2008, an economic survey was conducted on 115 farms in 34 randomly selected villages of the Kavery watershed in Kodagu, the main coffee-producing district in the Western Ghats with 1/3 of the Indian production. The objectives were: i) to estimate the cost and benefit associated with coffee cultivation across different farm sizes; ii) to estimate the economic importance of inter-crops (pepper, cardamom, arecanut) and fuelwood in CAFS,; and iii) to perform a preliminary assessment of the cost–benefit of shade management. Preliminary results indicate that cost of production is higher in medium farms (2 10 ha) than on small (<2 ha) or large farms (>10 ha). Labour (45%) and agrochemicals (17%) represent the largest expenditures. Although coffee is sold as dry cherries at the farm gate to middlemen, net income per kg of coffee is relatively high at 0.5 0.6 USD. The income to cost ratio is also high at 1.4, 1.2 and 1 for small, medium and large farms, respectively. This is due to the fact that the current Robusta price is high due to higher domestic demand (30% of the national production) and that Indian Robusta coffee benefits from a high premium on the international market due to its quality. The net income derived from intercrops accounts for 16% to 31% of farmers' revenues. As the opportunity costs of shade tree coffee cultivation are increasing due to increasing market opportunities, initiatives to improve quality, reduce risks and compensate for the loss of productivity while enhancing eco-friendly management will be difficult to achieve.

Physiological variables of growth of coffee plants in agroforestry system and monocrops

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Preferred session ***A6. Ecophysiological bases of agroforestry-system design***

Abstract Coffee is an important agricultural export commodity in the world, and the Brazil is in a leading position as the world's largest exporting producer. However, the product is quite vulnerable to market price floating. In this scenario, diversifying products can be an important strategy to keep the economic equilibrium of the property, and cultivation in agroforestry systems can be an alternative. The objective of this work was to study the analysis of growth of coffee plants in agroforestry system and monocrops. The research was conducted at ESALQ/USP, in Piracicaba-SP (Brazil). The experiment was composed of adult rubber trees and coffee plants planted in December of 2001 inside and outside rubber tree plantations. The treatments were constituted by an irradiance gradient (25, 30, 35, 40, 45, 80, 90, 95, 98, 99 and 100%), formed by coffee plant rows planted at different distances from the rubber trees: within (agroforestry system), interfacing the rubber plantation and in monocrop (full sun). The experimental design was random blocks with 11 treatments and 4 replications. The rates calculated concern a period of 30 months, taken between the first collection of data, at 8 months after planting coffee plant, and the last

collection of data, at 38 months after planting. The analysed variables were leaf area, dry matter, net assimilation rate (NAR), ratio of leaf area (LAR), specific leaf area (SLA), absolute growth rate (AGR) and relative growth rate (RGR). The growth of coffee plants increased with the solar radiation increment. However, the irradiance increment starting from 70% practically did not change the accumulation of the coffee plants' above-ground dry mass. The plants at lower availability of solar radiation had morpho-physiological changes such as, SLA and LAR, which could guarantee their survival in such conditions, however, there was quite low growth with very low dry matter.

Below -ground microbial diversity as influenced by a coffee agroforestry ecosystem in Kodagu, Western India

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Preferred session ***A1. Multistrata agroforestry systems with perennial crops***

Abstract There is increasing evidence that below-ground biodiversity is strongly influenced by the diversity of above ground biota. Soil is the habitat of a diverse array of soil organisms and vertebrate animals the activities of which contribute to the maintenance and productivity of agro-ecosystems by their influence on soil fertility. Soil micro-organisms contribute a wide range of essential services to the sustainable functions of ecosystems such as nutrient cycling, carbon sequestration, plant health etc. In coffee ecosystems, different shade managements occur. In this investigation, the effect of three different typologies/shade managements . i) coffee with one species of shade tree, ii) coffee with two different shade tree species, and iii) multi-storey coffee ecosystems with three or more shade tree species on soil micro-organisms was investigated at Kodagu region of the Western Ghats in India. Arabica and Robusta were the two coffee types under deciduous and evergreen vegetation with three types of shade typologies. Robusta significantly enhanced the actinomycete population while bacteria and fungi were not much affected by the type of coffee. Evergreen vegetation supported a higher population of actinomycetes and bacteria compared to deciduous vegetation. Amongst the three shade typologies, coffee with one shade tree, *Grevillea robusta,* increased the actinomycete population but its effect on fungi was not significant. Robusta harboured higher spore numbers of AM fungi compared to Arabica, and evergreen vegetation also supported higher numbers of AM spores and AM root colonization. Coffee plantation with *G. robusta* as single shade tree species harboured higher numbers of AM spores. The cellulose-decomposing organisms were considerably higher in Arabica coffee, and also under deciduous vegetation. Coffee with two shade tree species harboured a higher population of cellulose-decomposing micro-organisms compared to the other two typologies. Studies on nitrogen fixers, phosphate solubilizers and antagonistic organisms against plant pathogens are underway.

Development of RAMPT models for year-round diversified production in roadside, farmland, homestead and other slopeland agroforestry

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Preferred session ***A1. Multistrata agroforestry systems with perennial crops***

Abstract The necessity of improving food security, livelihoods and the environment of an overpopulated country such as Bangladesh demands judicious usage of every inch of land through sustainable multistrata produciton technologies for maximum yield compared to the existing production systems of farm and forest lands. There is also the presence of huge fallow and wastelands along the sides and slopelands of the network of roads, highways, railways, irrigation canals, embankments, farm and homestead boundaries, etc., in plainlands, and also in the riparian and hilly areas of Bangladesh. With a view to bringing these fallow lands under planned development and cultivation along with soil conservation, landscape development and environmental benefits, the three different models