

Shade: A Key Factor for Coffee Sustainability and Quality

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SUMMARY

For the last 5 years, research has been undertaken on associations of coffee and shade trees in Central America to promote coffee agroforestry systems in the region and to improve coffee farmers' incomes through diversification (timber production), production of high quality coffee and payment of incentives for environmental services in order to compensate for the low coffee prices of recent years. Field measurements have been undertaken to study and model partitioning of light, nutrients and water between coffee and trees, and impacts of shade trees on microclimate, coffee physiology and quality. Farm surveys have also been done to study farmer coffee agroforestry practices and changes in agricultural management in face of the persistent coffee crisis.

These results show that shade creates more favorable microclimatic conditions for coffee cultivation by decreasing leaf temperature of up to 4°C under sub-optimal conditions of low altitude (< 700 m) and by up to 2°C under optimal conditions (> 1100 m). Under sub-optimal conditions, the presence of shade trees reduces coffee heat stress, enhances coffee growth and productivity with an adequate shade level in the range of 20-40%. These results also show that coffee transpiration is lower under shade trees (*Eucalyptus deglupta* or *Terminalia ivorensis*) or artificial shade than in full sun.

These results demonstrate that beneficial effects of shade are not limited to sub-optimal conditions as the presence of shade improves coffee quality, irrespective of the ecological conditions, via a lengthening of the maturation period of coffee berries (up to 6 weeks under shade trees in sub-optimal conditions, and up to 3-4 weeks under artificial shade in optimal conditions). This translates into better bean filling, larger bean size, improved biochemical composition and higher cup quality. Coffee beverage from sun-grown coffee is bitter and more astringent than that from shade-grown ones. Furthermore, beverage acidity and preference are higher for coffee produced under artificial shade or timber trees compared to full sun conditions. Consequently, shade trees improve both the productivity and quality under sub-optimal conditions. Under optimal conditions, the reduction of coffee productivity (~20%) observed with shade can be economically compensated by a decrease in alternate production pattern and a premium paid for higher coffee quality.

The farm survey indicates that shade level and tree density are generally too high in coffee farms for a good compromise between an acceptable reduction in coffee productivity and a diversification of revenues from sales of timber products. Changes in farmers' practices vary according to ecological conditions and coffee prices at farm gate. In optimal conditions where

high prices are rewarding coffee quality, the farmers remain strongly focalized on producing coffee, although cutting costs without compromising too much plantation productivity. On the other hand, the role of trees is been reinforced in sub-optimal lowlands as sales of timber are representing up to 80% of coffee incomes.

These results highlight the fact that beneficial effects of shade are not limited to sub-optimal conditions and that payments for environmental services provided by coffee agroforestry systems are starting to take place in the Central America. Still, additional research is needed to model the effects of agroforestry practices on microclimate, resource partitioning, coffee physiology, productivity and quality in order to provide adequate recommendations for extension services and farmers on the selection and management of associated shade trees according to ecological conditions.