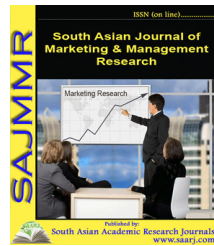




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MULTIPLE ECOLOGICAL SERVICES IN COFFEE AGRO ECOSYSTEMS ARE AFFECTED BY SHADE, ALTITUDE, AND MANAGEMENT

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ABSTRACT

Agro forestry systems contribute to farmer livelihoods and natural resource conservation by providing a variety of ecosystem services. Despite these well-known advantages, little is known about how shade trees influence the simultaneous supply of various ecosystem services, as well as possible trade-offs or synergies between them. To close this knowledge gap, we measured four major ecosystem services (pest and disease control, provisioning of agro forestry products, soil fertility maintenance, and carbon sequestration) in 69 coffee agroecosystems belonging to smallholder farmers in the Turrialba region of Cos. We next looked at bivariate connections between various ecosystem services, as well as specific ecosystem services and plant biodiversity, to see if there were any possible trade-offs or synergies. We also looked at which kinds of shade offered the best ecological benefits. The efficiency with which various kinds of shade provided ecological services was determined by how they interacted with altitude and coffee management, with different ecosystem services reacting differently to these variables. There were no trade-offs between the various ecosystem services examined or between ecosystem services and biodiversity, implying that several ecosystem services may be increased at the same time. Overall, low- and high-diversity coffee agro forestry systems were more capable of providing ecosystem services than full-sun coffee monocultures. According to our results, coffee

agroforestry systems should be planned with varied, productive shade canopies and maintained with a medium intensity of cropping techniques to ensure the ongoing supply of various ecosystem services.

KEYWORDS: *Agro Forestry, Carbon Sequestration, Coffee, Soil Fertility, Yields.*

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