Cattle production systems in Tropical Latin America are generally characterized by extensive grazing and low productivity. Traditional cattle production systems are not labor intensive (2-3 field workers/farm) and have a lower demand for labor, compared to other agricultural systems (Ruiz 2002, Gobbi and Ibrahim 2004). Environmental conditions in the Central American tropical areas are inappropriate for production models based on management of grass monocultures, because they lead to land and environmental degradation. More than 50% of established pastures are degraded, which affects livelihood of farmers; so, many small farmers are forced to sell their holdings and migrate to agricultural frontier.

In order that alternatives to extensive grazing are viable, they must fill, at least partially, the biophysical and socio-economic niche occupied by cattle in current farming systems. They should contribute to a reduction of environmental degradation and poverty at the same time as they improve and diversify farm productivity. In this respect, silvopastoral or agrosilvopastoral systems are some of the most promising holistic approaches for sustainable livestock production and may have the greatest probability of early adoption since more than 70% of cattle farmers have some experience on managing trees in their pastures (Souza et al. 1999; Villacís 2003). Silvopastoral systems can mimic forest ecosystems to some extent and are of significant value for improving farm productivity and generating environmental benefits to livestock farmers.

The Environmental Livestock Management (ELM) group in CATIE is managing several projects to evaluate the impacts of silvopastoral systems on farm productivity and biodiversity and to determine environmental benefits of these systems. This presentation will analyze how the implementation of silvopastoral systems can enhance livelihoods of farmers and rural poor. The results of the FRAGMENT project showed that socio-economic factors were key determinants in the tree cover of livestock farms. A survey conducted in the Dry Pacific Coast found that 100% of livestock farmers interviewed (n = 57) in Rivas, Nicaragua, depended on tree resources in pastures as a source of fuelwood compared to only 8% (n = 53) in Cañas, Costa Rica. In Cañas, small beef farms were characterized with higher tree densities in pastures compared to medium and large scale farms (13.91, 7.15 and 7.13 trees/ha respectively) indicating that small farmers were more dependent on tree resources to diversify farm income and to minimize risk. However, the tree cover on farms is affected by the level of intensification and management intensities; in Río Frío, Costa Rica, cattle farms which use a higher level of inputs were characterized with lower tree densities compared to those with lower inputs (13.6 vs. 26.3 trees/ha) (Villacís 2003).

The Regional Silvopastoral Project is funded by GEF (Global Environmental Facility) and is being implemented in Nicaragua, Colombia and Costa Rica. It is testing how livestock farmers will make decisions towards payment for environmental services, and is developing a methodology for payment of environmental services generated on livestock farms. Some of the working hypotheses that are being tested are: 1) Payment for environmental services will be an incentive for livestock farmers to adopt silvopastoral technologies; and 2) Intensification of livestock farms with the implementation of silvopastoral systems will generate greater income and create a greater demand for farm labor compared to traditional cattle production systems. Preliminary analysis showed that incorporating silvopastoral technologies in the farm increased milk production between 37% and 71% and the number of animals culled augmented between 11% and 53%, both in respect to farms with conventional cattle production systems. In addition, farms with silvopastoral technologies required between 34% and 106% more labor than farms with traditional cattle production systems.

More intensive systems involved a combination of trees with improved pastures, and the conversion of natural and degraded pastures to secondary forest. The use of those systems resulted in a higher total income generated on farms compared to farms that had 70% of the area on secondary forest (Table 1). Farms which

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had a higher percentage area under intensive silvopastoral systems (e.g., fodder trees and trees + improved pastures) had a higher demand for labor compared to farms with a large percentage of area under secondary forest (>60%) and those with extensive grazing systems. These results indicate that the conversion of pastures to only secondary forest will provide greater ecological benefits to farmers and communities but may have negative impacts on the livelihoods of rural poor and therefore conservation practices should be designed to improve the well being of farmers and rural poor while contributing to mitigation of environmental degradation.

### Table 1. Effect of different combinations of land use systems on total farm income/ha in Nicaragua (mean farm size 123 ha)

<table>
<thead>
<tr>
<th>Land use option</th>
<th>Natural pastures + trees (%)</th>
<th>Improved pastures - trees (%)</th>
<th>Improved pastures + trees (%)</th>
<th>Secondary forest (%)</th>
<th>Income/ha (US$)</th>
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</thead>
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<td>10</td>
<td>1593</td>
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### References


Souza de Abreu, M; Ibrahim, M; Silva de Siles. 1999. Árboles en pastizales y su influencia en la producción de pasto y leche. In: Memorias de VI Seminario internacional sobre sistemas agropecuarios sostenibles. Cali, Colombia, CIPAV. 8 p.
