Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

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Trip Report: Ecuador

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Purpose of Trip

1) Sample soils of the watershed for detailed analysis of fertility and erosion
2) Establish collaboration with INIAP scientists in area of erosion control

Sites Visited: Chimbo watershed

Description of Activities

Our team visited a range of landscapes in the watershed from 3600 meters above sea level (masl) to sea level, focusing on the principal land uses from 1800 to 3500 masl, including primary forest (or paramo), forest plantations, pasture, and annual cropping. We sampled 22 sites in total. At each site we took 3 subsamples at 4-5 depths, for a total of about 300 soil samples. In addition we sampled roots for mycorrhizal analysis, leaf tissue for foliar nutrient analysis, and measured soil resistance to penetration. Slopes averaged 60-70%. We sampled most intensively around Alto Guanujo and Chillanes. When possible we interviewed local farmers regarding trends in land use and productivity. On the last day of the visit J Lynch accompanied Paul Backman to Guayaquil, visiting low elevation cacao/plantain systems near the mouth of the watershed. Discussions were held with Eng. Franklin Valverde about collaborative training and research in soil fertility.

Conclusions

The watershed is experiencing a classic syndrome of soil resource degradation driven by uncontrolled deforestation and crop cultivation in an area of high erosion risk, without soil conservation. The high altitude soils of Alto Guanujo are fairly resistant to erosion and appear to be tolerating intensifying land use reasonably well. However, the older soils of Chillanes, many on slopes of 100% or more (i.e. a slope angle of 45 degrees or more) are suffering disastrous degradation that has already reduced productivity and will destroy the agricultural base of the central watershed within the next 2-3 decades if unchecked. Soils of this type in this environment should be minimally disturbed and covered with vegetation at all times. Rational land uses would be sustainable forestry or low impact agroforestry and silvo-pastoral systems. Instead, the region has experienced massive unregulated deforestation over the past 40 years, resulting in loss of about 80% of the original forest cover in the areas around Chillanes. Cleared land is used for crop cultivation with no regard for soil conservation methods, resulting in rapid loss of topsoil

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and soil nutrients, exposing infertile parent material or cemented horizons characteristic of volcanic soils of this region. Loss of forest and topsoil results in reduced soil water retention, more erosive runoff, and a vicious cycle of soil loss and water loss. Farmers reported to us that crop yields, which are only 5-10% of reasonable yield potential in this region, have dropped in half over the past 10 years. Fertilizer costs are growing and already account for over a third of production costs. Water has become scarcer, due to reduced water retention as well as reduced precipitation, which could be related to deforestation, which reduces transpiration and total water retention in the watershed. Our sampling confirmed this analysis, with intensive cropping being associated with reduced soil fertility and soil depth.

Soil degradation has already substantially reduced the productivity of the region and at current rates will likely reach catastrophic levels within the next 20 years, leaving unusable scrub vegetation on shallow infertile soils clinging to steep slopes in a drier, impoverished region. A number of interventions are available to reduce soil erosion that are not being used, apparently because of ignorance by farm communities. INIAP staff, including the project leader Eng. Valverde, is capable and aware of the problem but do not have funds and infrastructure for outreach/extension. Technical demonstration plots and outreach activities funded by the project could have substantial positive impact, especially if linked to autocatalytic dissemination mechanisms. More fundamental research on C retention by high altitude volcanic soils may identify opportunities for regional economic incentives for soil conservation in the long term.