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ABOUT SANREM CRSP

SANREM's mission is to assist in the analysis, creation and successful application of decision support methods, institutional innovations and local capacity approaches to support participatory sustainable agriculture and natural resource planning, management and policy analysis at local, municipal, provincial and national levels.

ABOUT THE AUTHOR

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SAVING SOIL: INTEGRATING EROSION CONTROL IN UPLAND AGRICULTURAL SYSTEMS (MINDANAO ISLAND, PHILIPPINES)

Can smallholders in developing countries afford sustainability? Can soil erosion be prevented at relatively low cost to producers? What conservation practices are most acceptable to farmers that live off the land in fragile upland environments?

These questions were explored by researchers David Midmore, Durga Poudel, and Todd Nissen through a series of on-farm trials conducted in collaboration with Philippines farmers in the context of the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program(SANREM CRSP).

They stress that efforts to prevent land degradation must focus on promoting better management practices rather than on restricting access and resource use. In their view, this approach is more likely to succeed in the long run than the top-down conversion of upland tropical areas into nature reserve and national parks that do not account for the livelihood needs of local people.

The researchers also point to the need to situate natural resource management and long-term development planning in a landscape perspective, based on an understanding of ecological and economic linkages between lowlands and highlands.

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age, but this also causes greater erosion and runoff of chemicals.

Many farmers are aware of the soil depleting effect of these crops and practices, but few fallow land, rotate crops, or invest in conservation technologies.

Corn is planted after tomatoes or potatoes and then the land is fallowed for three or four years. But fallowing is not always motivated by the desire to restore fertility. In some cases, farmers are forced to leave land uncultivated because they lack labor or capital.

BACKGROUND

As is the case with many upland ecosystems of the humid tropics, the Manupali river watershed in the Philippine island of Mindanao is plagued by population pressure and environmental stress. Mean annual rainfall is 2,470 mm and has a bimodal distribution with dry spells in July and November. Heavy rains fall at the onset of the rainy season in May and in August, while November is the driest month. Most of the soil erosion occurs due to steep slopes where forest is being cleared to grow temperate climate vegetables. Over the last 20 years, the permanent forest cover has diminished from half to one fourth of the total area, while land under corn and vegetables has grown from 20% to 40%. But average farm size is small, half of the farms are less than 3 ha, and three fourths are less than 5 ha.

Agriculture is the main source of income for at least two thirds of the population. Trade and price policies promote annual crops, such as corn and vegetables (whose management practices are highly erosive and require heavy doses of chemical inputs) compared to tree crops. In half of the farms, crops are planted up and down the slope to facilitate farm work and drainage.

Solutions that ensure financial returns, such as planting high value crops or fast-growing timber, are clearly more acceptable to farmers than taking land out of cultivation.

Measures on total suspended solids (TSS) across the watershed were significantly higher in more intensively cultivated areas and when land preparation activities are under way. Siltation, due to rainy season runoff in denuded upland areas, hampers the functioning of irrigation systems and of an important hydroelectric power generating reservoir, which only a decade after construction is half-filled with sediments.

RESEARCH FINDINGS

The SANREM scientists carried out field trials for two and a half years (seven cropping seasons) in collaboration with 12 participating farmers as well as on managed experimental plots.

Soil erosion varies with slope

The estimated rates of soil erosion under different management options by using two models (Erosion Productivity Impact Calculator and Modified Universal Soil Loss Equation) calibrated to the watershed conditions. Soil loss was found to be more severe on steeper slopes (being 4-6 times greater on 44% slopes than on 20% slopes). Loss of organic matter was greater in the upper portions of each plot, which usually produced lower yields.

Tomato associated with highest degree of erosion

Among vegetables, tomato was found to be associated with the highest degree of erosion because required tillage leaves the soil exposed and its foliage provides little protection during erosive rainfall events. For instance, soil erosion in tomato-cabbage-tomato was three times as

severe as in cabbage-tomato-cabbage. Corn provided better soil protection.

Farmer-endorsed soil conservation practices halve soil erosion rates

Implementation of conservation technologies will also be needed in conjunction with crop rotations. To identify effective and acceptable ways of preventing soil loss, a set of technologies, endorsed by 30 of about 100 surveyed farmers, were compared to planting up and down the slope. They included: planting on the contour; planting vegetables with strips of bean crosscutting the slope; and planting up and down the slope but with strips of high value hedgerow crops on the contour.

These practices were found to reduce soil erosion by half without negative impacts on crop yields. Vegetable and corn yields were highest where contour and strip treatments were used. Contour hedgerows were more effective in controlling erosion after three seasons as they became more established.

Trees and annual crops prove to be compatible

Trees can be planted in fallow land or intercropped with annual crops to provide canopy cover and retain nutrients that would otherwise be leached out. A shift from intensive vegetable production to tree crops, which are less demanding of labor and inputs, would also enable farmers to devote time and resources to other income generating activities.

The research evaluated benefits and drawbacks of intercropping trees with vegetables, particularly comparing the degree of above and below-ground competition. The performance of tree species alone was compared to mixed agro-forestry plots. The tree species intercropped with vegetables were analyzed for the effects of various planting densities, pruning practices, and supplementary fertilization treatments on trees.

Below-ground competition was minimal. In fact, intercropped trees grew twice as fast since they benefited from excess nutrients applied to vegetables. Above-ground competition for light affected crops planted in the vicinity of tree species with denser canopy cover (i.e. *Eucalyptus torreliana*), and as the trees grew. The shading effect can be managed by planting trees with sparser crowns (i.e. *Paraserianthes falcataria*), by adjusting intercrop density and geometry and by periodic pruning.

Indirect advantages of agro-forestry

While timber may not appear as profitable as vegetables on a per area basis, this is only true if one assumes that vegetable production does not decline with continuous cropping. But data from the field trials shows that productivity does decline overtime. Soil conservation and crop diversification may also offset the decline in vegetable prices if price supports are removed. As rural labor is increasingly absorbed by non-farm employment, less management-intensive agro-forestry systems appear more advantageous.

RESEARCH PRIORITIES

Targeting steeper slopes and upper field portions

Efforts must be directed to minimizing erosion and replenishing nutrients on steep slopes and upper field portions. Crop choices and planting time and applications of organic nutrient sources must be calibrated to this purpose.

Farmers identify feasible conservation practices for on-farm testing.

Testing efficacy of conservation technologies during heavy rainfall events

Conservation practices can reduce soil erosion by about half, but during highly erosive rain events the level of soil conservation effect was less than hoped for. In particular, research must explore ways of preventing scouring effects (digging into the slope) behind contour hedgerows.

Working with farmers to improve feasibility and profitability of agro-forestry

Multi-season trials show that trees and annual crops are compatible and, to some extent, mutually advantageous. Planting practices and periodic pruning can minimize competition for light between trees and vegetables. But, since pruning slows tree growth and moving vegetable rows away from trees reduces land area available to vegetables and limits nutrient access by trees, these options are likely to be less acceptable to farmers. Light competition management should rather be treated as a component of long-term farm planning rather than as a problem in need of short-term solutions.

Analyzing economic returns for different conservation technologies and intercrop mixes

Solutions that ensure financial returns, such as planting high value crops or fast-growing timber, are clearly more acceptable to farmers than taking land out of cultivation. This is particularly true if these techniques call for additional inputs of labor, as in the case of hedgerows. The effectiveness of different techniques and profitability of different crops and trees must be assessed overtime, to account for changes in growing conditions and in market demand.

This brief draws from articles by David Midmore et al. in: *Seeking Sustainability: challenges of agricultural development and environmental management in a Philippine watershed.* Edited by I. Coxhead and G. Buenavista. PCARRD, Los Banos, Laguna, 2001. PDF versions of individual articles can be downloaded from: http://www.aae.wisc.edu/sanrem-sea

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