Rev. Biol. Trop., 24 (Supl.1): 79-82, 1976

Soil conservation in Central America and Panama: current problems

by

Hugh Popenoe *

Abstract: Soil conservation measures in Central America go back to the Maya civilization, in which terracing was employed. After the Spanish conquest, plowing, livestock raising, and the succession of social and political changes all contributed to accelerate erosion. Through the past few decades, awareness of the need for soil conservation has again increased; El Salvador and Costa Rica began efforts in that direction in 1943. For sometime, the use of machinery and chemical fertilizers has masked the loss of topsoil, but under recent increases in population pressures, soil conservation measures are gaining in importance. Important agents of erosion in the tropics are heavy seasonal rains at high elevations, alternating with long dry seasons; wind erosion; and landslides after saturation of the soil during prolonged rains. Modern machinery often hastens soil removal, as do also overgrazing, deforestation and vertical crop rows. Under the present energy crisis, human labor is becoming again a significant element in crop production, and soil conservation becomes thereby more feasible and more important.

In the last few decades many people have argued for an increasing awareness and implementation of soil conservation measures. Two excellent groups have been established in Costa Rica and El Salvador for this express purpose. As early as 1943 these two countries sent agricultural specialists abroad to study soil conservation techniques. Too often, warnings have gone unheeded unless the lack of good conservation measures have resulted in dramatic changes such as the silting of dams or the destruction of waterways.

Soil conservationists were our early environmentalists. Though the modern generation thinks it has found something new in the idea that natural resources should be used judiciously and protected, soil conservationists have been preaching this gospel for years. Unfortunately, the use of cheap chemical fertilizers or machinery in agriculture has often been used to compensate for the loss of valuable topsoil which contains most of the available nutrients for crop growth.

Now, with the recent crises in energy and food, farmers are beginning to take a new look at their land. They are asking how can the cost of industrial inputs be

* Director, Center for Tropical Agriculture, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida 32611, U.S.A.

decreased without lowering crop production? How can labor be used to substitute for the rapidly escalating costs of machinery and fuel without substantially raising costs? How can food production be increased on presently used land now that the costs of opening up new lands has become so great? The soil conservationist is one of the few that has some answers to these questions.

The Maya were early practitioners of soil conservation in Central America though **Cooke** (3) contended that soil erosion was responsible for the downfall of the Classical Empire. **Lundell** (4) describes agricultural terraces used by the Maya in Belize which covered an area of approximately 400 Km^2. These terraces were held in place by walls of rough limestone blocks which varied in height from 0.5 to 3 m. Today one can still see the ancient remnants of Mayan terraces in mountain valleys of southern Mexico and eastern Guatemala.

After the Spanish conquest, land was not farmed with the same care. The many social and political upheavals resulted in less attention to the landscape as a very fragile part of the ecosystem. The introduction of the plow and livestock also accelerated erosion. **Cook** (2) studied demographic records of central Mexico after the conquest and has been able to demonstrate that towns shifted locations dramatically as the nearby soils were eroded and lost.

More recently, as Central Americans have become aware of the priceless value of their land heritage, and as density of populations increases one notes the growth of many soil conserving measures. Terraces are expanding, strip cropping is practiced more widely, windbreaks are more evident and more crops are planted on contours.

Baldwin *et al.* (1) published a soil erosion survey of Latin America in which they mapped areas according to the degree of erosion. Unfortunately, their survey was based mostly on the use of topographic maps and criteria from temperate environments. Also, much erosion is geological.

Many tropical soils respond differently to the effects of rainfall and topography than do their temperate counterparts. The older, more highly weathered soils on basic parent material (such as Oxisols) are quite resistant to erosion. The high content of iron and aluminum oxides flocculates and cements clay particles into a friable, porous, crumb structure. Infiltration rates in these soils are quite high and, consequently water runoff is not common. **Pendleton** (5) commented that the problem with many of these soils was not erosion but *undererosion*. He humorously suggested that if we could perhaps remove the senile, highly leached surface soils in many places like the Amazon Basin, the substrata might be more fertile. Many of the best soils in the tropics are those on hillsides where minimum erosion gradually removes the more leached soil, to be replaced by younger soils which are newly weathered from the parent material. However, an acceleration of this process through improper management may certainly be destructive. In contrast, several orders of tropical soils are very susceptible to erosion; most noteworthy are the Vertisols and Ultisols.

The tropical environments where erosion is most common are regions at higher elevations, with long dry seasons. These soils are often not well structured and plant growth is often limited. Consequently, heavy rains unimpeded by much vegetation may quickly strip off the surface soil, thus removing that part that is highest in organic matter and nutrients. Sheet and gully erosion are quite common in these areas. Wind erosion may also be prevalent.

In contrast, the main type of erosion in the humid tropics is usually through landslides. After several days of heavy rains, the contact plane between the soil and

parent material may become saturated. This water may then act as a lubricating film and large masses of soil may go hurtling down the mountainside. Unfortunately, little can be done to prevent this type of erosion. Dense stands of vegetation may only aggravate the situation since the tangled masses of roots may involve larger amounts of soil in the process.

Several management practices accelerate soil loss. Many workers in the tropics have said that the use of the native plow (which merely stirs the soil rather than inverting it as with the mold-board plow) has saved many hillsides from serious erosion. The use of modern tractors and plows has often hastened soil removal by breaking and inverting the protective layer of organic matter. Other agricultural practices which encourage erosion are overgrazing, deforestation and vertical crop rows (rather than contour).

Many of the methods to prevent soil erosion are well known though not adequately practiced. The use of strip cropping, contour planting, terraces, windbreaks, cover crops, mulches and reforestation provides some protection. Research is under way on types of chemical stabilization as well as plastic mulches which will help in some types of agriculture. The use of fire under some situations improves soil infiltration and may reduce runoff (**Suarez de Castro**, 6). The use of sedimentation techniques can reverse the process.

Why talk about soil conservation today when we have been talking about it for several decades with inadequate action? World food supplies have declined and agricultural inputs cost more. Much modern agriculture has relied increasingly on industrial inputs to increase productivity and, unfortunately, many times to supplant human labor. Now, many countries are turning to labor intensive agriculture to solve urban problems as well as the fact that labor is becoming more economical in a world where other forms of energy are becoming scarcer. In these times, then, soil conservation methods to maintain topsoil and reduce fertilizer costs become more necessary, and more easily achieved with human labor inputs. Maybe the time for soil conservationists has arrived once again as it did in the time of the Maya. Perhaps terraces will become as common as they are in the South Pacific. The Ifugao tribe in the Philippines alone have terraces which were begun 2,000 years ago, which now cover 400 Km^2 and would stretch half-way around the world if placed end to end.

RESUMEN

Las medidas de conservación del suelo en Centroamérica datan desde la civilización Maya, cuando se usaban las terrazas. Después de la Conquista, el arado, la ganadería y la sucesión de cambios sociales y políticos contribuyeron a acelerar la erosión. En las últimas décadas ha habido de nuevo una creciente preocupación por la necesidad de medidas de conservación del suelo; El Salvador y Costa Rica iniciaron esfuerzos en este sentido en 1943. Desde hace mucho tiempo los fertilizantes químicos y la maquinaria han disimulado la pérdida de la capa fértil superior del suelo; pero bajo el incremento reciente de presiones poblacionales, las medidas de conservación de nuevo están cobrando importancia. Son agentes importantes de la erosión en los trópicos: las fuertes lluvias estacionales que alternan con períodos largos de sequía; la erosión por el viento; y los aludes cuando el suelo está saturado después de lluvias prolongadas. Tanto la maquinaria moderna como el sobrepastoreo y los cultivos en eras verticales generalmente aceleran la

remoción del suelo. Bajo la presente crisis energética, la mano de obra humana se está convirtiendo de nuevo en un elemento significativo en la agricultura, y la conservación del suelo, consecuentemente, se torna más factible y más importante.

LITERATURE CITED

1. **Baldwin, M., C. S. Simmons, & W. F. Vanbeers**
1954. *Soil erosion survey of Latin America.* The conservation Foundation and FAO of the U.N.

2. **Cook, S. F.**
1949. *Soil erosion and population in Central Mexico. Ibero-Americana:* 34. Univ. Calif. Press, Berkeley.

3. **Cooke, C. W.**
1931. Why the Maya cities of the Peten District, Guatemala were abandoned. *J. Wash. Acad. Sci.*, 21: 283-287.

4. **Lundell, C. L.**
1940. *The 1936 Michigan-Carnegie Botanical Expedition to British Honduras. Botany of the Maya Area.* Carnegie Inst. Wash. Publ. 522, Paper XIV.

5. **Pendleton, R. C.**
1939. Soil erosion as related to land utilization in the humid tropics. *Proc. 6th Pacific. Sci. Congr.*, 4: 905-920

6. **Suárez de Castro, F.**
1957. *Las quemas como práctica agrícola y sus efectos.* Fed. Nal. de Cafeteros Col., Bol. Tec., Vol. 2, No. 18.