SOIL CONSERVATION

David Sanders
World Association of Soil and Water Conservation, Bristol, England,UK

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Contents

Summary

Soil conservation is about solving the problems of land degradation, particularly soil erosion.

Land degradation has been a problem ever since humans settled the land and started to cultivate the soil and grazed domesticated animals. At times, land degradation has become so severe that it has contributed to the decline of civilizations. Over the years, farmers devised ingenious practices and systems of land use to protect and rehabilitate their lands but most have been abandoned as population growth has placed greater pressure on the land. Modern soil conservation is largely based on research work started in the Unites States early in the twentieth century.

Soil erosion takes place when particles are detached and then transported by wind or water. Until recent years, soil erosion was seen as a physical problem and treated mainly with engineering works. Most of these were based on the use of the “contour principle”—the construction of barriers built on or near the contour. Alternatively vegetation or “biological” measures can be used. Basically, this is done by ensuring that there is sufficient vegetation, either living or dead, left on the surface to protect the soil from the effects of wind and water.

Recently, it has become appreciated that erosion is only the symptom of a deeper

problem—incorrect land use and bad management. The emphasis has therefore moved from engineering solutions to biological measures and better land management. It has also been realized that conservation projects can only succeed if the land users are fully involved in the planning and implementation of schemes. Meanwhile, the emphasis in research has moved from studies that just looked at how much soil was being lost to investigations into the effects of soil loss on soil productivity.

1. Introduction

Under natural conditions, different environments evolve which vary according to the available variety of plants and animals and the existing soil, climate and topographic conditions. These environments exist in a state of dynamic equilibrium, a state where they are usually able to adjust and recover after some unusual event such as the outbreak of a disease, a fire, or a drought. Wherever humans have settled and cultivated and grazed the land with their domesticated animals, these conditions have been upset and changed. In some places, and over time, new forms of land use have evolved which are in harmony with the soil, climate, and topography and a new, productive, and stable environment has been established. Unfortunately, this has not always been the case and over large areas of the world's surface land use systems are to be found which are not in balance. Where this is the case, various forms of land degradation are taking place.

Figure 1. Badly eroded hills in northeastern Turkey, cleared of their natural forests and heavily overgrazed

Soil conservation is about solving the problems of land degradation, particularly accelerated soil erosion. Accelerated soil erosion is a result of the operation of the physical forces of wind and water on soil, which has become vulnerable, usually because of human interference with the natural environment. For this reason, soil erosion can be viewed as a

symptom of bad land use and management.

Soil conservation is fundamentally a matter of determining a correct form of land use and management. A correct form of land use and management is one that provides a higher level, or a different form of productivity from that available in the natural state. This new form of productivity must, however, be one that must be capable of being sustained indefinitely.

Soil conservation can be defined as the combination of the appropriate land use and management practices that promotes the productive and sustainable use of soils and, in the process, minimizes soil erosion and other forms of land degradation.

2. The Past Problems of Land Degradation

The problem of land degradation is not new. In fact, soil erosion, soil salinity, and related forms of land degradation have been with us from the time when humans first domesticated animals, settled, and started to raise crops, at least 7000 years ago. At times, the problem of land degradation has become so severe that it has contributed to, if not caused, the decline of great civilizations in such places as China, Mesopotamia, Egypt, North Africa, and Greece.

Figure 2. Beautifully built terraces in Yemen carefully maintained over the centuries

Confronted with the problem of land degradation, over the centuries farmers have developed ingenious strategies and systems of land use and management to protect and rehabilitate their lands. Many of these have been very effective and the remains of some of

them can still be seen in old terracing systems in several countries, including Yemen, China, and Peru, as well as in farming systems such as shifting cultivation which is still practiced in parts of the tropics.

Great interest has been shown in these traditional soil-conservation systems in recent years and a number of studies have been conducted to find out more about them and if they can be adapted to present day conditions.

One of the more thorough of these studies was undertaken by the soil scientist Hallsworth. He concluded that modern research shows that the most effective way to control erosion is through the maintenance of soil cover and by reducing the gradient of channels and surfaces over which water flows. His study indicates that these principles have been used by farmers for centuries and have been incorporated into traditional conservation systems such as terracing, mixed cropping, mulching, and shifting cultivation. Modern research, Hallsworth claims, completely confirms the value of traditional conservation practices, some of which have been used for at least 1000 years.

But, conditions have changed considerably over the last hundred years. Population numbers have increased substantially and with this increase has come much more pressure on the land to produce more food, fiber, and fuel. At the same time, mechanization has been introduced to large areas of the world's agricultural land and the economics of farming have changed dramatically. As a result of these changes, many of the effective, traditional, conservation measures have been abandoned or neglected. Nevertheless, many fine examples of traditional conservation works can still be seen such as the carefully terraced vineyards and olive groves in Mediterranean countries and the beautifully terraced rice fields in The Philippines and China.

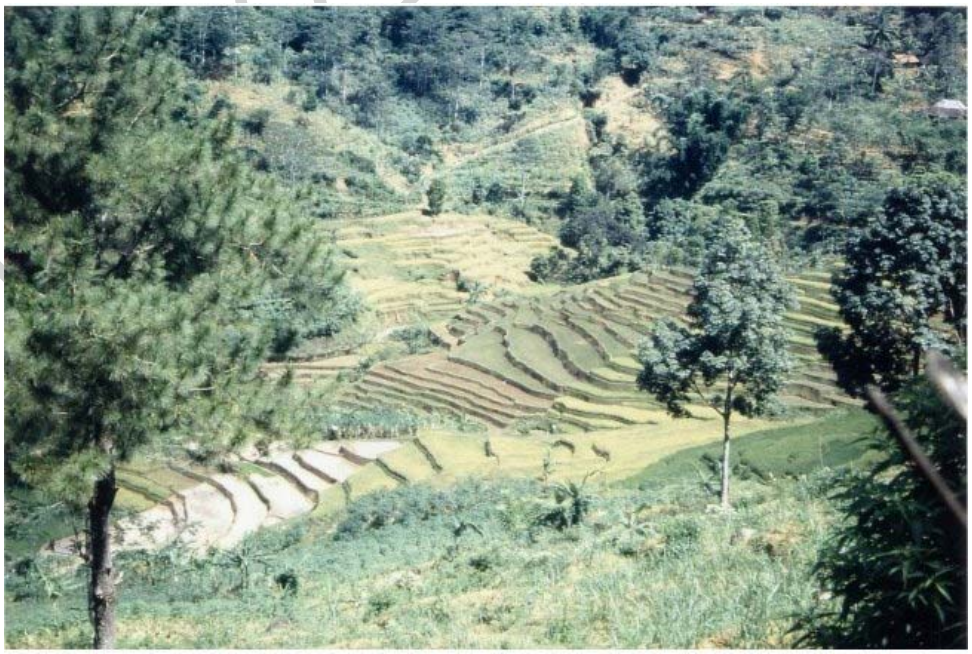

Figure 3. Steep slopes terraced and irrigated for rice growing over large areas (Java, Indonesia)

3. Modern Soil Conservation

The history of modern soil conservation as we know it today is short. Probably the first scientific investigations of erosion were those carried out by the German soil scientist Wollny between 1877 and 1895. Wollny used small plots to measure the effects of such factors as vegetation and surface mulches on the interception of rainfall and soil structure. He also looked at the effects of slope and soil type on runoff and erosion. However, the lead in erosion research has been provided by the United States of America where farmers were experimenting with mechanical conservation works as far back as the 1850s.

1907 was an important year in the history of soil conservation. In that year, the United States Department of Agriculture declared an official policy of land protection. In the same year, Iceland established what was to become the world's first soil conservation service.

In the United States, the first quantitative experiments were laid down by the Forest Service in 1915 in Utah. These were soon followed by trials in Missouri in 1917, which led in 1923 to the first published results of field plots. Other research work soon followed, stimulated by Congress allocating special funds for the purpose in 1923.

In spite of this early research work, it was some years before modern soil-conservation measures were applied in the field on a large scale. Eventually a large program was started in the United States in the 1930s. The fact that this program was started owes much to the work of an outstanding soil conservationist, Hugh Hammond Bennett, a man now regarded by many as the "father" of modern soil conservation. Early field trials and a number of surveys showed that much of the country's rich agricultural land was being badly degraded by erosion. Armed with this information, Bennett was able to convince Congress of the need to devote considerable funds to soil conservation. But there was one single event that greatly affected government and public opinion. At this time, huge areas of the Great Plains were suffering badly from wind erosion, to the extent that the area became known as the Dust Bowl. On 12 May 1934, a spectacular dust cloud swept across the country from the Great Plains to beyond the Atlantic Coast. It blotted out the sun over a large part of the nation and sifted through the windows of New York skyscrapers, bringing home to everyone the seriousness of the problem. Following this event, not only were funds allocated for soil conservation but also a soil conservation service was established to carry out a program which grew and has continued until today.

Meanwhile, soil erosion was becoming recognized as a serious problem in many countries and large-scale soil-conservation programs were launched in Africa and, a few years later, in Australia. Soil-conservation services were subsequently set up in a number of countries in Africa and in Australia, New Zealand, and India.

4. Erosion Processes and Soil-Conservation Technology

Soil erosion takes place when particles of soil are detached and then transported to a different place. The agents for this detachment and transportation are wind and water. The study of soil erosion is therefore normally divided into water erosion and wind erosion and dealt with as separate subjects. While this division may be convenient, it must be remembered that whether the erosion is by wind or water, the causes are frequently the

same, or similar, as are many of the principles of control.

Figure 4. Much of Lesotho's agricultural land has been lost through gully erosion in spite of the use of contour works.

4.1. Water Erosion

Raindrops falling on bare soil break down the structure of the surface soil and detach particles. If the land is sloping and the water cannot be absorbed by the soil, or detained by the microtopography, the water moves off down the slope in the form of runoff, carrying dislodged particles with it.

The basic factors affecting water erosion are how prone the soil is to erode (the soil's erodibility), the intensity of the rainfall (the rainfall's erosivity), the slope of the land, and the way in which the land is used and managed.

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Biographical Sketch

David Sanders started his professional career with the Soil Conservation Authority, Victoria, Australia, before joining the Food and Agriculture Organization of the UN in 1965. While with FAO he headed the soil-conservation section for many years providing advice to governments on their soil-conservation policies and programs as well as supervising soil-conservation projects in many countries. Since retiring from FAO in 1995, David has remained actively involved in soil conservation and has served as President of the World Association of Soil and Water Conservation and as a member of the Board of the International Soil Conservation Organization. He has contributed to a number of books, written numerous papers, and has appeared regularly as a keynote speaker at international soil-conservation conferences over the years.