(Southern Soil Conservation District, 1972). After World War II districts received surplus military equipment, which was also adaptable for building terraces and installing other conservation practices. Now most of these mechanical practices are installed by contractors while the Soil Conservation Service provides the guidelines and specifications. But districts have been invaluable in providing conservation services and materials which were not yet commercially viable.

In a way the system of district and state cooperation with the federal government could produce a service that was greater than the sum of its parts. For instance, the Soil Conservation Service had the staff to develop standards for various conservation practices and modify them to fit the local area. But the state, county or districts could accelerate conservation by helping to pay for installing conservation practices or by hiring additional technical staff. In those states which chose to hire additional staff, one might walk into a field and find people paid by the federal government, the state, or the district. Yet all would be doing similar work, using similar methods.

The districts focused first on promoting soil conservation. But additional federal and state legislation continually altered and expanded their role. New federal legislation for flood control in the small upstream watersheds passed in 1954 brought involvement in watershed projects for flood control, drainage, recreation, municipal and industrial water supply, and other purposes. Districts had to adjust to be an effective force in a changed economy in the United States. While many districts remained predominantly rural, others saw small towns grow and suburbia spread onto farmlands with the accompanying problems of increased human activity and resource pressures. The information available from the Soil Conservation Service through districts, such as soils information, knowledge of flooding hazards, erosion control techniques, and a host of other information, could be valuable in helping guide residential and business development wisely. Counties might choose to require that development plans be reviewed by the districts for approval. Districts became leaders in the passage and enforcement of erosion and sediment control laws designed to reduce sedimentation from construction sites.

The districts' national organization, the National Association of Soil and Water Conservation Districts (later the National Association of Conservation Districts), suggested changes districts might make to be more effective in the changed world (National Association of Soil and Water Conservation Districts, 1966). The report of NACD's District Outlook Committee urged districts to be inclusive and to be the natural resources representative not only of agriculture but also of business, industry, recreation, and community interests. State leaders sought changes in the state conservation district law to accommodate this broadened role. Between 1966 and 1969, some 82 changes were made in state conservation district laws (Sampson, 1985). Districts became a voice in erosion and sediment control laws designed to reduce sedimentation from construction sites.

Through the years the financial contributions of state and county governments grew. From 1973 to 1983, state appropriations for conservation districts programs doubled from $42 million to $96 million. By 1992, the appropriations from state and local sources amounted to about $493,000,000. Sources other than federal funds provide for 7,000 employees, about the same number as the SCS people in field offices. About one-half of the district employees are secretarial; thus SCS is providing a larger portion of the technical staff. In a few states, staff funded from state and local sources outnumbered the Soil Conservation Service personnel, but these states were the exception rather than the norm (NACD, 1991).

Developments during the last two decades in Nebraska represent another step in the maturation of the conservation district ideal. Nebraska currently has 23 natural resources districts with a broad-based natural resources agenda. Since the late 19th century special districts in Nebraska proliferated as they were created for irrigation, drainage, soil conservation, watersheds, rural water development, reclamation, sanitation, mosquito control, and other purposes. By the late 1960s there were some 500 special purpose districts created to deal with resource conditions. Officials in Nebraska, especially Warren Fairchild, Executive Secretary of the Nebraska Soil and Water Conservation Commission, recognized that there were too many districts with fragmented authorities and too little funding to be effective. They were influenced by the analysis of districts made by the District Outlook Committee of the National Association of Conservation Districts. Without providing specific guidance the committee did recognize the problem of the proliferation of special districts and the need for soil conservation districts to assume greater responsibility in the changed rural world. Nebraska legislation passed in 1969 called for natural resources districts to commence operations in 1972. Nebraska consolidated 154 special purpose resource districts into 24 natural resource districts in 1972 (Jenkins, 1975).

After 20 years some of the advantages of the Nebraska plan are obvious. One is the financial base. The legislation provided that districts be funded from the property tax. Statewide, districts received about one percent of the property taxes paid in the state. This contrasts with the "standard law" which did not recommend that districts be funded from property tax. M. L. Wilson believed such a provision would be the death knell of district law in state legislatures during the midst of the Depression (Glick, 1990). The assured funding makes it possible to hire a professional staff, which in turn makes the districts more effective. Since the districts are much larger than the typical soil and water conservation districts, there are some economies of scale involved and less money is spent for overhead expenses. The staff makes it possible for districts to be involved in a variety of activities and cooperative agreements with various state and local agencies, not just the Soil Conservation Service. The districts are large enough to have a voice in state government and to promote their interests. Districts which include both rural and urban areas can effectively deal with issues that connect the two such as water quality, flooding, and other issues. Since district directors are elected, there may be some fear that urban residents would dominate. But according to Steven G. Oltmans, general manager of the Papio-Missouri Natural Resources District, which includes Omaha, the urban contingent has been generous in spending the district's funds in the countryside for traditional soil and water conservation measures (Oltmans, 1992).

The natural resource districts do not see themselves as replacing the services provided by the Soil Conservation Service and duplicating the expertise SCS brings to conservation problems. Each district cannot reasonably do all the research needed and the development of methods and standards. But they can help accelerate the application of conservation practices in the countryside. The districts also worked on conservation problems outside the purview of SCS. The lack of administrative funds made the conservation district too dependent upon the Soil Conservation Service and perhaps too restricted in its natural resources agenda (Glick, 1990). The source of funding brings Nebraska natural resources districts closer to the original ideal of a district as a comprehensive resource agency for the local area. With the shrinkage in the number of farm operators and the need for districts to have a firm financial base, the consolidated districts with broadened authorities merit consideration.

Natural resource districts as they exist in Nebraska are the exception rather than the rule. The assured funding increased the influence of the local entity. For too long in their history many of the districts were allied exclusively with SCS or had little staff and funds to launch their own initiatives. The Nebraska model may not be the ideal for all of the United States, let alone the world. But it exhibits the potential of the district concept.

Summary

What might one say about the importance of districts in advancing soil and water conservation farming in the United States? What are the possibilities for using the concept elsewhere? First of all, the districts accelerated acceptance of soil conservation in the United States by making landholders feel a part of the movement. The movement was not led solely by government agencies, but also by landholders who converted friends and neighbors to the values of conservation farming. On the other side, this neighborly aspect has sometimes been a source of criticism about districts. It was difficult to make the hard choices where regulatory authorities were needed. This last issue has a paradoxical aspect. Recent federal farm legislation in the United States contains conservation requirements for farmers who receive crop support payments and other assistance from the U. S. government. But these regulatory activities should be seen as an addition to the conservation movement, not a replacement. All resource problems will not be solved through this instrument, and the need for local involvement will remain.

Within the American system of government the districts, through their national association, have influenced Congress to provide for soil and water conservation. They have been a major force in securing funds for the Soil Conservation Service. In the early history of the movement, there were a couple of times when the Soil Conservation Service might not have survived as an agency without the support of the districts. This is not to say there would have been no governmental support of soil and water conservation. But there might well not have been an agency charged to work primarily on soil and water conservation programs. Legislatively, the districts individually and through their association influenced other environmental legislation, and along with SCS they are seen as the primary delivery system to transfer legislative intent from Congress into action in the countryside. On the local level, the districts, especially in the case of Nebraska, offer a way to deal with a multitude of private and governmental agencies on a wide range of resource issues.

Any conservation advocate outside the United States should keep a few things in mind when evaluating the districts. The standard law was written with the American system of federalism in mind. Any attempt to import the system should carefully consider the cultural and governmental system of the country. Also, it should be remembered that part of the effectiveness was that in the partnership the SCS employees and the farmers were for the most part from similar backgrounds with similar values. This was a decided advantage in persuading farmers to use conservation farming techniques. Most SCS employees came from farm families and had earned college degrees in agriculture, or a related field, at the state university.

In other countries the representatives of government and local groups may not necessarily be of the same class or ethnic group. Conservation did not escape from the heritage of colonialism with a particularly appealing reputation among indigenous peoples. In some cases their recollection of "conservation" involved thoughts of the expropriation of the most valuable lands for white farmers and then the imposition of onerous rule for natives farming the poorer, steeper, more erodible lands (Stocking, 1985).

But the district concept can be an asset by involving minorities who have not been fully represented in the conservation movement. For example, attempts to work with native Americans have been was fraught with cultural misunderstanding (Kelly, 1985). During the last decade several native American tribes have formed conservation districts and are again cooperating with SCS. The fact that the district is operated by local people empowers them. Since they can assert themselves as decision-makers in the relationship, the potential exists to accomplish more than in a paternalistic relationship.

Finally, valuable as the district concept is, look at it if you will as one piece of the possible answer to conservation problems, not a panacea. The landscape of conservation is littered with too many simple answers to complicated problems.

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Bennett, Hugh, H. (1881-1960), American Soil Scientist, Soil Conservation Leader, Author

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A native of Anson County, North Carolina, Bennett graduated from the University of North Carolina at Chapel Hill in 1903, and then joined the Bureau of Soils in the U. S. Department of Agriculture. While making soil surveys in the southern United States Bennett became convinced of the threat soil erosion posed to the country's future agricultural productivity. His numerous speeches and articles soon earned him a reputation as the nation's leading advocate of soil conservation, and he was selected to head a temporary New Deal agency, the Soil Erosion Service in the Department of the Interior, in September 1933. On April 27, 1935, President Franklin D. Roosevelt signed the Soil Conservation Act which created the Soil Conservation Service (SCS) in the Department of Agriculture. Bennett set the course of the nation's soil and water conservation programs as the first chief of SCS, a position he held until November 13, 1951.

Bennett came to be regarded as the "father of soil conservation." He was significant in elevating concern about soil erosion from the level of a few disparate voices to a national movement of awareness and commitment. Soil conservation joined forestry and scenic areas as national conservation concerns. His successes are evident in federal laws for soil conservation, a federal Soil Conservation Service, professional organizations, public interests organizations committed to soil and water conservation, and increased emphasis on soil conservation in university curricula.

Bennett accomplished this task at a time when a few dedicated scientists in the Federal government became advocates for their respective causes, promoted federal legislation, and then served as heads of federal agencies they had virtually created. Gifford Pinchot's advocacy of forest conservation and Harvey W. Wiley's fight for pure food and drug legislation parallel Bennett's vision.

Bennett brought several attributes to the task of creating a national awareness of the menace of soil erosion. Before becoming the first head of the Soil Erosion Service, Bennett had already had a 30-year career as a soil scientist, involving extensive periods in the field observing the effects of soil erosion domestically and in several foreign countries. Gullies were obvious to the casual observer, but Bennett publicized the danger of sheet erosion, a process in which an almost imperceptible layer of soil is removed from the field. Thus, Bennett had scientific credentials and credibility to reach a national audience.

As a scientist Bennett wrote for professional journals. After commencing his crusade for soil conservation, he wrote for magazines with a wider, and sometimes more influential audience. If not as eloquent as some of the naturalist writers, he wrote clearly and with commitment about his cause. While Bennett, the publicist, recognized the need to reach the general public through the popular press, it was, nonetheless, a government publication which became his best known article, *Soil Erosion A National Menace*, USDA Circular 33. Co-authored with William R. Chapline, this piece provided a general survey of erosion conditions which was used in securing legislative support for a national program of soil conservation.

Bennett had obvious political skills and was a master at seizing the opportune moment. He successfully lobbied for funds in 1929 for a series of soil erosion experiment stations and then supervised their work. When it became obvious that there would be funds for soil conservation work, he pushed his ideas and his candidacy to head up the work. His sense of the dramatic was on display during the Senate Public Lands Committee hearings on the Soil Conservation Act in April 1935. Realizing that a great dust storm from the Great Plains was blowing eastward, he used its sky-darkening arrival to dramatize the cause of soil conservation and win approval for the legislation creating the Soil Conservation Service.

Finally the most valuable element of Bennett's character was his passion for his crusade. As a long-time colleague remarked, he loved to carry the message. He spoke with a fervor that impressed politicians on Capitol Hill, scientists at the Cosmos Club, or farmers on the courthouse square alike.

After elevating soil to a national concern and securing legislation for a permanent commitment to its conservation, Bennett made several decisions, contributions, that influenced national soil conservation programs, especially the Soil Conservation Service, for decades. He recognized the complex causes of soil erosion and insisted that numerous disciplines be involved in devising solutions. Bennett did not believe in panaceas, but thought that the solution to a complex problem should rely on the analytical contributions from several physical and biological sciences including agronomy, biology, forestry, engineering, range management, soil science, and other disciplines. SCS recruited from all these fields and then devised training courses to give the field staff broader training in a variety of disciplines. Bennett also insisted that SCS should work directly with farmers on conservation measures rather than simply disseminate information. Plans for conservation work on the farm should be designed specifically for that farm and be based on the capability of the land. The personal contact has made programs more effective and created as a source of political support for conservation programs.

The viability of soil and water conservation as national concerns was further assured by the creation of the Soil Conservation Society of America (now the Soil and Water Conservation Society) and The Friends of the Land. Though not solely responsible for either organization, Bennett was an influential founding member of both groups. The former group, made up largely of people personally involved in the field of soil conservation, published the *Journal of Soil and Water Conservation.* The latter group drew members from diverse backgrounds who were concerned with conservation issues. Friends of the Land published a well-written, at times eloquent magazine, *The Land,* whose authors came from diverse fields in business, science, literature, and other areas.

Hugh Hammond Bennett is buried in Arlington National Cemetery, Arlington, Virginia.

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He Loved to Carry the Message

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The problem of soil erosion in the 1920s and 1930s had an impact on our entire nation. But it was largely the effort of one man that brought the problem to national attention and inspired the creation of the Soil Conservation Service, an agency of the United States Department of Agriculture (USDA). That man was Hugh Hammond Bennett.

Bennett was born near Wadesboro, North Carolina, on April 15, 1881. He grew up in an area along Brown Creek where soil erosion was a constant problem for farmers. As a young man he watched his own father build terraces in the effort to reduce erosion.

After earning a degree in chemistry at the University of North Carolina at Chapel Hill in 1903, Bennett moved to Washington, D.C., to work for the USDA Bureau of Soils. Although he was hired to analyze soils in the laboratory, he soon switched to a job as a surveyor in the USDA's soil survey program. The surveys produced in the program were (and still are) used to help farmers decide which crops to grow on their farms and what fertilizers to apply.

The work of the soil surveyor in the early 1900s was indeed arduous--lugging heavy surveying equipment without the benefit of automobiles, digging hundreds of holes to collect soil samples, calling on generous farmers for a night's lodging. While going about his work in Tennessee, North Carolina, and Virginia, Bennett saw huge gullies that had been created by large-scale erosion. He also became aware of another type of erosion that was not obvious to the average observer. On some hillside fields, a thin layer of topsoil was washed away with each rain. This process he called "sheet erosion." Sheet erosion drained soil of the nutrients that enabled it to produce healthy crops. Although the erosion itself was not always obvious in the fields, its devastating effect on farm families was obvious in the homes where Bennett stayed overnight.

Bennett continued work as a soil scientist in the USDA into the 1930s. His position as head of soil surveys in the South and his writings in scientific journals and other publications brought him an international reputation. Yet he was frustrated that soil conservation was being neglected.

Clamor for forest conservation had resulted in the creation of the National Forest and National Park systems, but the need for conservation on American farmlands was ignored. Bennett decided that if no one else would make soil conservation a national issue, then he would have to do it. He began to write articles for the popular magazines of the day--not scholarly writings for his fellow scientists but articles for magazines that would arrive in the mailbox of the average American home.

Probably the most influential of Bennett's writings was a USDA publication, *Soil Erosion: A National Menace*. Bennett and his co-author, W. R. Chapline, estimated that 500 million tons of soil flowed to the sea each year. They also believed that another billion tons was deposited in locations such as reservoirs and streams. In 1928, in response to the publication, Bennett's influence, and other factors, the Congress provided money for a group of experiment stations to research the means of conserving soil on agricultural lands. It was a beginning.

The research was a valuable and necessary step, but Bennett still wanted a national plan of action. The tragedy of high unemployment that came with the Great Depression of the 1930s provided the opportunity for such a plan. On August 25, 1933, five million dollars was made available for soil conservation work. Because of his reputation as an expert in the field, Bennett was selected in September 1933 to head the newly established Soil Erosion Service. He decided to start a series of demonstration projects on some of the nation's most eroded farmlands. Workers from the Civilian Conservation Corps and Works Projects Administration--two programs that created jobs for the unemployed--would do much of the work. They would be aided by farmers, who also contributed labor and equipment.

Through demonstration projects, Bennett put his ideas to the test. He knew there would be no single or simple solution to soil conservation problems. Engineers, soil scientists, foresters, biologists, hydrologists, and others would all contribute to the effort, and each farm would have its own conservation plan.

Bennett also believed in using each area of land according to its soil characteristics and slope. If an area could not be used as cropland without erosion, then perhaps it should be used for pasture, or woodland, or for something else. In this way, Bennett hoped to make it possible to use the land indefinitely without damaging its ability to produce.

Bennett won another victory in his campaign on April 27, 1935, when Congress passed the Soil Conservation Act. That act established the Soil Conservation Service (SCS) with Bennett as the Chief. Bennett's demonstration projects had been successful, but it was the Dust Bowl that convinced Congress of the need for the SCS. Eastward winds blew soil from the prairie states of Kansas and Colorado all the way to the Atlantic Coast in the early 1930s, and awakened the American public to the effects of drought and wind erosion on the people of the Great Plains.

As the need arose to spread soil conservation outside the demonstration project areas, officials in the USDA decided they could best solve problems if they worked through conservation districts. Under this arrangement, the Soil Conservation Service would provide people trained in soil conservation to the conservation districts. A locally elected board of supervisors would direct the conservation programs for the area. The Brown Creek Soil Conservation District, including the Bennett family farm, became the first district to sign a cooperative agreement with SCS on August 4, 1937. Today 2,932 conservation districts around the country include more than two billion acres. More than one billion acres of this land is farmland.

Bennett continued as Chief of the SCS until November 13, 1951. He died on July 7, 1960.

Bennett's work as a soil surveyor was often solitary and his fellow workers thought him shy. But his vision and work resulted in important changes. His zeal for soil conservation led him to become a rousing, inspiring speaker to Congress, fellow workers, and the American public. As one colleague recalled, "He loved to carry the message."

Walter Lowdermilk's Journey: Forester to Land Conservationist

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This paper was given at "History of Sustained-Yield Forestry: A Symposium," at the Western Forestry Center in Portland, Oregon, on October 18-19, 1983, coordinated by the Forest History Society for the International Union of Forestry Research Organizations (IUFRO) Forest Group (S6.07). The proceedings, edited by Harold K. Steen under the same title, were published by the Forest History Society, 109 Coral Street, Santa Cruz, CA 95060 in 1984.

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Walter Clay Lowdermilk often described his profession as reading "the records which farmers, nations, and civilizations have written in the land." Few others have belonged to this profession. Certainly few had the inclination, ability, and opportunity to indulge in it as did Lowdermilk. The profession required expertise in many fields of study, but as practiced by Lowdermilk it was not a purely academic exercise. Rather he sought an ambitious objective--a permanent agriculture for the world. Through an understanding of human activities in the past and the earth's response, he hoped to "find the basis for a lasting adjustment of human populations to the Earth."[1]

Lowdermilk became a member of the early twentieth century conservation movement in the United States, a movement with a strong scientific bent.[2] The scientists held that treatment of natural resources should be in accordance with scientific principles, not propelled by emotionalism or untested theories. Lowdermilk's inquisitiveness, intellect, and foreign travel took him on an unusual professional journey. Veering from forestry, he circled the field of land conservation--a field encompassing several sciences and disciplines. In foreign travels Lowdermilk found situations where people's relationship with the land had reached a precarious balance, or an imbalance resulting in famines. Coping with these situations required an integration of knowledge from science, technology, and engineering. Other scientists in the movement had not embraced a multidisciplinary approach. The abundance of natural resources in the United States, and the low population density, had allowed scientists of his era to view solutions to resource problems as a set of discrete alternatives--a view which further entrenched their fealty to their chosen disciplines.

Walter Lowdermilk was born on July 1, 1888, in North Carolina, but spent his childhood at numerous points westward during the family's extended migration to Arizona. As a college student at the University of Arizona, he realized his dream of earning a Rhodes scholarship. The curriculum at Oxford permitted him time to study forestry in Germany. Herbert Hoover's Commission for Relief in Belgium called Lowdermilk and other young Americans in Europe to interrupt their studies. After the scholarship years, he served as a ranger in the Southwest for the Forest Service. Returning from World War I, he became the Forest Service's regional research officer in Montana.[3]

A man who enjoyed research work, he had found a position that offered satisfaction. Given his ability, there was opportunity for advancement. But he was not to remain on that career ladder. Soon he would be in China, where, he later recalled, the "full and fateful significance of soil erosion was burned into my consciousness."[4]

Through the years in England and afterward, the young forester had corresponded with Miss Inez Marks, a friend from Arizona. On leave from her missionary work with the Methodist Church in China, she agreed to meet him at the Rose Bowl, New Year's Day, 1922. Marriage plans quickly followed. Her entreaties that China desperately needed talented scientists led to his applying for a position with the University of Nanking's school of agriculture and forestry. The couple married in August and departed for China in September 1922. Lowdermilk's charge, for a small salary, was to assist in solving the flooding problems and resulting famines. Exactly how a forester was to help with food production remained a mystery as he attended university classes to learn Mandarin during the first year.[5]

An expedition to the Yellow River solved the mystery. There he stood atop a section of the 400-mile-long dike that held the river 40 to 50 feet above the flood plain. This marvel was a result of Chinese labor necessitated by silting of the river's channel--aggradation in the terms of earth scientists.

Lowdermilk set out to find the source of the silt.[6] In spring 1924, O.J. Todd, engineer of the International Famine Relief Commission, accompanied Lowdermilk on a two-thousand-mile trip on the watersheds of the Yellow and Wei rivers. Todd's mission was to study the Wei-Peh irrigation project. Few foreigners had visited the area of northwest China where the pair completed a third of the journey afoot or on mulecart or muleback. In Shensi province, they found a plateau consisting of deep, undulated deposits of loessial soils. Depth, fertility, and erodibility made these fine, wind-deposited soils prime locations for man-induced erosion. In the deforesting activities of the people Lowdermilk found the reason for the gigantic six-hundred-foot-deep gullies, "So great is the demand for fuel and wood that the mountainsides are annually shaved clean of all herbaceous shrub and tree growth."[7] Paradoxes abounded on the trip. Temple forests, reproduced naturally and protected by Buddhist priests, provided evidence of the denuded hills' capability for sustaining vegetation. Bench terraces festooned some slopes. Yet some of the best agricultural land on the level, alluvial plains was used for timber production under irrigation. Surrounding hills were little used for timber.

The pair visited Sianfu, the capital city of China during its Golden Age, where Todd wanted to inspect the irrigation works. The area retained little of its former prosperity, which Lowdermilk conjectured had flowed from a great irrigation project which was now "silted up and out of use." The forester returned to his post at the University of Nanking with an impression of "colossal erosion" contrasted with "evidences of former grandeur." Already he had decided to expand his study of the sciences involved with natural resources to include the actions of people as well. The trip had provided "abundant material for an entrancing study of man's relationship to nature."[8]

Historical research revealed that the Yellow River had changed course eight times since A.D. 11. Several times the river had been restrained by dikes only to break free. Once it emerged four hundred miles from its former outlet. Dikes, therefore, were essential to using the plain for agriculture. But building higher dikes, Lowdermilk concluded, was not a lasting solution unless the aggradation of the river was reduced by checking the supply of silt.[9] Lowdermilk's supposition that erosion caused frequent and severe flooding had been recognized in the United States, but only on the small water courses, not on the lower reaches of major rivers. The China experience--siltation of a major river channel as a cause of flooding and channel relocation--was on a scale unknown in the United States.

Lowdermilk's recommendation for flood control gave some indication of the breadth of his training in sciences, especially geology, and his ability to assimilate the findings into a solution. The Yellow River and her tributaries had excavated a deep channel into the plateau created by the wind-deposited soils. Recognizing that removal of vegetation allowed runoff to carve gullies in the loessial plain and that gully wash accounted for most of the silt, he proposed attacking erosion by planting trees on the talus slopes at the foot of the gullies. The forested gullies would be guarded and managed by villages as community forests to provide wood. Undissected portions of the loessial plateau could be used for agriculture. Where and when possible, check dams should be used to raise the base level of streams and prevent incision by the gullies farther into the plateau.[10] Treatment of the watershed was directly tied to famine prevention. He concluded that soil and water conservation were urgently necessary to increase the productivity of this region of China.[11]

Lowdermilk was not content to base his recommendations exclusively on empirical evidence. Certainly the scientific forestry school, whence he came, demanded another explanation. Using the runoff and erosion plot study method devised by F.L. Duley and M.F. Miller at the University of Missouri, he and his Chinese associates set up plots on twenty temple forests and on denuded areas for comparison. After three years of study, he presented the findings. Runoff from denuded areas greatly exceeded that of temple forests or areas reclaimed through reforestation. The main reason for the excess runoff, he believed, was that particles of soil on the denuded areas clogged the pores of the soil surface. Forest litter arrested this action.[12]

Further study convinced Lowdermilk that forty to sixty percent of the uplands in northern China had little cover to retain runoff. So great had been the rapid runoff that it had reduced evaporation and brought on a period of decreased precipitation in the area. With this argument, Lowdermilk projected a hypothesis that he would later apply to other lands. Scholars had long been presented with anomalies of twentieth century poverty contrasted with evidences of former civilizations which possessed a high degree of culture and prosperity. Some scholars, notably Ellsworth Huntington and Baron Von Richthofen, found the answer in climatic change. In the case of north China, Lowdermilk not only saw soil erosion and flooding as the reason for decline, but also claimed their effects as the reason for a climatic change.[13]

The communist uprising of March 24, 1927, in Nanking ended the Lowdermilks' stay in China. Leaving behind all possessions, they barely escaped. At the University of California, he combined study for a Ph.D. from the School of Forestry (minors in soil science and geology) with research at the California Forest Experiment Station. Here he reentered the fray over the effects of vegetative cover on runoff, erosion, and flooding. On one of his treks in China, Lowdermilk had heard the proverb, "Mountains empty--rivers gorged." He judged the application of timber management in that locale to be superior to any system he had observed in Germany.[14] The Chinese and other civilizations had recognized the value of forest cover and acted upon their observations. Scientists in the conservation movement demanded more than proverbs for proof, and the influence of forest cover on soil erosion and streamflow had been warmly debated by hydrologists, engineers, and foresters.

In the United States, the advocates of scientific forestry on public lands, who emphasized a sustained supply of forest products as the major benefit of public ownership, received support from irrigation farmers who needed an assured supply of water--water that was free of ditch-clogging silt. In their support of watershed protection they relied on observation, and were undeterred by the absence of scientific proof. Lines of inquiry into watershed treatment resulted not only from the inquisitiveness of the scientist's mind but also from these public policy questions. Legislation for forest reserves, upstream reservoirs for flood control, and comprehensive water development programs touched off research by the government agencies affected. The research results could seriously alter their project plans and budgets.[15]

Lowdermilk believed that builders of large engineering works downstream should provide for soil erosion control in the catchment areas, as a portion of the project's benefits was attributable to watershed management. The value of watershed management, however, had not been satisfactorily measured and described. A review of the literature convinced Lowdermilk that most watershed studies which tried to measure the influence of one factor on runflow were flawed. In an open setting there were too many variables which were observed, not measured. He must create a laboratory type experiment which would isolate the factors, measure them, and explain the processes.[16]

In his study of the influence of forest litter on runoff and erosion, he used rainmaking machines, soil profiles transferred to tanks, and measuring instruments of his design. In 1929, he presented the confirmation for what he and others had observed. On bared soil the raindrops splashed up muddy. As muddy water percolated into the soil profiles, "fine suspended particles were filtered out at the soil surface."[17] The thin layer thus formed reduced percolation and increased runoff. The water-absorbing capacity of forest litter had little influence on runoff. However, by keeping the water clean, the litter maintained the soil profile open to percolation. The experiments confirmed a hypothesis that Lowdermilk had first presented at the Third Pan-Pacific Science Congress in 1926 at Tokyo.

Lowdermilk did not elaborate on the implications of his research. Perhaps this omission was in keeping with the accepted method of presenting the results, but the value to soil conservation was obvious. If forest litter served not as an absorber of water, but as a buffer between the raindrop and the ground, then any vegetative land cover could be valuable for soil erosion control. Pastures, hay crops, any close growing crop, or crop residues could serve as barriers to the erosion process.

As Lowdermilk pioneered in the field of reading records written in the land and applied scientific explanations, he needed new terminology. At the Stockholm meeting he seized the occasion to introduce two terms for the conservationist's lexicon. "Accelerated erosion" arose from the "artificial disturbance of factors which controlled the development of soil profiles." In the absence of such disturbances, one could view any erosion as the "geologic norm of erosion."[18]

Back in California, Lowdermilk set about measuring the other factors in runoff and erosion that would provide a "basis for enlightened management of watershed areas."[19] Experiments focused on elements of the hydrologic cycle: precipitation, temperature, evaporation, runoff, infiltration, percolation, and transpiration. The Agricultural Appropriations Act of 1929 provided funds to U.S. Department of Agriculture agencies for erosion and runoff experiments. The research program made it possible to establish experiments on a large, isolated watershed. The San Dimas watershed of southern California provided an excellent opportunity to test the effects of watershed management on water yield. Expanding towns and citrus orchardists at the foot of the watershed had to dig increasingly deeper wells to reach underground aquifers. Whether the vegetative mantle should be burned to reduce transpiration or protected from fire for maximum ground water supplies was a matter of controversy. To demonstrate and measure the relationship of percolation to aquifer levels Lowdermilk had Civilian Conservation Corps enrollees build water spreading structures which led to a gravelly basin where the silt settled out and water percolated to the aquifers.[20]

Though Lowdermilk had devised the research plan for San Dimas and supervised the early work, he was not destined to see it to completion. Events and foreign travel again intervened to set Lowdermilk back on the path to land conservationist. When the Soil Erosion Service was established in 1933, Assistant Secretary of Agriculture Rexford Tugwell, who had toured the California experiments, insisted that Lowdermilk serve as Assistant Chief to Hugh Hammond Bennett.[21] Their personalities differed greatly, but on the matter of conserving farmland there were points of agreement. Bennett, like Lowdermilk, emphasized that conservation was not exclusively a matter of maintaining fertility on hillside soils. Lowdermilk had seen the effects on the Yellow River flood plain.

Bennett, as an inspector of soil surveys in the South, had seen the same effects on a smaller scale in flood plains of the South where sand, and eventually gravel, piled up on flood plains. Looking at the situation in strictly agricultural terms, the use of erosion-inducing farming practices on some of the least valuable lands was preempting the most valuable from food production.[22] Thus, they held the belief that conservation should be applied not just to the individual farm, but to an entire watershed.

Both men also viewed the coordinated use of vegetal and engineering measures on the individual farm as necessary for soil conservation. Lowdermilk, the forester, realized that erosion control in a country such as China with famine problems could not be achieved strictly by vegetal control. Bennett had obtained his conservation experience in the South, where the broad-based channel terrace had been invented to contend with erosion problems. He saw the limitations of engineering measures as well as their values. In Central America, he had seen coffee interplanted with bananas, plantains, and other fruit-bearing trees on steep land, where they nonetheless provided excellent erosion control.[23] As an institutional goal, the young Service would attempt to assimilate and coordinate many disciplines into its conservation program. Individually, the Service's field men working on farms should be what Lowdermilk called "land doctors," general practitioners of the conservation sciences.[24]

In addition to working with farmers on watershed-based demonstration projects in critical erosion areas, the Service had a considerable research program which Lowdermilk directed. The experiment stations established under the 1929 Agricultural Appropriations Act were already engaged in research on terracing, crop rotations, stripcropping, tillage methods, and their value to soil conservation. Lowdermilk added runoff and erosion studies that included the collection of hydrologic, climatic, physiographic, erosion history, and sedimentation data. While these fifty-year long watershed studies were to be comprehensive, particular aspects were related to debates among scientists and government agencies. The bedload studies involved the degree of sediment sorting by stream action and the amounts deposited in stream channels. In a practical way, the studies countered the accepted method of measuring erosion from a watershed by simply measuring the silt emerging at the watershed's lower end.[25]

In 1938 chance again intervened in Lowdermilk's life. As usual, he seized the opportunity. Representative Clarence Cannon suggested that a survey of the Old World could be useful in the United States' efforts toward a permanent agriculture. The trip, August 1938 to November 1939, involved more than twenty-five thousand miles of automobile travel in Europe, the Mediterranean area, and the Middle East. Here he perfected his art of reading the land for evidence of past use and misuse. Before undertaking surveys in each country, Lowdermilk consulted agriculturalists, scientists, and officials. Geologists and archaeologists were especially interested, and valuable to Lowdermilk in explaining the cultural and physical factors involved in land use. In addition to searching for soil conservation and flood prevention measures that might be imported to the United States, Lowdermilk was engaged in what he called "agricultural archaeology." Ruins of some pre-industrial civilizations indicated a prosperous agriculture, although these areas now had serious resource problems. What events brought about such conditions? What were the lessons for contemporary civilizations?[26]

Lowdermilk's land-read records of past civilizations appeared in numerous articles. Indeed, there were "Lessons From the Old World to the Americas in Land Use," as Lowdermilk titled an article in the annual report of the Smithsonian Institution. He gladly noted the cases of wise land use through centuries, but was usually obliged to find a story of deterioration.[27] The Soil Conservation Service published a summary, *Conquest of the Land Through 7,000 Years,* in 1953 and followed it with several reprintings until more than one million copies were distributed. Readers who know

Lowdermilk only through this publication have perhaps a truncated view--that of the globe-trotting chronicler of calamities awaiting civilizations that abuse their resources. He realized that a civilization's decline could not be interpreted solely on the basis of soil erosion. However, in writing the pamphlet, he embarked on a didactic mission aimed at all Americans, not just farmers. Soil fertility was a matter of concern for the farmer. Maintaining the medium for fertility--the physical body of soil resources--concerned the nation. Without it, "liberty of choice and action" was gone.[28]

World War II terminated the trip in Europe but it opened a new opportunity, a return to China. At the behest of the Chinese government, Lowdermilk undertook the dangerous journey to advise the Chinese about increasing their food supply. During the intervening years in the United States, he had continued to study the agricultural archaeology of China. While in China he bought gazetteers, local histories, which Dean R. Wickes, a Chinese language specialist, then researched for evidences of erosion problems. This research showed that in northern China, an area with a small percentage of level land, the population had increased threefold since the mid-eighteenth century. This rapid population increase sent people to the hills for firewood and arable land, without any orderly installation of engineering measures for soil conservation. Unlike areas of central and southern China, they had no elaborate bench terraces to protect farmland. The gazetteers provided accounts of clearing the slopes, removing farmland from the tax rolls as wasteland, and abandoning homes along streams due to frequent flooding.

The forester turned historian found an impressive case for the effects of erosion on agricultural productivity in the Wei-Peh irrigation system along the Wei River. Begun at least as early as 246 B.C., the system had irrigated 400,000 acres. According to Lowdermilk's research, the area became prosperous and dominated the surrounding territories. A Chinese chronicler believed the reason for prominence lay in the assured food supply: "Thereupon Kuanchung became fertile territory without bad years; whereupon Ch'in became rich and powerful and finally conquered the feudal princes." The Chinese remade the irrigation system eleven times during twenty centuries in their never-ceasing battle with silt. Piles of excavated silt thirty-five feet high lay on the canal banks in the fourteenth century. Usually they preferred digging new canals to clearing out sediment. During the eighteenth century, while the Chinese labored ceaselessly at keeping the canals open, the irrigated acreage was only one-tenth its original size. American engineers, under the direction of Lowdermilk's old traveling companion O.J. Todd, used modern equipment and reinforced concrete to rebuild the project. Even with modern equipment the problems remained, because water entering canals following heavy rains in 1931-32 measured 46 percent silt by weight. The irrigation farmer in China, like his counterpart in the Western United States, had to look to watershed protection as a source of silt-free water.[29]

Controlling erosion on the upper reaches of watersheds became a passion for Lowdermilk's generation of conservationists. They favored land cover for increased absorption and engineering works for the controlled disposal of water without erosion. The upstream reservoir on the small watersheds was an integral part of the river development--an assertion that was often contested. Proponents of the control and use of headwaters had stated their case in the publications *Little Waters* and *Headwaters: Control and Use.*[30] In the later 1940s they had another opportunity when Morris Cooke, a force behind *Little Waters,* became chairman of the President's Water Resources Policy Commission. Lowdermilk assumed chairmanship of the Committee on Standards for Basic Data. The Cooke and Lowdermilk views held sway in the committee report that emphasized a comprehensive, interdisciplinary approach. The interdependence of land and water called for watershed management which had been neglected due to "our natural endowment and relatively low population density."

Furthermore, the small watershed, the unit of watershed management preferred by the authors, was a cultural unit. The watershed unit had to be small enough so that residents understood its influence on their lives. Then they would devote the time and money needed to bring it to fruition as a community watershed. Lowdermilk's experience in semi-arid climates came through in the committee's attitude toward flood control. Where feasible, reservoirs should not be used solely to control floods, but also to store storm waters for later use.[31]

The attitude toward reservoirs and engineering works illustrated, as did other beliefs, the length of Lowdermilk's professional journey from forestry. He had come to believe that the earth had to be prepared to accept the benefits of rain. In his system of "physiographic engineering," reservoirs could be designed to perform functions other than storing water and controlling floods. For example, reservoirs could create intermediate base levels of stream cutting which reduced head cutting of tributaries. Downstream, the clear water flowing from a reservoir could excavate alluvial fill in a channel and reduce the frequency of flooding.[32]

As a man of many sciences, Lowdermilk also became a man of many reputations. Most Americans knew him from his call to heed the lessons of the Old World in conserving soil resources. Archaeologists and historians searched the physical and documentary remains of civilizations for refutation or confirmation of his land reading expertise. In the international scientific community his reputation rested on the hydrologic studies. The Chinese and Israelis recalled his humanitarian activities to increase food production.

Lowdermilk's experience in Israel illustrated that facility in physical sciences which allowed him to interpret past land use patterns also made him a master at proposing measures for increased food production. During the trip to the Middle East in 1938-1939, Lowdermilk became inspired by the efforts of urban-born European Jews to reclaim land. Upon returning to the United States, he wrote *Palestine: Land of Promise*, which proclaimed that the land could once again support a large population. After retirement from the Soil Conservation Service he worked with the Israelis to implement some of the measures outlined in the book. Many Israelis favored technical assistance for agricultural development over direct food assistance. That sentiment was concisely conveyed when Minister of Development Mordecai Bentov coined the saying, "We don't need powdered milk; we need Lowdermilk."[33] While there, Lowdermilk helped establish at Haifa a school to train conservationists, a school which later bore his name. The Lowdermilk School of Agricultural Engineering emphasized the basic sciences as preparatory to agricultural studies. Students took two years of mathematics, chemistry, physics, geology, and biology before moving on to the agricultural sciences. A job-related project in the fifth year was necessary to earn the degree.[34]

The fifth year requirement of field experience reflected the Lowdermilk experience. He believed that field work was a necessary component of research. In the Soil Conservation Service, field personnel were to be encouraged to suggest alternative ways of accomplishing conservation objectives. Field work, especially in an area such as China, where farming had been practiced for centuries, could uncover useful information. There was always the possibility that "some unheralded genius may have already found the solution to our problem, a solution in whole or in part if we know what we are looking for."[35] After all, it was in the field, on the Yellow River, that Lowdermilk's career as a land conservationist began.

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33 Conversation with Abraham Avidor, Foreign Agricultural Service, U.S. Department of Agriculture, December 2, 1983. Richard D. Siegel, Deputy Assistant Secretary, U.S. Department of Agriculture, brought this saying to my attention and Mr. Avidor, who grew up on a kibbutz and who knew Mr. Bentov supplied the details. Bentov was seeking to promote the development of agriculture and viewed the direct food assistance as an inhibiting factor. Avidor reports that the saying was quite prevalent in Israel in the 1950s.

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The Civilian Conservation Corps: Demonstrating the Value of Soil Conservation

A public works program of the depression-ridden 1930s became a godsend to Hugh Bennett in his attempt to show how land might be farmed within its capabilities.

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Most conservationists are familiar with the contributions the Civilian Conservation Corps (CCC) made to forestry and recreational projects for the established conservation agencies of the 1930s, the Forest Service and National Park Service. But other agencies or their predecessors, such as the Fish and Wildlife Service, Bureau of Reclamation, Bureau of Land Management, and Soil Conservation Service (SCS), also made use of CCC labor. For example, CCC work enabled SCS to demonstrate the value of conservation activities. The federal role in soil and water conservation, therefore, did not end after the Great Depression and the termination of emergency employment programs.

Today, the CCC is the beneficiary of a positive public reputation that has obscured the history of problems that any large organization of individuals almost necessarily has. But that is not our story for now; it is the CCC's contribution to the cause of conservation.

<u>Putting young men to work</u>
In 1932, one-fourth of America's men between the ages of 15 and 24 could not find work. Another 29 percent worked only part-time (8). Incoming president Franklin D. Roosevelt proposed on March 21, 1933, that Congress create "a civilian conservation corps to be used in simple work, not interfering with normal employment, and confining itself to forestry, the prevention of soil erosion, flood control and similar projects."

Congressional deliberations resulted in several alterations to Roosevelt's proposal, one of which held great significance for the future course of soil conservation. Major Robert Y. Stuart, chief of the Forest Service, asked that state and private land be made eligible as work areas. Otherwise, men from the East would have to be transported west of the Rocky Mountains, where 95 percent of the public domain lay (8). Stuart's argument was persuasive in part. The Act for the Relief of Unemployment allowed soil erosion control work on state and federal land, but restricted work on private land to activities already authorized under U.S. laws, such as controlling fire, disease, and pests in forests and "such work as is necessary in the public interest to control floods." The future of CCC work in soil conservation on private land henceforth depended on interpreting provisions of the act.

On the day Roosevelt signed the bill, Secretary of Agriculture Henry A. Wallace wired each governor to send a representative to Washington to discuss cooperation on forestry work. He also mentioned the flood control work and surmised that it "probably [included] control of soil erosion."

But soil conservation work was to be severely circumscribed. In April a U.S. Department of Agriculture (USDA) representative met with Roosevelt, who wanted CCC work on erosion and flood control directed to solving flooding problems over broad areas rather than benefiting an individual parcel of land. CCC Director Robert Fechner reiterated the president's reservations about work on private land to the governors in May.

Concern about the public's objections to expenditures of federal funds on private lands caused some of Roosevelt's reservations. He continued to warn Fechner about the criticism that too much work on private land would bring (3, 4). Also, Roosevelt, like many of his contemporaries, too often thought soil conservation required land use changes from cropland to woodland and was unfamiliar with the many conservation practices that could be installed on cropland with CCC labor. But he also had to heed the calls for a full share of CCC camps in those states where the acreage of public land was small. Thus, Roosevelt asked Fechner and Wallace to grant requests from midwestern states for soil erosion control camps.

Within USDA, the Forest Service administered the erosion camps similarly to its state and private forestry work. Under signed agreements with states, personnel from state agencies and land grant colleges actually operated the camps. CCC efforts followed soil erosion control guidelines established by USDA that limited work to "controlling gullies by means of soil-saving dams, forest planting and vegetation." Gradually the concept was extended to include construction of terrace outlets.

The first soil erosion control camp under Forest Service and state control opened in Clayton County, Alabama, on June 18, 1933. By September 1934, there were 161 such camps.

There the matter of the so-called soil erosion camps rested until August 25, 1933. Then Secretary of Labor Harold Ickes, also acting in his dual role as administrator of the public works, allotted $5 million for soil conservation work under the National Industrial Recovery Act of June 16, 1933. On September 19, 1933, a USDA soil scientist, Hugh Hammond Bennett, the country's acknowledged expert on soil conservation, moved to the Department of the Interior as head of the newly formed Soil Erosion Service (SES). The soil erosion camp guidelines then in effect hardly fit the SES director's notions of soil conservation.

To Bennett's thinking, erosion had to be reduced through a coordinated effort that allowed farmers to continue farming without reducing income. Land that was too steep and erodible would have to be converted to pastureland or woodland to provide groundcover throughout the year. On cultivated land a mixture of interdependent and mutually supportive structural and vegetative practices needed to be tailored to the needs of each farm and farmer. Bennett's years of observation had taught him to be wary of single-method approaches that could create new problems while mitigating existing ones.

Bennett's approach did not require drastic changes in the crops that farmers grew. But his ideas about farming land according to its capabilities did entail rearrangement of fields to follow contour lines, changes in planting methods, and use of cover crops. It would have been difficult enough to sell the new conservation farming system without asking farmers, during the depth of the Depression, to borrow money for seed, fertilizer, equipment, and labor to install terraces, waterways, and fences and to improve pastures. Furthermore, Bennett wanted to demonstrate the values of conservation on an area larger than the individual farm--demonstration projects of watershed size where the concentration of CCC labor would be ideal.

SES encountered difficulty acquiring camps, however, especially because soil conservation, in the eyes of the CCC administrators, was being attended to in USDA. Nonetheless, CCC allotted 22 camps, less than half the number requested, to SES in April 1934.

Linking the two pieces of legislation--the CCC act and employment act under which SES operated--permitted Bennett to implement his coordinated, comprehensive plans for conservation farming. Money from the public works appropriation bought the supplies, while CCC supplied the labor. The solicitor of the U.S. Department of the Interior ruled that the public works money could be used for work on private land, as proposed by Bennett. The restrictions on CCC work in soil conservation largely were reinterpreted.

Coon Valley leads the way

In May 1934, Fred Morrell, in charge of CCC work for the Forest Service, visited Coon Valley, Wisconsin, which was destined to become one of the most successful demonstration projects. There he found Ray Davis, director of the project, ready to use the "camps to further any and all parts of their program...to demonstrate proper farm management to control sheet erosion." What Bennett and Davis had in mind for Coon Valley and other areas went far beyond simply plugging gullies, planting trees, and building terrace outlets.

The Coon Valley project, characterized by the narrow, steep valleys of southwestern Wisconsin's Driftless area, illustrated how Bennett and the CCC broadened the scope of soil conservation activities. Through the winter of 1933-1934, erosion specialists on Davis' staff contacted farmers to arrange five-year cooperative agreements. Many of the agreements obligated SES to supply CCC labor as well as fertilizer, lime, and seed. Farmers agreed to follow recommendations for stripcropping, crop rotations, rearrangement of fields, and conversion of steep cropland to pasture or woodland. Alfalfa was a major element in the stripcropping. Farmers were interested in alfalfa, but the cost of seed, fertilizer, and lime to establish plantings had been a problem during the Depression (13).

Another key erosion-reducing strategy was increasing the soil's water-absorbing capacity by lengthening the crop rotation and keeping the hay in stripcropping in place longer. A typical three-year rotation had been corn, small grain, then hay (timothy and red clover). Conservationists advised farmers to follow a four- to six-year rotation of corn, small grain, and hay (alfalfa mixed with clover or timothy) for two to four years.

Grazing of woodlands had contributed to increased cropland erosion. Trampling soil and stripping groundcover reduced the forest's capacity to hold rainfall and increased erosion on fields downslope. Moreover, grazing slowed the growth of trees while providing little feed for cows. Most of the cooperative agreements provided that the woodlands would not be grazed if CCC crews fenced them off and planted seedlings where needed.

SES also tried to control gullying, especially when gullies hindered farming operations.

Streambank erosion presented another problem. While the conservation measures on cropland would ultimately reduce sediment flowing into Coon Creek, streambank erosion was still a problem. The young CCC'ers built wing dams, laid willow matting, and planted willows.

In the area of wildlife enhancement, workers established some feeding stations to carry birds through winter. But generally the schemes to increase wildlife populations were of a more enduring nature. Gullies and out-of-the-way places that could not be farmed conveniently served as prime wildlife planting areas. Some farmers agreed to plant hedges for wildlife that also served as permanent guides to contour stripcropping. Insofar as possible, trees selected for reforested areas were also ones that provided good wildlife habitat (13).

Between the fall of 1933 and June 1935, 418 of the valley's 800 farmers signed cooperative agreements. Aerial photographs revealed that long after the demonstration project closed, additional farmers began stripcropping. From Coon Valley, this practice spread during the 1940s, 1950s, and 1960s into adjacent valleys of the Driftless area (15). To James G. Lindley, head of CCC operations for Bennett, this dissemination was the "sincerest form of flattery."

The discrepancy between this program and the more restricted one operating through the states did not go unnoticed. Director Fechner certainly preferred uniformity. The Forest Service had no great enthusiasm for keeping the soil erosion camps, but to turn them over to SES would cause problems with the states. Nor was the Forest Service inclined to broaden its program to resemble Bennett's SES program. After visiting Coon

Valley, the CCC representative for the Forest Service, Fred Morrell, believed that SES was contravening the President's instructions because the "Act [CCC] is apparently a forestry Act."

SCS assumes a greater role

If Roosevelt knew, and he probably did not, that soil erosion had been interpreted so broadly, he certainly did not reprimand anyone. The President appreciated an innovative mind, initiative, and a facility for bending the rules. Bennett received a compliment rather than a scolding. Years afterward, he told and retold the story of being summoned to the White House. Roosevelt explained how he, without detailed knowledge of the program, knew Bennett and his colleagues were doing a good job because established agricultural organizations wanted to absorb the new and as yet temporary agency. According to Roosevelt's political instincts, the desire for conquest was a measure of the quality of the prey.[1]

But Roosevelt did act to unify the programs by moving SES to USDA in March 1935. Bennett and his group's impressive showing were no small part in the President's decision to support and sign the Soil Conservation Act in April 1935. Later that month the newly renamed Soil Conservation Service took over more than 150 CCC camps previously under the general supervision of the Forest Service.

As the Depression continued, SCS assumed a greater role in supervising youth work through CCC. For example, in fiscal year 1937 an average of 70,000 enrollees occupied about 440 camps. Ninety percent of the camps worked not on the watershed-based demonstration projects but in a work area whose radius encompassed about 25,000 acres. As local communities began organizing soil conservation districts and signing cooperative agreements with USDA in 1937, SCS began supplying a CCC camp to further each district's conservation program (11). During the life of CCC, SCS supervised the work of more than 800 of the 4,500 camps. Black enrollees worked in more than 100 of those camps.

The expanded camp program brought CCC crews to new farming areas with a variety of conservation problems. Nonetheless, a majority of camps were located in the prairie states and eastward, especially the areas of row crop farming in hilly areas under humid conditions. The Reconnaissance Erosion Survey of 1934 provided additional guidance on where demonstrations were most needed. The map of CCC camps under the expanded program often coincided with maps of the areas of severe erosion.

In addition to the type of work performed at Coon Valley in a dairying and general farming area, CCC crews also worked with orchardists in the Northeast. There, CCC labor was used as an inducement to get farmers to lay out orchards on the contour, build terraces and provide outlets for established orchards and, most importantly, plant cover crops (9).

An agent of change

Generally, the CCC camps and demonstration projects served as agents for agricultural change. An SCS engineer reported from Columbus, Nebraska, that "the terracing prompted by the camp is the first that has been done in this county." Southern farmers had terraced land for a long time, but feared grassed outlets and waterways as sources of weeds. Thus, camp SCS-2, a black CCC camp at Collierville, Tennessee, received compliments for convincing tenants to accept Bermudagrass outlets and pastures. The project was judged to be the best example of such work in the state. Not one farmer in the Duck Creek Demonstration Project at Lindale, Texas, used Bermudagrass for soil conservation when the project began, but there were 2,138 acres of Bermudagrass a few years later (14). During an era when fertilizer was used sparingly, if at all, on pastures, the labor and supplies available through the CCC made possible a demonstration of the importance of pasture improvement.

As Hugh Benentt's plan to work with nature involved more vegetation, especially on highly erodible areas, there was a great need for planting materials. CCC crews worked at the nurseries established in conjunction with demonstration projects. Sometimes a CCC camp worked exclusively at a larger nursery. In 1936, after taking over the Bureau of Plant Industry's erosion nurseries, SCS had 48 major nurseries, which produced 130 million trees and seedlings for the CCC work areas and demonstration projects. CCC crews took to the pastures, range, and woods in the same year and collected 664,973 pounds of native grass seed and 1,647,064 pounds of conifer and hardwood seed for nursery stock (10).

Collecting grass seed was also part of the conservation program in semiarid areas, where regeneration of rangeland for grazing often involved CCC work in seeding and fencing for grazing distribution and contour furrowing, developing springs, and building water spreaders and stock water dams for water conservation. Enrollees at Camp SCS-4 near Huron, South Dakota, for instance, spent most of their time in 1938 and 1939 building stockwater ponds. During the life of the SCS-supervised camps, enrollees built 134,167 miles of contour furrows to improve range and reduce erosion.

In areas of small, irrigated farms, work on leaky canals, overuse of water, and control of erosion on steep, irrigated slopes had to be incorporated into the program to attract cooperation. One strength of CCC and SCS leaders was their ability to recognize the need for new work and add it to the conservation program and concept.

Further west the mediterranean climate made the Pacific Coast a prime area for vineyards and orchards. As it did for orchards of the Northeast, SCS promoted contour planting and cover crops. Winter cover crops were particularly important on the Pacific Coast, where much of the rain falls during those months. On the Corralitos Creek Demonstration Project at Watsonville, California, enrollees worked on 29 miles of terraces and grade ditches and constructed 33 major outlet structures.

<u>A public land focus too</u>

CCC work on farms and ranches provided the model for future SCS work with landowners. But CCC and SCS established some of their larger, coordinated projects on federal and state lands. The Rio Grande watershed above Elephant Butte Reservoir in New Mexico included both public and private lands. The reservoir, a Bureau of Reclamation project, had a capacity of 2.6 million acre-feet of water when completed in 1917. In the fall of 1935, SCS began deploying CCC camps to work on conservation measures to slow siltation of the reservoir. By 1937 silt had reduced the reservoir capacity 20 percent.

Enrollees from seven camps worked above the dam, while those from three camps below the dam concentrated on flood control for the towns. Within a year the 10 camps built 14 large impoundment dams and 49 smaller ones for stockwater and flood control, 6 miles of fence, and 900 miles of contour furrows. They dug 123,000 feet of ditches to divert water from gully heads. To further control gullies, they built 30,000 check dams, seeded or sodded 19.6 million square yards on banks, and planted 407,000 trees (1).

Some projects combined flood control for towns with water retention for agricultural uses. Camp SCS-4-N built a 2,400-foot, wire-bound rock diversion structure across Angel Canyon to protect El Rito, New Mexico, from flooding. The water was diverted along a 20,000-foot dike, where waterspreaders carried it to cultivated land and improved pasture.

Camp SCS-25 at Safford, Arizona, developed water spreaders for water infiltration on state lands in the Gila River Valley. Camp SCS-7 at Leeds, Utah, developed levees and dikes and built flood-control devices to protect irrigation systems.

Native American CCC enrollees worked under the auspices of the U.S. Department of the Interior's Indian Service, which carried out the functions of feeding, clothing, and transporting enrollees that the U.S. Army performed for other camps. SCS developed land management plans for several reservations, including the largest SCS work area, the Navajo Project. Along with other laborers, the Indian CCC workers installed numerous measures from the reservation's conservation plan (5, 6).

Enrollees at camp SCS-7, Warrenton, Oregon, participated in a project that became internationally known to experts on coastal sand dunes. A jetty built at the mouth of the Columbia River in the late 19th century resulted in scouring of the channel bottom. The sand drifted down the coast to be driven inland by strong winds onto the overgrazed sand dunes. This combination of events caused a wide sand flat, often covered by water at high tide. CCC enrollees logged and split fire-killed timber, donated by the county, to build a picket fence along the beach. They then planted European beachgrass on the dune that formed over the picket fence. The work restored the coastal area as a popular recreational site (2, 7).

Cooperative agreements with state highway departments allowed CCC enrollees to work on roadside erosion problems. Before the close of the CCC camps, 841 miles of roadside demonstration projects were completed (12).

To be sure, not all of the ideas for conservation originated with SCS. Local communities and states brought their problems to the attention of SCS and CCC officials. When the CCC program began, the Kansas Forestry, Fish, and Game Commission announced that it wanted to construct a series of lakes in state parks with CCC labor. The commission met objections that large structures were out of the purview of the CCC by agreeing to pay for materials and design work. The Forest Service supervised the work until SCS became part of USDA. The construction of each dam required the fulltime work of a CCC camp. The camps built at least seven lakes larger than 100 acres.

CCC valuable to SCS

In retrospect, the material accomplishments of CCC activities, while important, seem less important than the educational experience for conservation. The work of the CCC crews was valuable to Bennett in proving the validity of his ideas about the benefits of concentrated conservation treatment of an entire watershed. The large-scale approach also permitted experimentation. Few of the conservationists' techniques were new, but the process of fitting them together was. The work led to the refinement and improvement of conservation measures still used today.

This experience, among both SCS staff and the enrollees, provided a trained, technical core of workers for SCS for years to come. Former enrollees joined the staff and during the early years, CCC funds provided for nearly half of the agency's workforce. In addition to contributing to the passage of the Soil Conservation Act of 1935, the CCC also was instrumental in helping the soil conservation district movement off to a healthy start. When the states began enacting soil conservation district laws in 1937, it came as no surprise to the SCS field force that the first districts were organized near CCC camp work areas.

CCC's real contribution, however, lay in proving the feasibility of conservation. The positive public attitude associated with CCC work, including soil conservation, helped to create an atmosphere in which soil conservation was regarded, at least in part, as a public responsibility.

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Coon Valley, Wisconsin: A Conservation Success Story

Prepared for a talk at the 50th Anniversary of the Coon Valley Demonstration Project, Coon Valley, Wisconsin, August 13, 1983.

by Douglas Helms
National Historian, Soil Conservation Service

The town of Coon Valley hosted a celebration yesterday to mark the 50th year of one of America's conservation success stories. Coon Valley is located in the Coon Creek watershed in southwestern Wisconsin. The picturesque valley with fields of stripcropping winding around the hillsides, offers a startling transformation from the 1930s' scene of rectangular fields with straight rows that induced soil erosion.

In 1933 a new federal agency, the Soil Erosion Service, selected Coon Creek as the first watershed in which to demonstrate the values of soil conservation measures. This agency became the Soil Conservation Service (SCS) in 1935. Under the National Industrial Recovery Act of 1933, soil erosion control was included as one means of public employment. The announcement caught the attention of a soil scientist in the U.S. Department of Agriculture, Hugh H. Bennett. For years Bennett had been making speeches and writing articles to alert Americans to the need to do something about soil erosion. After discussions between public works administrator Harold L. Ickes and Secretary of Agriculture Henry A. Wallace, Bennett became head of the Soil Erosion Service in September 1933.

Bennett had $5,000,000 to demonstrate how farmers could plan farming operations to include soil conservation for long-term productivity. He decided to select a number of erosion-prone areas for demonstrations. Through cooperation with farmers, he would demonstrate the validity of his ideas about soil conservation. In addition to the long-range value of sustained productivity, Bennett was convinced soil conserving measures would increase the farmers' incomes

To head the watershed-based demonstration projects, Bennett would appoint acquaintances who were also working on soil erosion problems. At La Crosse, Wisconsin, Raymond H. Davis was conducting research on soil conservation as superintendent of the Upper Mississippi Valley Erosion Experiment Station. Thus, Bennett wanted one of the demonstration projects in the Driftless area of narrow, fairly steep valleys where research results from the La Crosse experiment station could be tried. As the Coon Creek watershed was representative of a much larger area, the methods that proved successful could be spread throughout the unglaciated section of the Midwest.

Davis responded enthusiastically. He soon seized on the 91,000-acre Coon Creek watershed as the best location for a successful demonstration. Important in his decision was the cooperation he anticipated from farmers. They seemed to be ready for a change. A few farmers were already attempting stripcropping. The strips of hay, alternated with strips of corn, slowed the runoff of water and reduced erosion from the corn strips. But most of the area was beset by erosion problems. Gullies hindered farming. Coon Creek was subject to frequent, intense floods. Some valuable bottom land had reverted from cropland to pasture due to floods. Trout abandoned the sediment clogged stream.

That the Coon Creek farmers raised dairy and beef cattle and thus needed hay and pasture encouraged the prospect for contour stripcropping and retirement of the steeper fields to pasture. Davis wrote to Bennett, "If it were not for the diversified type of agriculture generally practiced and the relatively large areas of timber, the entire area would be a barren waste within a short time. Since most of the farmers here try to diversify their farming operations, any comprehensive erosion control program should be relatively easy of accomplishment because it would mean only a change in certain farming methods rather than a complete change in the agricultural set-up."

Initiatives by Coon Valley farmers and businessmen and officials at the University of Wisconsin led to Coon Creek's selection. Noble Clark, assistant director of the experiment station, and biologist Aldo Leopold welcomed Davis' proposal. Davis and Clark traveled to Washington, D.C., to meet with Hugh H. Bennett on October 3, 1933. On October 10, Bennett appointed Davis a regional director with authority to select a demonstration area in the Driftless area.

Enthusiastic response by Coon Valley area farmers decided the issue as to where the project would be located. In mid-October, Regional Director Davis met with 125 farmers at Coon Valley who listened to his proposal for soil conservation work. They promised to present a petition by 500 to 600 of the valley's 800 farmers requesting that the project be located at Coon Valley. Davis was pleased beyond expectation. He wrote to Bennett, "In fact, I was surprised at the way the farmers grasped the importance of such a program. They all realize the necessity of something (sic) being done....I feel that we need not worry about lack of cooperation in this particular area."

With the decision made, I. N. Knutson, Coon Valley banker, urged farmers to cooperate. Mail carrier Ben Einer notified farmers. Davis began preparing for the spring work. Aerial photographs were to be made for the farm planning. Seed, fertilizer, and equipment had to be acquired. Davis also needed specialists to visit each cooperating farmer to determine the needed work to reduce erosion. To do this work, Davis hired Herbert A. Flueck, Marvin F. Schweers, Joseph P. Schaenser, and John R. Bollinger. Others hired during the initial days were Gerald E. Ryerson as agricultural engineer and Melville H. Cohee. Aldo Leopold believed that the program could be used to increase wildlife in the area. At his suggestion, Ernest G. Holt became the biologist for the staff.

Through the winter of 1933-34, the erosion specialists contacted farmers to arrange 5-year cooperative agreements. The agreements often obligated the government to supply fertilizer, lime, and seed. Farmers agreed to follow recommendations for stripcropping, crop rotations, rearrangement of fields, and retirement of steep land to pasture or woodland. Alfalfa was a major element in the stripcropping program. Farmers were interested in alfalfa, but the cost of seed, fertilizer, and lime to establish plantings had been a problem during the Depression.

Another key element in reducing erosion was building up the water absorbing capacity of the soil by lengthening the crop rotations and keeping hay strips in place longer. A typical three year rotation on the farms had been corn--small grain--hay (timothy and red clover). Conservationists advised farmers to follow a four- to six-year rotation of corn--small grain--hay (alfalfa mixed with clover or timothy for two to four years.)

Civilian Conservation Corps enrollees and emergency employment workers were available. The town of Coon Valley rented land for a CCC camp. The young men and other workers were quite useful in a number of phases of the conservation work. They crushed the locally available limestone to provide the lime needed to establish the hay and pasture planting. Terracing required considerable labor, as did the fencing and reforestation work.

Grazing of woodland had been a contributing factor to erosion from cropland. Trampling down the ground and stripping ground cover reduced the forest's capacity to hold rainfall. Moreover, the grazing delayed tree growth while providing little feed for cows. Most of the cooperative agreements provided that the farmer would not graze the woodlands if the CCC workers fenced them off and planted seedlings where reforestation was needed.

The workers also tried to control gullies, especially where they hindered farming operations. Streambank erosion presented another problem. While the soil conservation measures would reduce sediment flowing into Coon Creek, there was still the problem of bank cutting and deposition in the stream. Wing dams, willow matting, and planting willows were the most used methods of control.

Workers also established feeding stations to carry birds through the winter. Gullies and out of the way places, not conveniently farmed, were used for wildlife plantings. Some farmers agreed to plant hedges for wildlife which also served as permanent guides to contour stripcropping. In so far as possible the trees selected for reforested areas were also ones that provided good wildlife habitat.

What then were the results? Clearly the farmers of Coon Valley came to believe stripcropping with longer crop rotations was the system of farming best suited to the area. From fall 1933 to June 1935, 418 of the valley's 800 farmers signed cooperative agreements. Others would have joined, but the Soil Conservation Service shifted new funds to other projects. Aerial photographs reveal that long after the demonstration project closed, additional farmers began stripcropping. From Coon Valley this practice spread during the 1940s, 1950s, and 1960s into adjacent valleys of the Driftless area. It is now the commonly accepted way to farm hillsides. Gradually the demonstration projects were phased out. But beginning in the late 1930s SCS provided technicians to locally authorized conservation districts to assist farmers with conservation measures.

Since Coon Valley is one of the nation's most studied watersheds, we know the effects of the conservation practices on erosion and sedimentation of streams. In a 1982 study, Stanley W. Trimble, geographer at the University of California at Los Angeles, and Steven W. Lund, U. S. Army Corps of Engineers, used earlier sedimentation studies by Vincent McKelvey and Stanford Happ in assessing the current situation. They calculated that erosion has been reduced at least 75 percent since 1934. Sediment reduction came without converting much cropland to other uses. There has been a 6 percent reduction in cropland since 1934. With less sediment flowing into Coon Valley, the trout returned as Raymond Davis had hoped and expected.

The young conservationists gained valuable experience at Coon Creek and the other 174 demonstration projects. On the cooperating farms, they tried numerous ideas. A few failed, but many are in use today. SCS people who started at Coon Valley moved on to other responsible positions. Marvin Schweers became SCS's state conservationist in Wisconsin and Herbert Flueck held the sane position in Minnesota. Gerald Ryerson and Melville Cohee eventually moved to SCS's national headquarters. Leopold's friend Ernest Holt became head of SCS's wildlife work and earned an international reputation. Numerous others took the Coon Creek experience and moved to other demonstration projects.

Coon Creek and the other projects were designed to demonstrate the value of soil conservation to farmers. In doing so, they also attracted a larger audience and contributed to the passage of the Soil Conservation Act of 1935, which made SCS a permanent agency in the U.S. Department of Agriculture.

But one need not look to legislation and landmarks for the significance of the Coon Creek project. Its heritage is available for all to see who venture that way.

Impact on Wildlife Guided SCS From Start

Reprinted from *Soil and Water Conservation News* 10, no. 9 (December 1989): 3-4.

by Douglas Helms,
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and
Billy Teels,
National Biologist, Soil Conservation Service

As Hugh Hammond Bennett went about assembling a team to start soil conservation demonstrations in late 1933, Aldo Leopold's classic *Game Management* had just been published. Its central thesis, and the central thesis of the new discipline of game management, held that "game can be restored by the creative use of the same tools which have heretofore destroyed it--axe, plow, cow, fire, and gun."

The concept fit perfectly the notion of rearranging farming operations to conserve soil. Methods for wildlife conservation could be used on the farm in conjunction with soil conservation methods.

Leopold and others had come to realize that publicly owned wildlife areas could help preserve some large predators and provide habitat for some migratory birds, but the impact of these publicly owned areas was limited. The use of the vast areas in farmland would eventually determine the nature of the nation's wildlife population. The realization that public agencies alone could not provide for healthy wildlife population was in part the foundation of Leopold's concept of a land ethic--that it was the responsibility of all land users to conserve land resources, including wildlife.

Hugh Bennett, his small staff, and a group of professors at the University of Wisconsin planned a soil conservation demonstration project for Coon Valley, Wisconsin. Leopold, then a University of Wisconsin professor, suggested that biologist Ernest Holt be hired to add wildlife considerations to project plans. In Bennett, the founder of SCS, Leopold found a ready convert who supported the integration of wildlife conservation into soil conservation programs.

Bennett, who had hunted the woods in his youth and tramped the country as a soil scientist, had reached the conclusion that wildlife was less abundant than in his youth. Bennett also had written seminal articles on the influence of erosion on vegetational change. While he did not dwell on the effects on wildlife, the impact on quality and quantity of food for wildlife was clear.

Farming had at one time benefited some varieties of wildlife. The interspersion of forests, swamps, and fields of small grains and other food crops provided the three crucial elements of survival--cover, food, and water--and actually resulted in an increase of bobwhite, cottontail rabbits, and certain nongame birds. The "edges" or zones between different vegetational types gave wildlife a variety of habitats that increased their ability to thrive.

But larger fields and the use of heavy, modern equipment reduced this variety and caused a decrease in wildlife habitat. Merging wildlife considerations with soil conservation sought to re-create these edges or zones of habitat.

Fencing of woodlands to eliminate grazing reduced erosion, improved timber production, and provided more wildlife habitat. Stripcropping, especially with hay crops and small grains, benefited wildlife. Field borders slowed water runoff and provided more edges for wildlife habitat. Biologists recommended plants with high wildlife value for badly eroded areas.

In addition to Coon Valley, other demonstration projects in North Carolina, Pennsylvania, and South Dakota employed biologists. But the discipline had little presence in USDA until a Secretary of Agriculture's memorandum in November 1935 authorized a section of Wildlife Management in SCS. By 1938, the staff nationwide had grown to 79 people.

Holt recruited such people as William Van Dersal and Edward H. Graham, who became noted experts and authors in the field. Graham's *Natural Principles of Land Use* examined the ways in which knowledge of living things could help guide land management.

Actual field work provided SCS biologists an opportunity not only to increase wildlife on the farms, but to learn new methods of wildlife enhancement. The field biologists worked with farmers and SCS field staff to incorporate wildlife considerations into farm plans. They disseminated the lessons of their practical field experience through numerous guidelines, technical bulletins, and popular articles.

With the expansion of programs and national legislation to enhance fish and wildlife, the role of biologists and the requirements made of them have changed. Rather than serving as planners who spend a great deal of time developing the wildlife section of conservation plans, they now more likely work as trainers who instruct others in how to integrate biology with the various SCS programs.

Concerns about the impacts of small watershed projects on fish and wildlife habitat increased the biologist's role in evaluating design changes to lessen adverse impacts on wildlife. The passage of the Endangered Species Act and the National Environmental Policy Act have further broadened the scope of the biologist's role.

SCS biologists are now required to have a thorough knowledge of SCS and other USDA programs to address fish and wildlife concerns. Biologists advise on policy matters and evaluate the effectiveness of measures for fish and wildlife in the Great Plains Conservation Program, Water Bank, Conservation Reserve Program, "Swampbuster," and other programs to make the job of planning easier.

Farmers and ranchers are becoming more interested in wildlife-associated recreational income. This, plus the public's growing interest in fish and wildlife, will likely result in additional programs and authorities that need the expertise provided by biologists.

Ranging Back to History

Reprinted from *Soil and Water Conservation News* 10, no. 8 (November 1989): 3-4.

by Douglas Helms,
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Today, approximately half of all ranchers cooperate with the Soil Conservation Service in developing their range management systems. From its inception, SCS has been concerned with rangeland as well as cropland.

When SCS began operations in the 1930s, it was well recognized that the effects of erosion on rangeland presented as much of a problem as the erosion on cropland. The U.S. Department of Agriculture's Forest Service had begun imposing grazing fees to try to reduce overgrazing on the rangeland under its control. Researchers in USDA, many of them in the Forest Service, had begun to examine the relationship of grass cover to flash floods and to explore the best methods of trying to establish grasses on rangelands. Erosion from rangeland was recognized as a threat to large Government-financed reservoirs for flood control and irrigation water.

By the 1930s, USDA plant explorers were being sent to discover "drought resistant" plants for the semiarid West. Concerns over the condition of rangeland led to a USDA survey in the 1930s, "The Western Range.'

The USDA bulletin "Soil Erosion: A National Menace" furthered Hugh Hammond Bennett's crusade to awaken agriculturalists to the dangers of soil erosion. His coauthor, William Ridgely Chapline, who was in charge of grazing research for the Forest Service, wrote the section on the western grazing lands.

The assignment of the young SCS range specialists was to work with ranchers to develop grazing systems that would conserve and improve the condition of rangeland. Ranchers could certainly observe changes in their range and in the mixture of plants and their vigor after heavy grazing. But the exact relationship of range to the number of cattle and the timing and the intensity of use of the range remained complex. The highly variable nature of rainfall complicated the matter. Impacts of poor or wise usage of the range on beef production would not immediately be obvious. The task of the young conservationist was to persuade ranchers that range management benefited not only the land, but also, given time and patience, the rancher.

The range specialists in SCS needed a system to promote range management that was understandable to the SCS field technicians and ranchers alike. Ranchers needed a system that would give them some indication as to when and how much the range might be grazed without causing deterioration and would allow rangeland in poor condition to improve.

Early 20th-century range specialists came to realize that intense grazing caused a change in the composition of range plants. Some plants increased, others decreased in the mixture; new plants, or invaders, appeared.

About the same time, ecologists such as Frederic Clements at the University of Nebraska were studying prairie plant communities. Clements theorized that grasslands were a community in various stages of plant succession progressing toward a climax. By applying this concept to rangeland, SCS developed range condition classes--poor, fair, good, or excellent. E. J. Dysterhusis, an SCS range scientist, applied the principles of quantitative ecology (inventorying the plant community) to the system. The variance of the existing plant community from the potential climax community determined the range condition for that site. Relic sites provided an approximation of the climax community.

Armed with this information, the range specialist could then determine the range condition for the ranchers and advise them on grazing practices that would help maintain or improve range conditions.

The range site and condition system has served SCS and the range well for several reasons. First, this system is easily understood. Second, by trying to approximate or maintain natural range conditions, it produces a plant community that is valued for many uses, such as wildlife habitat, water retention and infiltration, and erosion control.

Various specialized grazing systems have been proposed and used. However, the range site and condition classification has remained the foundation of SCS's range management assistance. Indeed, surveys between the 1930s and the present have indicated a general improvement in rangeland.

International Conservation: It's as Old as the Hills

Reprinted from *Soil and Water Conservation News* 12, no. 2 (July-August 1991): 18-19.

by Douglas Helms,
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All conservation is international in the sense that few of the methods tried, at least those that are successful, remain isolated in one region forever.

The early European migrants to North America who would make a "Nation of immigrants" brought their culture, including their agriculture. The oft-told story is that America's problems with soil erosion derived from a type of agriculture developed in a land of moderate rainfall and slopes. Its transferral to a land of intense rainfall and steep slopes caused soil erosion.

But that is only part of the story. Europe also sent methods of conservation. Scottish farmers had long been regarded by their contemporaries as backward. But in the 18th century, Scotland revolutionized the way its hilly lands were farmed to such an extent that its farming became regarded as the best in Europe. Sir John Sinclair converted the Scots to horizontal ridges (on the contour). For very steep lands, Sinclair recommended the turn-wrest plow, a progenitor of the hillside plow.

Some of the German groups settling in North America became model farmers who concentrated on maintaining fertility on small, intensively used farms rather than following the pattern of land exhaustion, abandonment, and westward migration.

The immigrants learned from the Native Americans, who had adapted agriculture to climate and geography. Native American methods varied from the slash and burn of the East to intricate irrigation and water-spreading systems in the West. Americans during the 18th and 19th centuries made many adaptations and ingenious inventions of their own.

When the Soil Conservation Service started field operations in the 1930s, it also started investigating the nature and control of erosion. Much of this involved research at experiment stations.

But Hugh Hammond Bennett, then Chief of SCS, and Walter Lowdermilk, the Assistant Chief, were firm believers in learning from foreign countries. Their interest extended not only to particular practices, but also to a broader understanding of the impacts of erosion on the welfare of nations.

Both traveled widely. On his trip to Europe, the Mediterranean area, and the Middle East, Lowdermilk examined the influence of erosion on civilization. SCS has distributed more than 1 million copies of his bulletin about the trip, "Conquest of the Land Through 7,000 Years."

SCS erosion history staff studied historical soil conservation practices, in both the Old World and the New, for solutions that could be used in work of the new and burgeoning Soil Conservation Service.

Other countries established soil conservation agencies in the late 1930s and 1940s. Several founders of those agencies visited and studied the U.S. system. Indeed, a trip was almost obligatory. SCS made its published manuals on soil conservation available in Spanish.

SCS started a system whereby young students of soil conservation would come to the United States to work in field offices and learn the latest conservation methods. This method had another important aspect: When returning to work in his or her native land, the conservationist should be attuned to any cultural or geographical conditions that might call for modifications of the methods used in the United States.

In the decades since World War II, SCS has become more involved in foreign assistance missions. Current thinking on the best means of technology transfer seems happily matched with some of SCS's preferences and operating methods. Throughout its history, SCS has emphasized the technically trained person assisting the land user.

Experience has shown one of the preferred methods of technology transfer to be when the foreign country plays a role in the decision-making. Institution-building, such as helping establish a soil and water conservation unit operated by that country's citizens, bears great promise, not only for the present, but also for the future--which, after all, is what conservation is about.

The Development of the Land Capability Classification

by Douglas Helms,
National Historian, Soil Conservation Service

In understanding the land capability classification (LCC), the author benefited greatly from conversations with Richard W. Arnold, Kenneth C. Hinkley, Tommie J. Holder, Donald E. McCormack, and Ralph J. McCracken.

The 1985 Farm Bill which Congress is currently considering includes provisions that have far-reaching consequences for conservation. Part of the concern over erosion during the last decade or so has focused attention on USDA farm programs and specifically on the possibility that the programs encourage the use of very erodible land for clean-tilled crops. One tactic advocated in restructuring programs has been to discourage the bringing of highly erodible land into production. In the 1985 farm bill this provision has been called "Sodbuster." The other thrust has been to encourage the removal of highly erodible land from cultivation to be put to other productive uses. The "Conservation Reserve" would remove highly erodible land from cropland uses.[1]

But how do we identify these highly erodible lands for purposes of writing legislation and operating USDA programs? The Sodbuster provision uses the land capability classification to identify highly erodible land, specifically classes IIIe, IVe, VI, VII, and VIII; while the Conservation Reserve clause gives the Secretary of Agriculture discretion to use LCC and/or the erodibility index--a system based on quantifiable factors in the universal soil loss equation.

The discussions have raised questions as to the value of land capability classification, particularly for identifying erodible farmland. The merits and limitations of the LCC have not been without debate, but previous discussants have been mainly soil scientists and soil conservationists. Their discussions seldom reached the pages of the professional journals. Now farm organizations and conservation groups have differing opinions as to the value of land capability classification for the purposes stated in the bills.

How did the LCC come to be regarded as a suitable indicator of erosion hazards? First, we need to investigate the origin of the system, see how the Soil Conservation Service implemented and used it, and see how it has been put to uses other than the ones stated. For over forty years the Soil Conservation Service has used land capability classification as a planning tool in laying out conservation measures and practices on farms so as to farm the land without serious deterioration from erosion or other causes. The land capability classification is one of innumerable methods of land classification that can be based on broad interpretations of soil qualities and other factors of place.[2]

The current LCC includes eight classes of land designated by Roman numerals I thru VIII. The first four classes are arable land--suitable for cropland--in which the limitations on their use and necessity of conservation measures and careful management increase from I thru IV. The criteria for placing a given area in a particular class involve the landscape location, slope of the field, depth, texture, and reaction of the soil. The remaining four classes, V thru VIII, are not to be used for cropland, but may have uses for pasture, range, woodland, grazing, wildlife, recreation, and esthetic purposes. Within the broad classes are subclasses which signify special limitations such as (e) erosion, (w) excess wetness, (s) problems in the rooting zone, and (c) climatic limitations. Within the subclasses are the capability units which give some prediction of expected agricultural yields and indicate treatment needs. The capability units are groupings of soils that have common responses to pasture and crop plants under similar systems of farming.[3] In choosing to designate classes not suited to continuous cultivation, the drafters of the legislation seized on classes VI thru VIII and subclasses IIIe and IVe. The question for the policy and law makers is whether the land capability classes, especially IIIe and IVe, are accurate and the best method of identifying erodible land.

The most common problem pointed out is that the land capability subclasses do not necessarily indicate the degree of erosion on a progressive and consistent basis. For example it is possible that a subclass IIIe soil is more erodible than a IVe soil. There are reasons inherent in the grouping of soils in the LCC to explain this situation. But it nonetheless causes some confusion when looking upon the LCC as an indicator of erosion.[4] Since the system was designed to deal with numerous factors of suitability of land for agricultural uses, a review of the development of LCC should add some degree of understanding to the debate over measuring erodible soils for program purposes.

Hugh Hammond Bennett, the creator and first chief of the Soil Erosion Service, influenced nearly all aspects of the Soil Conservation Service. While he did not originate the LCC, he embraced it. More importantly for our discussion the LCC was born out of the attempt to farm land without loss of quality or quantity. The early soil conservationists often spoke of developing a permanent agriculture in the United States--a system of cultivation under which land would be used without deterioration. This attitude was the philosophical heritage of the land capability classification.

As a soil surveyor for the Bureau of Soils, Bennett became concerned about the problem of soil erosion. Promotion to inspector of the Southern Division of the soil survey work afforded him an opportunity to view problems on a wider basis. Foreign assignments also influenced his thinking. Long before the development of the land capability classification, it is possible to detect some of the thinking that would go into it from Bennett's voluminous correspondence and numerous articles. One of his first forays into suggesting corrective action for soil erosion was a more traditional type of land classification--the sepration of forest lands from farmland based on soil type or series. Based on his years of work in the South he wrote an article on classification of forest lands in the proceedings of the Third Southern Forestry Congress published in 1921. He admitted that there was little experimental research on tree productivity or cost-of-production information to justify classifying certain soils as forest soils. But he definitely believed that there were other criteria which disqualified some soil types as farmland. He wrote, "Through the Coastal Plain and Piedmont regions...there are here and there areas of eroded rolling lands and even of stony lands which are obviously not adapted to farming on account of topographic unfavorableness or stoniness...."[5] Since slope is one of the factors influencing soil formation, it followed that certain soil series were nearly always found on slopes. The Susquehanna clays were one such soil.[6] Lauderdale was another soil that usually occurred on rough topography. He classed other lands as forest land because of stoniness or poor drainage, but he was also concerned with the influence of slope on erosion. In the Piedmont section of Georgia he believed that over a million acres were best suited to timber, because of "rolling or gullied surface and stoniness, and probably an equal area, if not more, should be devoted to timber or grass or both because of its slope and resultant susceptibility to washing, representing land which under the ordinary systems of cultivation eventually will be completely and irreparably destroyed."[7] To Bennett's thinking the student of soils had a particular reason for wanting to contribute to the reforestation effort. It was he who had seen the most "land wastage through unnecessary erosion...and wasted effort on poor farm land."[8]

Also, Bennett was becoming aware that erosion was not related strictly to the degree of slope. Evidences of different degrees of erodibility certainly existed in the United States, but foreign travel provided striking examples. While working on the soil survey of Cuba, Bennett found a "peculiar tropical" soil in which the clay particles clustered together in floccules and allowed rapid infiltration of water. The soil seemed "to be not in the least susceptible to erosion."[9]

By 1928 Bennett had formed some ideas about the causes of erosion. These were "(1) soil character, (2) character of vegetative cover, (3) degree of artificial ground modification, (4) degree of slope, and (5) climate."[10] He preferred not to rank the causal factors in importance, except that he thought "soil character probably should head the list."[11] To illustrate the influence of soil properties on erodibility he contrasted an Abilene clay loam in Texas where 27 inches of rain removed 40 tons of soil from an acre of bare land on a two per cent slope with a Cecil sandy clay loam in Piedmont North Carolina where 36 inches of rain removed 25 tons per acre from bare ground on a nine per cent slope.[12] Nationwide, this was not the best comparison to make as the Cecil sandy clay loam was also a highly erodible soil. But Texas and North Carolina were two of the few places where the agricultural experiment stations had gathered data on erosion. While the Piedmont soils were very erodible, there existed soils in the U. S. on steep slopes with little erosion, namely clay lands in the Pacific Northwest which were used mainly for fruit production.[13]

Gradually field observations led Bennett to some ideas about farming systems and slope of the land which were revealed in his writing. He corresponded with J. Russell Smith, a geographer, who wrote *Tree Crops.* Smith wanted to devote lands too steep for cultivation to tree crops--not just timber but all manner of food, forage, fibre, oil, and other crops. In the Southern Piedmont, Bennett wrote to Smith, slopes over 15 per cent should not be plowed except to establish grass or legumes, and that it was "unwise to use any of these Piedmont slopes for continuous production of the clean-tilled crops except in nearly level areas."[14] The solution to man-induced erosion would be at hand Bennett wrote to another of geographer, when agriculturalists learned the best methods of farming "under the varying conditions of climate, soils, slope, vegetative cover and agricultural usage."[15]

Slowly, the U. S. Department of Agriculture and a few state experiment stations were beginning to accumulate some of the information Bennett believed was needed to design farming methods under these varying conditions. One of his first successes in the crusade for soil conservation was the creation of a group of soil erosion and moisture conservation experiment stations. Congressman James Buchannan added an amendment to the 1930 Agricultural Appropriations Act to provide for the stations. By the summer of 1930 there were six stations established and another four were added. Bennett hoped to have some 25 to 30 stations eventually.[16] At the least he hoped to have stations in the 18 erosion problem areas that he had identified.[17] The stations began evaluating the influences of various combinations of crop rotations, tillage practices, and mechanical and engineering conservation practices on erosion. Bennett, under the title, "In Charge, Soil Erosion and Moisture Conservation Investigations," supervised the research of the Bureau of Chemistry and Soils, while the Forest Service and Bureau of Public Roads handled other stations. Prior to the establishment of these stations the information about influences of farming systems on erosion had indeed been scant. Texas had established a station at Spur devoted to soil erosion research,[18] while Missouri and North Carolina had some soil erosion work among their experiment station research programs.[19]

The stations were to provide some of the quantitative data from field plots that was needed to devise soil conservation farming methods. But there remained much to be learned from the point of view of examining where erosion had occurred and the reasons. In many ways the product of this thinking, the erosion survey--which was to influence the land capability classification--was another Bennett-inspired idea. As head of the soil erosion investigations he supervised detailed soil erosion