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FLOOD AND EROSION CONTROL AS POSSIBLE UNEMPLOYMENT RELIEF MEASURES[1]

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FLOOD control and erosion control are national problems because the extent and magnitude of losses caused and control measures involved are beyond the powers of the individual states to cope with successfully. That the water problem, of which these are part, is of national scope can be shown in various ways.

Many large cities are seriously affected by the problem of getting and maintaining domestic and industrial water supplies; Boston plans to tap a stream sixty miles away; New York brings part of its supply over 92 miles; the Hetch-Hetchy Reservoir, built at a cost of $126,500,000, will furnish part of San Francisco's water supply from a distance of 200 miles; the water system of southern California will cost $350,000,000.

Irrigation water is a commodity of enormous importance to 19 states west of the Mississippi River, involving an area of 19,547,544 acres and a value in 1930 of lands, building and machinery, reservoir and distributing systems of nearly $6,000,000,000.

Water power is being utilized in practically every state. Twenty-six states, by 1931, scattered from Maine to California, have each developed over 100,000 horsepower.

The inland waterways of the country, exclusive of the Great Lakes and interior and intra-coastal canals, carried 130,000,000 short tons of freight in 1929. The War Department has spent tremendous sums in the deepening and widening of natural channels and in engineering works to make navigation possible during

[1] Address at the thirteenth annual meeting of the Southwestern Division of the American Association for the Advancement of Science, Las Cruces, New Mexico, May 1 to 4, 1933.

periods of low water. On one stream alone—the Ohio River—the army engineers spent some $118,000,000 in the building of 49 locks and dams. During the 50 years ending June 30, 1932, $844,452,177 have been spent by the Federal Government on existing river and harbor projects directly connected with stream-flow. It is interesting to note that not one cent of these millions was spent in the Colorado, Great Basin or Rio Grande drainage regions. Contrast these sums with the expenditures for reclamation in the West, which in 1930 totaled about $162,000,000. Of this amount only a little more than five million dollars is a direct appropriation from the general treasury. Surely the Western states are justified in asking for more than their per capita share of unemployment relief funds.

So much for the story of beneficial uses of water. The figures showing harmful effects of floods and erosion exceed even the values mentioned above. The Mississippi flood of 1927, which inundated 18,000 square miles, drove 750,000 persons from their homes, did some $300,000,000 worth of damage and took 246 lives, is only an instance of what is happening annually on a smaller scale in nearly every state. The 1932 floods on the Rio Grande damaged $2,500,000 worth of property and cost 12 lives. In 1927 New England floods did $35,000,000 damage to property and cost 84 lives. In the Middle West in 1913 the Ohio River damaged property worth $180,000,000 and sacrificed 400 lives. For the last 20 years flood damage in South Carolina and Tennessee has averaged nearly $1,000,000 a year.

Soil erosion is unquestionably a national menace, greater than war. Mr. H. H. Bennett, of the Bureau of Soils, U. S. Department of Agriculture, states:

> The writer, after 25 years spent in studying the soils of the United States is of the opinion that soil erosion is the biggest problem confronting the farmers of the Nation over a tremendous part of its agricultural lands. . . . Not less than 126 billion pounds of plant food material is removed from the fields and pastures of the United States every year. The value of the plant food elements in this waste is two and a half billion dollars annually. Of this amount, there is evidence to indicate that at least 200 million dollars can be charged up as a tangible yearly loss to the farmers of the Nation. Rain wash removed not only the plant food elements, but also the soil itself. The plant food elements removed by crops can be restored in the form of fertilizers, manures and soil improving crops, but the soil that is washed out of fields can not be restored except by the exceedingly slow natural process of soil building, that requires in many instances centuries to develop a comparatively thin layer.

In the high valleys of the Appalachian Mountains, on the rich bluff lands of the Mississippi as far north as Wisconsin, on the Piedmont plateau of the Southern states, in the states bordering the Ohio River, in Missouri, Oklahoma and eastern Texas, and in other agricultural sections of the United States, erosion has been the principal cause for abandoning millions of acres of cleared land. On the wide-spreading expanse of the public domain unregulated grazing has resulted in erosion, which not only has seriously reduced the value of the forage but threatens the very existence of the Western irrigation projects.

The principal factors which influence the normal division of run-off into useful subsurface waters and less useful or destructive surface waters are the character of the precipitation, the geology and topography of the surface on which it falls and the vegetative cover on that surface. The vegetative cover is the only one of these factors which it is within human power to control. Floods and erosion will continue, unless the lands are reclothed in permanent vegetation such as forest, brush or grasses, so that the soil will be held in place, absorption increased and run-off from the slopes slowed down.

National action is necessary because the extent and magnitude of control measures transcend state lines. Some control measures are properly within the province of a state or smaller political subdivision. The major control measures, however, for several reasons require federal participation. Briefly, federal participation is necessary because the beneficiaries under interstate rivers outnumber so greatly the persons living where the streams rise. In the Western states particularly, where so many streams rise on land untaxed for state purposes in the Forest Reserve or Indian reservations, it is impossible to allocate the burden on persons receiving the grazing benefits, or the lumber in reserve, or the benefits from power development resulting from flood and erosion control, since title to these lands may be kept in the Federal Government. Furthermore, sales of power may be mainly without the state, or to a municipality in another state, as in the case of the Elephant Butte Dam in New Mexico and the city of El Paso, Texas. In these public land states the private lands are a small part of the beneficiaries and can not bear the costs of control measures.

Furthermore, where control measures might be left to a country or community, there is grave danger that while the type of control measures may be satisfactory to the local region, the results may be disastrous to interests lower down on the stream. For illustration, the middle Rio Grande region around Albuquerque is menaced by a higher river bed than portions of the surrounding country. This condition could be remedied by straightening and narrowing the river channel, thereby increasing the velocity in the artificially

maintained river bed, resulting in an increased silt-carrying capacity of the river and eliminating the silted condition of the river channel at the locality. Such a policy would result in carrying the silt into the Elephant Butte reservoir, thereby decreasing its water storage capacity, and harming the farmers on the Rio Grande project. Further down the river a similar policy of channel straightening would menace agricultural lands or even cause international problems, for the Rio Grande is an international stream. The leaving of corrective measures to local authorities, I believe, should only be done in such cases where the cheapest form of relief for the locality is not hazardous to greater interests below.

The federal government, through the work of the army engineers, has proceeded on the principle of primary farm protection. Colonel T. N. Robbins, division engineer, U. S. Army Engineering Corps, in an address on "Water Storage and its Relation to Agriculture in the Public Lands States," before the Second National Waterusers Conference, stated: "In the development of both the Mississippi and the Sacramento flood control projects, the protection of agricultural land was a primary consideration. The Mississippi project will protect about 13,000,000 acres; the Sacramento project about 1,000,000 acres."

Constitutional support for federal participation in projects primarily for flood control might be found (1) in the interstate commerce clause, for the improvement of navigation where the watershed is on a navigable stream; (2) in the treaty-making power where the watershed is on an international stream in connection with which the United States has undertaken to fulfil a treaty obligation; (3) in the authority reserved to the states to enter into compacts subject to approval by Congress where the watershed is on an interstate stream, the use of which has been made the subject of such compact approval by Congress, and necessarily involves a program of flood control for the protection of that use, or uses, especially where the Federal Government owns reservoir sites and rights of ways, instrumentalities essential to the prosecution of such a program; and (4) in the authority of the United States as a proprietor to construct irrigation projects for the improvement of its public lands where the watershed is above a project already built and flood control measures would protect that project from silting or other damage from uncontrolled floods.

The primary requirements of a Federal Unemployment Relief program are: (1) the program should be national in scope; (2) it should provide for the beneficial use of large groups of unskilled labor; (3) it should provide the possibility of year-round employment. Flood and erosion control measures fully meet these requirements. The types of control measures will vary with conditions in different parts of the country. Where rainfall is abundant, replanting of trees and brush, etc., and construction of small check dams are practicable. It is only in the Southwest, however, that all-year employment can be readily provided. Therefore, I shall discuss in more detail control measures particularly adapted to southwestern conditions.

The Forest Service has submitted a statement covering the average work that might be done by a 200 man camp during six months on erosion control in the West. It is largely based on the Utah plans. It provides:

(1) About 30 miles of fencing of critical areas to control or eliminate live stock which would damage the work or which would prevent rapid natural revegetation where reseeding is not feasible.

(2) Seeding 1,000 to 1,200 acres (some camps in Utah and further north under favorable soil and moisture conditions may have 4,000 or more acres seeded). Grasses or other plants suitable for the specific soil and moisture conditions should be used. If there are native plants with rootstocks available in the locality digging and replanting of these on the eroded areas should be considered. Trees should be used where they can be effectively planted and where stock is available. Collection of seeds of suitable native plants should be included in the revegetation plans and such seed used for reseeding purposes this fall or next year. This would apply, for example, to native mountain brome and violet wheat grass, which have proven successful for seeding in central Utah.

On steep slopes a contour furrow should be plowed to give a base for seeding, and to catch seed which washed down from the face of the slope. The contour furrows will be necessary for the seeding of yellow sweet clover, since it should be seeded only on exposed soil.

(3) Small check dams of local rock, brush or mesh wire in active gullies.

(4) Cutting and throwing brush into small gullies and in large gullies between the check dams.

Modifications of this plan for the Southwest would provide probably larger amounts of fencing and smaller amounts of seeding. The experimental results of artificial reseeding in southern New Mexico do not seem sufficiently conclusive to make advisable a recommendation of extensive planting. However, where the rainfall is 20 inches or more, as in the northern part of New Mexico, artificial reseeding with such plants as blue grass, white clover, orchard grass, timothy and smooth brome should be experimented with.

I believe that immediate flood control measures may well come before long-time erosion prevention measures, particularly in the light of furnishing relief for unemployment.

A broad statement of the theory on which flood control measures are based might be that the control measures are designed to check the velocity of the flow of water. Among the important reasons why checking the velocity is important are: (1) checking just a little of the velocity diminishes the debris carrying power of the current a great deal (to either the 5th or 6th power); (2) when a stream is laden to capacity with boulders, silt, gravel, logs and brush, the ordinary channel is rapidly filled and the stream floods over the banks, thereby damaging the surrounding country; (3) checking the velocity increases absorption owing to the greater clarification of the water; it increases absorption due to increased time of discharge; it increases absorption due to increased head produced by bays back of the check structures; it increases the absorption by increasing the wetted perimeter of the stream; in fact, it enables nature to recover herself from the spoliation of the forces of waste and to build up again the fern and willow growth and to recreate the moisture-filled soil storage that all through the dry season should be furnishing its little quota of flow to the river below.

Since, on large areas of southwestern desert land the rock and brush commonly recommended for the construction of small check dams are not available, I suggest the use of earth-filled sacks in small gullies. These sacks will retain the dam for two or more years. My experience on a farm near Dona Ana, New Mexico, subject to arroyo floods, indicates that our rains in southern New Mexico are very spotted and that floods of sufficient size to wash out these bags of earth will not be wide-spread over a long period of time. On that farm the arroyo has run only 4 times in 18 years. These bag dams should serve long enough to check a considerable quantity of silt and perhaps permit the growth of native vegetation in their vicinity. On a farm in Arizona, using check dams and transplanted willows, I filled level in 4 years a 3,000 yard gully which had been from one to ten feet deep and three to five feet wide.

I desire also to suggest the possibility of utilizing labor in planting Tamarisk or similar plants at the inflow of large reservoirs, such as Elephant Butte or Roosevelt Lakes. It has been found on Lake McMillan that this plant made a dense growth, varying in diameter from the size of a pencil to 6 or 8 inches. There it caused heavy deposition of silt, thereby preventing a reduction in the water storage capacity in the reservoir through silting.

I think also it would be possible to establish small rodent-proof seeding areas, wherein native grasses and shrubs would reproduce their seed, which would be wind-sown.

Another means of using unemployed labor is in the development of additional underground water supplies on our grazing areas. Dr. William Peterson, in an address before the 3rd Water Users' Conference of the American Farm Bureau Federation, stated:

> The development for stock water over our grazing areas is going to become an important problem. Even in the face of an extreme drought as the country faced in 1931 when grazing was scarce, hundreds of square miles of good grazing areas went untouched because of lack of water supply. Experiments in grazing work indicate that an animal might walk two and one-half miles to water and still continue to gain. This means that one watering hole might serve an area of as much as 20 square miles. A stream of 10 gallons per minute would be sufficient to supply 1,000 head of cattle. For such service pumping of great depth may be permissible.

There is no question in my mind but that federal control of the public domain, preferably under such an agency as the Forest Service, is indispensable to the solution of the erosion problem. Such control would permit regulation of grazing. Under such a plan, much winter work could be done on telephone lines, fire protection, roads and trails, headquarter stations, fencing for management of stock, water development, as mentioned above, and revegetation and erosion control.

One further line of work which, it seems to me, might be developed is in the poisoning of rodents on the range. It has been shown on the Jornada Range Reserve that these rodents eat great amounts of the feed, and where the stand is scant, they even overgraze the range. However, I am not certain what the probable ecological upset would result in.

A final suggestion is the possibility of using unemployed labor in straightening the channels of large arroyos and widening the channels where the construction causes the arroyo floods to overflow and damage adjoining farm lands, as does the San Simon arroyo in Arizona.

In conclusion, I believe that flood and erosion control are ideally suited for unemployment relief measures, because the control would be reasonably effective, but principally because of the possible excellent effect upon the unemployed themselves. The spirit behind these ideas was phrased as early as 1919 by Frank H. Olmstead, who, in a report on the Gila River flood control, wrote:

> The building the small retarding structures must proceed without plans and specifications and preferably should be handled by force account, using young, active men interested in conservation work. If there could be a great army of the youth of the Nation encamped in the glorious mountains of the upper Gila and in the wonderful canyon lines of the Mogollon, Black, San Francisco, and

Tularosa Mountains, for, say, one year, under competent instructors and subjected to drill and obedience not alone in the use of arms but of tools and in building some hundreds of thousands of these little structures, the young men would be better off and the Nation wonderfully enriched. There would be recreation and sport of occasionally killing a black tailed deer or a wild turkey or the gray squirrels, which we saw almost every hour of every day while in this region. Our national life would not only be reinforced through a pronounced conservation achievement along material lines, but the spirit of true national defense would have a new birth.

RESEARCH WITH A HEN[1]

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THE subject of this address was unwittingly suggested by a member of the board of governors of one of the largest universities in the United States. This institution employs upwards of two hundred graduate students as assistants in research and in teaching, but when the board was requested a few years ago to appoint a research assistant in the Department of Poultry Husbandry, it was confronted with a situation quite unprecedented in all the years of the university's existence. It was not surprising, therefore, that one member of that body should have expressed his doubt about the desirability of the proposed new appointment, but it was surprising that he should do so by asking the very pointed question, "What research can you do with a hen?"

What research can you do with a hen? Among the members of this society there are over a hundred who could answer this question by quoting investigations now under way in the various universities and experiment stations which they represent, and concerned with the nutrition, genetics, physiology, embryology, pathology, parasitology or psychology of the fowl. These experiments are planned in nearly every case to discover new facts and to add to our store of knowledge. It is because such investigations have been carried on for many years that we now have a sufficiently great accumulation of facts to justify the designation of this branch of knowledge as poultry science.

To discuss research intelligently we must have an understanding of what the word implies, but, in attempting to define it, no one realizes better than I the difficulty of giving any arbitrary and fully satisfactory definition. As every director of an experiment station knows, there are investigations of divers kinds, not all of which are entitled to be designated as research. Some are merely *re*-search, but, in so far as they improve upon previous methods and by so doing establish new facts or provide more accurate interpretations, such investigations may fairly be classified as research. This can hardly be said, however, for the all-too-common repetition of experiments in which the results have been so conclusive that additional substantiation is entirely unnecessary. Nor can we classify as research those investigations in which sources of error and of environmental modification of results have been so ill-controlled that no definite answer to the original problem is provided by the experiment. Fortunately such experiments are becoming fewer.

The majority of our experiments, however, are set up to determine new facts about the hen and about other domesticated birds. Except for studies of costs of production, which are largely economical rather than biological in nature, our investigations are concerned with the hen's nutritional requirements, her physiology, her genes and the characters they produce, her embryonic and postnatal growth, the parasites that beset her, the bacteria that invade her and, withal, the mental processes that are responsible for her often inexplicable peculiarities of behavior. In pursuing these researches we usually apply already well-known principles of nutrition, physiology, genetics, embryology, parasitology, bacteriology and animal psychology. We are not concerned primarily with extending the boundaries of these fields of science, but rather with utilizing them to give us more information about the fowl. However, if an investigation adds one small fact to the already large amount of knowledge about the hen, that investigation is undoubtedly research so far as poultry science is concerned. It may also be called research in nutrition, genetics or any of the other sciences, if it extends to a new species the application of a principle not yet known to have universal application.

But there is still another kind of research with a hen, a kind which has not been adequately appreciated even by members of this association, and certainly not by the gentleman who asked, "What research can you do with a hen?" I refer to those investigations in which the hen has been used, not for the application of existing principles, but for the discovery of entirely new concepts in biological science.

[1] Address of the president at the twenty-fifth annual meeting of the Poultry Science Association, East Lansing, Michigan, August 2 to 5, 1933.