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CONSERVATION OF THE SOIL.

[Address of President Taft before the National Conservation Congress, at Kansas City, Mo., September 25, 1911.]

Members of the National Conservation Congress:

At last year's convention of this congress I had the honor and pleasure of delivering an address on the subject of conservation of our national resources, and therein attempted to state what the term "conservation" of our national resources meant, what were the statutes affecting and enforcing such conservation, classified the different public lands to which it would apply, and suggested what I thought was the proper method of disposing of each class of lands. Nothing has been done on this subject by Congress since that time, but it is hoped that the present Congress at its regular session will take up the question of the conservation of Government land containing coal and phosphates or furnishing water power, adopt some laws that will permit the use and development of these lands in Alaska and in continental United States, and evolve a system by which the Government shall retain proper ultimate control of the lands, and at the same time offer to private investment sufficient returns to induce the outlay of capital needed to make the lands useful to the public. The discussion did not invoke the consideration of any question which directly concerned the production of food.

To-night, however, I wish to consider in a summary way another aspect of conservation far more important than that of preserving for the public interests public lands; that is, the conservation of the soil, with a view to the continued production of food in this country sufficient to feed our growing population.

We have in continental United States about 1,900,000,000 acres. Of this, the Agricultural Department, through its correspondents, estimates that 950,000,000 acres are capable of cultivation. Of this, 873,729,000 acres are now in farms. The remainder, about 1,000,000,000 acres, is land which is untillable. It is reasonably

certain that substantially all the virgin soil of a character to produce crops has been taken up. It is doubtful how much of the part not included in farms can be brought into a condition in which tillage will be profitable.

The total acreage of farms in the last ten years, although the pressure for increased acreage by reason of high farm prices was great, was increased only about 4 per cent, or about 35,000,000 acres. There are upward of 25,000,000 acres that will be brought in under our irrigation system, and perhaps more, and the amount of lands which can be drained and made useful for agriculture will amount to about 70,000,000 acres.

The total improved farm lands in the United States amount to 477,448,000 acres, which is an increase in the last 10 years of 62,949,000, or 15.2 per cent. The product per acre actually cultivated increased in the last 10 years 1 per cent a year, or 10 per cent. The total product increased in 10 years nearly 20 per cent.

The population in this same time increased 21 per cent. If the population continues to increase at its present rate, we shall have in 50 years double the number of people we now have. It is necessary, then, that not only our acreage but also our product per acre must increase proportionately so that our people may be fed. We must realize that the best land and the land easiest to cultivate has been taken up and cultivated, and that the additions to improved lands and to total acreage in the future must be of land much more expensive to prepare for tillage. The increase per acre of the product, too, must be steady each year, yet each year an increase becomes more difficult. Still, even in the face of these facts, there is no occasion for discouragement. We are going to remain a self-supporting country and raise food enough within our borders to feed our people. When we consider that in Germany and Great Britain crops are raised from land which has been in cultivation for 1,000 years, and that these lands are made to produce more than two and three times per acre what the comparatively fresh lands in this country produce in the best States, it becomes very apparent that we shall be able to meet the exigency by better systems of farming and more intense and careful and industrious cultivation. The theory seems to have been in times past that soils become exhausted by constant cultivation; but the result in Europe, where acres under constant use for producing crops for 10 centuries are made now to produce crops three times those of this country, shows that there is nothing in this theory, and that successful farming can be continued on land long in use, and that great crops can be raised and garnered from it if only it be treated scientifically and in accordance with its necessity. There is nothing peculiar about soils in Europe that gives the great yield per

acre there and prevents its possibility in the United States. On the contrary, there is every reason to believe that the application of the same methods would produce just as large crops here as abroad.

One of the great reasons for discouragement felt by many who have written on this subject is found in the movement of the population from farm to city. This has reached such a point that the urban population is now 46 per cent of the total, while the rural population is but 54 per cent, counting as urban all who live in cities exceeding 2,500 inhabitants. This movement has been persistent, and has made it very difficult for the farmers to secure adequate agricultural labor, with an increase in the price of labor which naturally follows such a condition. Still we ought to realize that enormous advance in the machinery used on the farm has reduced the necessity for a great number of farm hands on each farm.

Mr. Holmes, of the Department of Agriculture, in the Yearbook of that department for 1899, points out that between the years 1855 and 1894 the time of human labor required to produce 1 bushel of corn on an average declined from 4 hours and 34 minutes to 41 minutes, and the cost of the human labor required to produce this bushel declined from 35¾ cents to 10½ cents. Between 1830 and 1896 the time of human labor required for the production of a bushel of wheat was reduced from 3 hours to 10 minutes, while the price of the labor required for this purpose declined from 17¾ cents to 3⅓ cents. Between 1860 and 1894 the time of human labor required for the production of a ton of hay was reduced from 35½ hours to 11 hours and 34 minutes, and the cost of labor per ton was reduced from $3.06 to $1.29.

In 1899 the calculation made with respect to the reduction in the cost of labor for the production of seven crops of that year over the old-time manner of production in the fifties and sixties shows it to have been $681,000,000 for one year. But while it is possible to say that there may be in the future improvements in machinery which will reduce the number of necessary hands on the farm, it is quite certain that in this regard the prospect of economy in labor for the future is not to be compared with that which has been effected in the last 30 years. Hence we must regard the question of available population and available labor in that population for the cultivation of the fields as an important consideration. My impression from an examination of the figures is that the change in this last decade from farm to city has not been as great in its percentage as it was in previous decades, and, if this be true, it indicates that there is in the present situation an element that will help to cure the difficulty. Farm prices are increasing rapidly, and the profits of farming are becoming apparently much more certain and substantial. While the

acreage of the improved land only increased 65,000,000, or 15 per cent, and the total acreage only 4 per cent, the value of the farms in money increased from $17,000,000,000 to $35,000,000,000 in 10 years, an enormous advance. This of course was due somewhat to the investment of additional money in the improvement of land and somewhat to the increase in the supply of gold, which had the effect of advancing all prices; but the chief cause for the advance is in the increase in the price of farm products at the farm. So great is this increase that the value of the average farm has now gone from $2,895 to $5,470, while the average value per acre has increased from $19.81 to $39.69. In addition to this, comforts of farm life have been so greatly added to in the last 10 years by the rural free delivery, the suburban electric railway, the telephone, and the automobile, that there is likely in the next 10 years to be a halt in this change toward the city, and more people in proportion are likely to engage in gainful occupation on the farm than has heretofore been the case. Such an effect would be the natural result of the actual economic operation of the increase in the value of the farm product, and the increase in the certainty of farming profits.

It is the business of the country, in so far as it can direct the matter, to furnish the means by which this economic force shall exert itself along the lines of easiest and best increase of production. Of course the Government, by furnishing assistance in irrigation, increases the amount of tillable land, and the States, if they undertake the drainage of swamp lands, will do the same thing. The cost of such improvements will be considerable, and will affect the farming profit, but the result generally in such cases is to yield such great crops per acre that the farmer can well afford to pay interest on the increased investment. Increased acreage from any other source is likely to be, however, in more stubborn land, calling for greater effort in tillage and producing less per acre. We may reasonably infer from the high prices of the decade immediately past that everything was done by those who owned land to enlarge the acreage where that was easy or practical, and that what is yet to be brought in as tillable land presents greater difficulties and greater expense. The way in which the States can help to meet future increased demand is by investigation and research into the science of agriculture, and by giving to the farming community a knowledge which shall enable them better to develop the soil, and by educating those who are coming into the profession of farming. It is now almost a learned profession.

The first great step that has to be taken in reformed agriculture is the conservation of the soil. Under our present system the loss to the farms in this country by the erosion of the soil is hardly to be calculated. Engineers have shown how much is carried down the

great rivers of the country and is deposited as silt each year at their mouths. The number of cubic yards staggers the imagination. The question is how this can be prevented, as it must be, because the soil which is carried off by this erosion is generally the richest and the best soil of the farms which are thus denuded.

Of the rain or snow which falls on the land, a part evaporates into the air; a second part flows down the slopes to the streams, and is called the run-off. The third part soaks into the soil and subsoil, and thence into underlying rocks, perhaps to reappear in springs or seepage into streams. This is called ground water. The fourth part is absorbed by organisms, chiefly by trees, grasses, and crop plants, either directly through the tissues or indirectly through the roots penetrating the moistened soil. Erosion is due to the run-off, and its quantity is dependent on the slope of the farm and also the nature of the soil and its products. Any reasonable slope, and any full cover of forest or grass with an abundant mulch, or a close crop on a deeply broken soil, or a friable furrow slice kept loose by suitable cultivation, will absorb rain and curtail the run-off, or even reduce it to slow seepage through the surface soil, which is the ideal condition. Now, the ground water is the most essential constituent of the soil, because solution, circulation, and organic assimilation are dependent on water. All the organisms and tissues are made up of this solvent of water, and it constitutes a large percentage of the bodies and food of men and animals. The question of the amount or ratio of ground water in the soil is a vital one. If it is excessive it makes a sodden mass, sticky when wet, but baked when dry, so that there is no possible absorption further into it, and it sends on the water that falls on it to erode easy slopes.

The erosion begins on the farm and should be remedied there. Deep cultivation tends to absorb the product of each rainfall and to reduce the run-off. Deep cultivation brings up fresh earth salts to the shorter rootlets, but carries down the humus and mulch to thicken the soil and feed the deepest roots. In flat-lying fields and tenacious soils tile drainage is the best method of relieving the farm from the danger of too great run-off. Deep drainage permits both soil and subsoil to crumble and disintegrate and through mechanical and chemical changes to become friable and capable of taking on and holding the right amount of moisture for plant growth, while the water which runs out through the drain is clear without carrying the soil with it, and therefore without erosion. Of course, different farms require different treatments. Certain farms require what is called contour cultivation, by which each furrow is to be run in such a way as to level and to hold the water. On hilly lands strips of grass land are grown, called balks or breaks, separating zones of plow land, and

they should curve with the slopes; and the soil being carried by the water will be caught by them and constitute them a kind of terrace without effort. The use of forests, of course, in foothills and deeply broken country is essential and should be combined with grazing. They will prevent the formation of torrents by making the mulch and soil deep and spongy. Of course, over all mountain divides the retention of forests greatly helps to prevent the carrying off of the good soil to the valleys below. The proper selection of crops has much to do with the stopping of erosion.

I gather these facts from the reports of the Secretary of Agriculture as to the best method of preventing erosion. They are simple and easily understood, but they need to be impressed upon the farmers by education and by reiteration. Then the productivity of the soils might very well be increased by more careful use of commercial fertilizers. In 1907 $100,000,000 was expended in fertilizers, but the Agricultural Department is of opinion that one-third of this was wasted for lack of knowledge as to how to use it.

Careful crop rotation is essential because it has been found that the remains of one crop have a poisonous effect upon the next crop if it is of the same plant, but such remains do not interfere with the normal production of a different plant. Then a kind of crop may and should be selected to follow which will renew that element in the soil which the first crop exhausted.

Then there is the organization of the farm on plain business principles by which the buildings and the machinery are so arranged as to make the movement of crops and food and animals as easy and economical as possible. A study as to the character of the soil and the crops best adapted to the soil; the crops to be used in rotation for the purpose of strengthening the soil—all these are questions that address themselves to a scientific and professional agriculturist, and which all farmers are bound to know if the product per acre is to be properly increased. We have every reason to hope, from the forces now making toward the education and information of the farmer, as to the latest results in scientific agriculture, that the country will have the advantage of improvement in our farming along the proper lines. Further agricultural development is to be found in the breeding of proper plants for the making of the best crops, while the growth of live stock is made much more profitable both to the owner and to the public by improving the breed and the infusion of the blood of the best stock.

The improvement in agricultural education goes on apace. All the States are engaged in spending money to educate the coming farmer, and this system is being extended so that now we have the consolidated rural school, the farmers' high school, and the agricultural col-

lege, and one who intends to become a farmer is introduced to his profession soon after he learns to read and write, and he continues his study of it until he graduates from his college and applies for a place upon the farm.

The land-grant colleges established by the Federal Government have vindicated the policy in making the grant. Now the department employs 11,000 persons, many of whom are engaged in conducting experiment stations and spreading information all over the country. The cooperation between the State agricultural school system and the Federal Government's publicity bureau and experimental work is as close and fine as we could ask. It is difficult to justify the expenditure of money for agricultural purposes in the Agricultural Department with a view to its publication for use of the farmers, or to make grants to schools for farmers, on any constitutional theory that will not justify the Government in spending money for any kind of education the country over; but the welfare of the people is so dependent on improved agricultural conditions that it seems wise to use the welfare clause of the Constitution to authorize the expenditure of money for improvement in agricultural education, and leave to the States and to private enterprise general and other vocational education. The attitude of the Government in all this matter must be merely advisory. It owns no land of sufficient importance to justify its maintenance of so large a department or of its sending into all States agents to carry the news of recent discoveries in the science of agriculture. The $50,000,000 which has been spent for research work in the department, however, has come back many fold to the people of the United States, and all parties unite in the necessity for maintaining those appropriations and increasing them as the demand shall increase.

It is now proposed to organize a force of 3,000 men, one to every county in the United States, who shall conduct experiments within the county for the edification and education of the present farmers and of the embryo farmers who are being educated. It is proposed that these men shall be paid partly by the county, partly by the State, and partly by the Federal Government, and it is hoped that the actual demonstration on farms in the county—not at agricultural stations or schools somewhere in the State, but in the county itself—will bring home to the farmers what it is possible to do with the very soil that they themselves are cultivating. I understand this to be the object of an association organized for the improvement of agriculture in the country, and I do not think we could have a more practical method than this. It is ordinarily not wise to unite administration between the county and State and Federal Governments, but this subject is one so all-compelling, it is one in which all people are so much inter-

ested, that cooperation seems easy and the expenditure of money t
good purpose so free from difficulty, that we may properly welcom
the plan and try it.

On the whole, therefore, I think our agricultural future is hopeful
I do not share the pessimistic views of many gentlemen whose sta
tistics differ somewhat from mine, and who look forward to a stron
probability of failure of self-support in food within the lives of per
sons now living. It is true that we shall have to continue the im
provement in agriculture so as to make our addition to the produc
per acre 1 per cent of the crop each year, or 10 per cent each decade
but considering what is done in Europe, this is not either impossibl
or improbable. The addition to the acreage in drainage and in ir
rigable lands will go on—must go on. The profit to the State o
to the enterprise which irrigates or drains these lands will becom
sufficient to make it not only profitable but necessary to carry throug
the project, and we may look forward to the middle of this century
when 200,000,000 of people shall swear fealty to the starry flag, as
time when America will still continue to feed her millions and fee
them well out of her own soil.

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