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8-1-1912

# Soil and Crop and Their Relation to State Building

A.N. Hume

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### Recommended Citation

Hume, A.N., "Soil and Crop and Their Relation to State Building" (1912). *Bulletins*. Paper 139.  
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**BULLETIN NO. 139**

**AUGUST, 1912.**

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**Agricultural Experiment Station.**

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**SOUTH DAKOTA  
STATE COLLEGE OF AGRICULTURE  
AND MECHANIC ARTS**

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**Soil and Crop  
and  
Their Relation to State Building**

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**By A. N. Hume, Agronomist and Superintendent of Substa-  
tions, South Dakota State College of Agriculture and  
Mechanic Arts, and Agricultural Ex-  
periment Station.**

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### SUMMARY OF BULLETIN NO 139

(1). It is estimated upon the basis of commercial prices, twenty-five million dollars worth of nitrogen was removed from South Dakota soils in 1910. Most of it was never returned. Page 9.

(2). Replace nitrogen by growing legumes, such as alfalfa, clover, field peas, or even sweet clover. Page 11.

(3). That it is possible to reduce the nitrogen content of South Dakota soils below the limit of profitable crop production is certain. Page 9.

(4). To be brief, there is only one thing to do, namely, South Dakota must at once provide for a *state wide study of her soil and crop conditions*. Page

(5). By helping to solve the problems of the soil, and by generously and far sightedly according to its people that which is their due, can we "build the State." Page 16.

(6). A desire to call attention to the urgent need that the state acquire definite knowledge concerning its own soil and crop conditions, and at the same time place this knowledge into intimate contact with farms and farm people—this desire has led to this publication.



## SOIL AND CROP AND THEIR RELATION TO STATE-BUILDING

By A. N. Hume, Agronomist.

It has been well said at different times and in different places that things talked and written about should be practical. Our times should not be entirely given over to visions and visionaries.

The subject of this Bulletin, "Soil and Crop and Their Relation to State-Building" is practical enough. Every man of us appreciates that if there is not a crop this year, all the interest of legitimate business in this state must suffer tremendously. We note eagerly that the rains of last fall and the snows of the past winter have established more than reasonably good amounts of moisture throughout our soil areas, all over the state. Whether we say it or not, a worded or unworded prayer goes up for earlier and later rains for the coming year. We are dependent upon the resources of the soil and the atmosphere in South Dakota. There is no logic about it. To say it is not even statesmanlike because it is so absolutely self-evident. Anybody who said anything else would be either a fool or a knave, or perhaps part of each. When the supplies are withheld we feel our dependence upon what we call "nature" especially keen, and among other things, we discuss, and very properly so, what *we* can do to build a state. We are standing, as a matter of fact, before great natural forces that go to make up a state, not in utter helplessness, but at least in childlikeness.

How long have the forces which make up South Dakota been in operation? How many million years is western South Dakota older than what we see east of the great Missouri? In the face of such forces, acting through such milleniums, what can we do today? Do we have the impression that we, severally or collectively, have a great deal to do with state-building? Let us contemplate for

just a moment, at least for one little moment, the fact that if it were necessary for the myriad years of the glacial era to repeat themselves in our day in order that the fair state of South Dakota be made ready once more for us to live in, our human race, with its vaunted accomplishment, would appear utterly impotent. We build a state! You and I build a state! You and I and all the rest of us will have enough to do to make our mighty little share, which will be at least as much as the impression which a man makes by sticking his finger into the ocean and pulling it out again.

In great measure, the state of South Dakota, therefore, is already made. Her soil is laid down. It was laid down thousands and thousands of years ago. For ages before our time the rivers divided the dry land. The mineral wealth of the hills was locked in its hiding place. The forces that acted so long ago to build this state are acting still, silently, irresistibly, continuously.

We dimly realize all this, but in order that we shall deserve it all, the name which we as citizens oftentimes give ourselves, that of "State Builders", must rather be turned into meaning the best ways for not becoming "State Spoilers."

As we have had mighty little to do with the creation of the resources of South Dakota, we can have less to do with re-creating them if we waste them.

"The Soil and the Crop--The Foundation of the State", created not by us, entrusted to us as stewards for safe-keeping in our generation and for the generations to come. Is that not practical?

Every dollar of wealth which South Dakota can rightfully claim must come eventually out of her soil. Every immigrant that comes into the state must come because he hopes in the end to establish a permanent and respectable home for himself and his posterity. If such hope were to



be in a measure deceived, the prospective immigrants would sooner or later find it out, and the homes they might establish be established elsewhere or possibly not at all. Whatever building of this state is done or of any other state so far as that is concerned, will be done upon the soil.

We are looking forward to the coming year. We hope to do something practical which will increase the revenues of the state. It may be as easy for us to fool ourselves as it is to "feed cream to a cat." But most of us can think clearly enough to know that what we can altogether do will not equal the "boosting" effect of fifteen inches of good rain properly distributed. That which we can do in South Dakota is to save the rain and use it, possess the soil and live upon it. In South Dakota our measure of citizenship is and will be for next year and for years to come, expressed in our ability to use the rain and use the soil, and use them aright and not abuse them.

That which has been said of an older state is increasingly true of South Dakota. "The wealth of South Dakota is in her soil and her strength is in its intelligent development." It is as much true of South Dakota as it is of any state, that the soil wealth is represented by the wealth of the farms. The state has one other considerable source of wealth, namely, the mines in the Black Hills. Of the production of mineral wealth from these mines, we are all justly proud. Herewith is included the estimated value of gold and silver produced in South Dakota for seven years, ending with 1910. It is as follows, given in thousands of dollars:

	1904	1905	1906	1907	1908	1909	1910
Gold	7025	6914	6605	4138	7742	6574	5183
Silver	108	109	105	70	105	102	61
Total	7133	7023	6710	4208	7847	6676	5244

In round numbers our state produced one-fourth as

much gold as either California or Colorado, and that with a population of about one-fourth the former and about the same as the latter. But this mineral wealth, which means so much in income to the people does not measure one-third of the value of the wheat crop nor one-third of the value of the corn crop. The oats crop of South Dakota in 1910 was worth one and one-half times as much as all the mineral wealth taken out of the Black Hills. So was the barley crop. The four million bushels of flax seed produced in the state were worth as much as the gross income of gold and silver, and the hay crop brought more than twice the wealth to South Dakota that was produced in precious metals. The festive hen, which could live in large part on grasshoppers and weed seeds, if necessary, was just about as valuable in 1910 as the mines in the Black Hills in dollars and cents. If one should add the farm values of the most important crops produced in 1910 and divide the sum by 15, the quotient would about equal the mineral wealth produced in that year, while about four thousand of the productive workers of the state are engaged in producing wealth. All the rest of the productive workers are engaged in living and working on the farms.

The problems confronting the majority of citizens of South Dakota are problems of the farms because so much of her wealth comes from the farms and will continue to come therefrom so long as she has wealth. In large part, her problems in engineering have to do with farm mechanics or with irrigation projects that have to do with getting wealth out of land. It is as much a matter of interest to a farmer to know whether we are to have good roads or poor roads over which he may haul crops to market, as it is to the man who owns or rents a tourist car.

It is evident to every thoughtful man or woman that good business demands the carefulest development of our mining and manufacturing industries. For instance, in



years of crop failure upon the farms, the mines need not fail. Therefore, they not only add largely to the total wealth of the state, but add it in such a way as to steady the state's total output of wealth. In like manner, the proper development of manufacturing industries will serve to counterbalance the effects of untoward seasonal conditions, which we will learn sometime how to meet. Much of the happiness of our citizens will depend, therefore, upon the symmetrical development of all our industries. Surely no one will make the mistake of thinking that the importance of our other great industries is forgotten, in an effort here to direct attention toward our primary and greatest source of wealth.

If you will do something to help build a state, it is not necessary to neglect any proper industry, but if you will do something to build the state, do something for the permanent benefit of the farmers of South Dakota for they represent the productive intelligence of the state, without which our natural resources will be wasted, or worse than wasted. They bear the burdens of civilization in considerable part, whether you will or no. Living upon the soil, they are often most likely to be cheated out of their birthright without their knowing it. Called upon to furnish the sinews of our civilization, their ranks are depleted by the trend of population toward the city until instead of half the people in our nation living on land, only one-third of the people are there and some of those remain because they can not get away.

The farms of our states cannot withstand the pressure that is being made upon them. The pivotal point, as they are, upon which all our civilization turns, the farms of our states and the people who dwell on the farms, can not continue to hold up under the present strain.

By the subtle processes of plant growth, tons of precious materials are taken out of our soils every year. Every

wheat plant that grows, every corn stalk that ripens its yellow ear, every clump of millet or grain sorghum that withstands the drought and hot wind of an unfavorable summer, even every alfalfa plant or Canada-field-pea, is a little machine marvelously equipped for extracting mineral wealth from South Dakota soils. No plant will germinate and grow to maturity without ten elements of plant food. They are, carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, calcium, iron, magnesium. No plant ever grew in South Dakota or anywhere else without using some quantity of all these elements.

Practical! If it is practical to know that fifty-four million bushels of corn were raised in South Dakota in 1910, it is practical to know that it took fifty-four million pounds of nitrogen to grow that corn and that no one can grow that much corn without that much nitrogen. It is practical to know that the value of the corn was twenty-two million dollars and it is fully as practical to know that the commercial value of the nitrogen within the corn at the price which one would have to pay for it in Chili salt-peter or sodium nitrate, would represent a value of eight million dollars—the amount of wealth taken from the Black Hills. More than as much nitrogen was used by the wheat crop, half as much by the oats crop. In 1910 the crops of South Dakota required one hundred and sixty-five million pounds of nitrogen. In the form of sodium nitrate, it was worth more than twenty-five million dollars. Under our present system of farming, an overwhelming share of it came out of the soil, and an overwhelming share of it was never returned thereto. Some of it may have gone in the form of wheat bran to enrich the soil of Connecticut or of some other eastern state. One thing is sure, as long as it is gone from the state of South Dakota, it will no more appear again in the form of wheat or other grain than the mill will grind “with water that is passed.”

So far as human intelligence has been able to predict,



it is an unalterable conclusion that in order for South Dakota to continue long as a prosperous agricultural state, its great body of farmers must desist from despoiling the land of this element, nitrogen, without returning nitrogen to the soil to take its place. A great deal has been said about returning nitrogen to the soil by means of leguminous plants, but exceedingly little has been done about it compared with that which must be done. That it is possible to reduce the nitrogen content of South Dakota soils below the limit of profitable crop production is certain. That it is possible, by such reduction to reach the limit indicated in the near future, is also probable.

So far as one can predict, after some little investigation, of the matter, such catastrophe is indeed imminent. It may not seem so to the careless observer. Nevertheless, the indications of such exhaustion are already so clear that "the wayfaring man, tho a fool" may see them. Experiments conducted in Canada on soil similar to some of our best wheat land in South Dakota showed that at the beginning of the test in question, the nitrogen content of the land was about seven thousand pounds per acre in the surface soil. The land in question was put into small grain and it was continued in small grain for twenty-two years, during which time there were thirteen crops of small grain and nine years fallow. At the end of the period it was found that one-third of the original nitrogen content of the soil had some way or other been lost.

One-third of the nitrogen content of virgin soil lost in thirteen crops—in twenty-two years! One may imagine the extreme case of losing the remaining two-thirds and all within a period of sixty or sixty-five years, which is about the life of two generations, or a very usual lifetime of one individual. Indeed, it is a matter of common knowledge on South Dakota farms that old land does not produce so well as new land, providing the latter has once been well broken and put into good physical condition. It is



frequently remarked that strains of corn which will mature on new soil will be almost certainly caught by the frost on older soil. These are common indications of the fact that South Dakota soils will not last forever. The more nitrogen taken out and the faster it is taken out, providing none is returned, the sooner will be our stringency.

I cannot too strongly indicate that this is a practical matter for imminent concern. Moreover, it is not here necessary to go into long-drawn-out theories about a possible remedy. The only practical place for securing this nitrogen which must be replaced in our soils, is the great ocean of the atmosphere, which is four-fifths nitrogen. It is a matter of almost common knowledge that in order to make any of this nitrogen available for various farm crops, some of the family of plants known as legumes, must be introduced into our crop rotations. There is no other way known under heaven or among men whereby we can get nitrogen, practically for crops on large areas, than to grow legumes and turn them under. It is important that we produce alfalfa in South Dakota, because in many places, alfalfa will prove, and is proving, to be the most profitable crop on the farm, but from the fact of its nitrogen-gathering ability, it is also an imperative necessity. The difficulties of producing alfalfa in various sections of South Dakota are not all imagined, but the difficulties of producing it should only intensify the intelligent study of the problem working toward knowledge which will make this queen of the legumes a frequenter of our farms.

Alfalfa is a perennial. It takes it long to grow. It is not suited to short rotations. The seed is expensive. It will be a long time, as a matter of fact, before it will rule its entire realm.

We may need, and will need to resort to other annual and biennial legume crops in our rotations, which in their

turn may supplement the nitrogen to be replaced by alfalfa. In this respect, common red clover may be expected to play an important part. Annual legumes, such as Canada field peas, perhaps vetches, may prove of increased value. Last, and mayhap not least, it may appear that the until-now despised sweet clover, which has been rejected as a roadside weed, may be found to be vastly better fodder than Russian Thistles, and of great value to our state. One thing is sure, the depletion of nitrogen from South Dakota soils must cease. The practical thing to do is to increase the area of legume crops, put in on South Dakota farms. *Do it now.*

Some millions of dollars worth of other elements beside nitrogen are annually removed from South Dakota soils. One refers especially to phosphorus and potassium. I do not know how long it will be before the supply of these will be so reduced that the lack of them will limit our crop yield in South Dakota. Neither do you know. Neither does anyone else. And so, since we do not know anything about phosphorus and potassium as great factors in the farming of South Dakota, we had better not talk about them much until we are enabled to find out.

The following table will summarize briefly the amounts of three plant-food elements removed from South Dakota soils in 1910, and their estimated value in dollars and cents:

**FERTILITY IN FARM PRODUCTS OF SOUTH DAKOTA—1910**

Product	Nitrogen	Phosphorus	Potassium
Corn	54,050,000	9,188,500	10,269,500
Wheat	66,342,400	11,212,800	12,147,200
Oats	23,149,500	3,858,250	5,612,000
Barley	14,327,040	3,044,496	3,443,216
Flax	6,061,440	1,053,360	1,478,400
Rye	586,422	123,284	159,938
Potatoes	49,368	106,640	696,960
Totals	164,566,170	28,583,130	33,857,214
Price per lb.	15c	5c	6c
Value	\$24,684,925.50	\$2,858,313.00	\$2,031,432.84
Total value of N. K. and P.	25,507,756.35	1,429,156.50	2,539,291.05



South Dakota soils are not all equally fertile. They do not all have equal ability to produce crops even with equal amounts of rain. They vary in physical condition. They vary in content of plant food. They will not all respond equally well to the same kind of treatment or the same kind of crops.

One thing will make the conditions of farming as a business and as a mode of life in South Dakota more profitable and more stable, and that is more definite knowledge concerning the conditions of such life on the part of farmers themselves. It is one thing to get knowledge, another thing to get that knowledge into the hands and heads of all people. Both things are absolutely essential.

The first thing that South Dakota needs to do is to get a fund of knowledge about herself. The laws which affect this state at large are made by the legislators which the people send to Pierre. The problem of building a state is no local problem. We have progressed to the point where localized efforts are no longer effective in reaching the whole people. South Dakota has already several Sub-Experiment Stations. They are solving a number of important problems for the communities in which they are situated, and contributing valuable, more general knowledge.

In this connection, one may use the Highmore Substation field as an illustration, especially since it is the one, among all those fields, which has been in operation long enough to have yielded results which are averages of several yields. South Dakota Experiment Station has published five bulletins giving information of benefit to all the State, relative to crops grown at Highmore. The introduction of Sixty-day and Swedish-Select oats, of vigorous strains of alfalfa, Minnesota No. 169 and Kubanka wheats, Hannchen barley, Kursk millet—all this



and other important work is associated closely with Highmore Sub-station Field. The other Sub-station fields at Cottonwood, and Eureka and Oelrichs, will accomplish similar good in due time. The next most necessary thing to do is to strengthen the work of these established fields, and so correlate them that they will become still more state-wide in importance. *Present appropriations of funds by the State, should look rather toward this strengthening, and correlation of the Sub-stations with state-wide needs in agriculture than the establishment of additional similar sub-stations.*

There is yet an enormous demand from the farmers of this State for immediate aid. The information necessary in answering many of their questions is not available, owing to the great diversity of soil and crop conditions.

To be brief, there is only one thing to do, namely: South Dakota must at once provide for a *State-wide study of her soil and crop conditions*. This plan must include every county and every great soil type, and at last every farm and every farmer's family. *This great aim of reaching the individual can be accomplished by the merging of localism and individualism, for the benefit of the state.*

What is the size of the foundation upon which we are to build this state, not for a day, but for all time? Where are the great soil areas? Where begin, where end? What crops are profitable to grow, which more profitable than others?

How will one find out the soil areas of South Dakota? Send a man out to make examination and report. What will you do with the report? Make a plain statement of it, and map perhaps, and publish it. Will the people read the report? Yes, increasingly.

What will one do when he learns the position of the great soil areas of South Dakota? Take samples of the soil from various parts of them. Then what do with the

samples? Make a chemical analysis of them at the South Dakota Experiment Station to find their plant-food content. What further? Put some of the soil from each type into pots in a greenhouse and grow plants thereon. What good will that do? That will give an excellent indication of what may be done to improve crops on these soils in the field.

Is that all? No. After finding the soil types, analyzing for their plant-food content and making pot cultures of them in the greenhouse, go out into the field in the several sections of our State where the areas are located, and try out results thoroughly there on the good farm of some good farmer.

Such experiment-demonstration fields need not be very large. Have enough of them to establish facts and to clearly demonstrate them to all people. Such a thorough system of study of soils and crops, *the very foundation of the State*, would result: (1) In knowledge without which we have no power; (2) The very process of getting such needed knowledge would cause the Experiment Station and College of Agriculture to reach hundreds and thousands of farms in a personal way, "a consumation devoutly to be wished;" (3) These experiment-demonstration fields established on the various soil types, with the results of the work done upon them would not only furnish the basis of knowledge for farming systems on such soil—they would also become a dynamic force in the rural communities. Many of them could be established somewhere near one of the rural high schools, which will be established before very long in South Dakota.

I have indicated that in order for South Dakota to lay a firm and deep foundation upon her soils and crops, she must require her Experiment Station to secure that knowledge and then to disseminate it and make it reappear on the farms of the State. The extension feature of



Experiment Station and College work ought to go hand in hand with the gathering of facts. Knowledge is not real knowledge until it is disseminated. "The greatest knowledge we have," said a wise jurist, "is the common knowledge of the common people."

*It is a function of the State to look after the education of the people of the State.* It is not the essential function of anybody or anything else.

Forgetting all little, puny, selfish, short-sighted, sectionalism, and in order to look after her permanent income and her coming people, the people of South Dakota will provide for at least three things: (1) Funds for requiring the State Experiment Station of the State College to secure and disseminate information relative to soils and crops. (2) More adequate equipment for the teaching of Agriculture—and by this latter, I mean not only in the College of Agriculture, but also in the rural schools of the State, and on the farms themselves.

In this day when the people of the mines and the factories and the farms, are beseeching for and getting their rights, it is within your power to use your influence to help them.

By helping to solve the problems of the soil, and by generously and far-sightedly according to its people that which is their due, can we "build the State."