https://doi.org/10.29321/MAJ.10.A04109

Madras agric. J., 45 (4) : 135—141, 1958.

The Value of Productivity Ratings in the Soil Survey Report

by

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It is now accepted by soil scientists as well as agronomists all over the world that soil surveys should be the starting point for the systematic exploitation of land resources. The chief objective of a soil survey is to identify the various kinds of soils occurring in a given region, describe their characteristics, classify them and locate the positions of the classified soils on a base map. The fundamental purpose of soil survey is to make predictions. As such each soil survey report should contain in its body an assessment of the agricultural capabilities of individual soils shown on the soil map and a prediction in terms of expected average yields of specified crops from these soils under defined management practices. To this end of supplying a table of predicted yields for the mapping units, the use of 'Productivity Rating' has come into vogue.

A productivity rating is an attempt to express quantitatively the crop producing power of a soil. It is well known that many factors contribute to crop growth such as favourable soil conditions, climate and management practices. Therefore it is not feasible to fix the productive capacity of a soil in absolute terms. The problem should rather be tackled on a relative basis. Starting with a soil map which shows the distribution of individual soil types in a given region and the soil survey report which describes the characteristics of each soil type, the problem narrows down to one of constructing a table of predicted yields for each soil type occurring in the region. Much work has been done in the matter of evolving a systematic method for assessment of productive capacities of soils and as a result the productivity rating is used to bring out the soil type-crop relationship. The primary function of a productivity rating in a soil survey report is "to present in black and white, as it were, the comparative productivities of individual types for specific crops under definite systems of management" (1).

Method of Presentation of Productivity Ratings: In the earlier productivity rating tables, the notations used to express the ratings were numbers ranging from 1 to 10 with and without parentheses to

denote respectively, the natural productivity and productivity of these soils under management practices that included the use of amendment and fertilisers. An example of this type is the table of productivity ratings given by Bruce and Metzger for Maryland soils. (4)

Soil type	Crop productive index (values outside brackets are with fertilisers)				
	Corn	oats	fruits	pasture	potato
Hagerstown clay loam	8 (6)	9 (6)	9 (6)	8 (6)	8 (5).

Other Workers like Pohlman (7) have used this method for reporting productivity ratings.

In some cases such as the productivity tables of soils of Pentotoc county, Oklahoma, presented by Fitzpatrick (5), ratings ranging from 0 to 100 are assigned to individual soil types in the country having the rating of the best soil of the country, based on average annual yields of principal crops of the region on each soil and the percentage of each soil type utilised for each crop.

But, the modern trends in the matter of presentation of productivity ratings in the soil survey report are highlighted by the following important features (2): inclusion of a table of estimated yields for the mapping units (soil types), as well as productivity indexes, the use of indexes ranging from 1 to 100 instead of 1 to 10, the assignment of indexes for individual soils for each major crop of the region and reporting the yields obtainable under current practices and yields obtainable under the best management of the soil type. The indexes refer to 100 as the standard. The standard for any particular crop "has been selected to represent the approximate averege yield obtained for that crop on the more extensively and widely developed soils of the region in the whole country or state in which the crop is a principal product". A sample table (drawn from Ref. 3), given below, will bring out the unsefulness of such a productivity rating table:

Soil type	Productivity Rating							
	corn		wheat		alfalfa		sugarbeet	
	A	B	A	B	A	B	A	B
Miami silt loam	70	90	70	100	70	90	60	70

A = Rating under common practices (averege farming) in the region.
B = Rating when put under best current practices of management.

The standard yields for the crops are given as, corn 50 bushels per acre, wheat 25 bushels, alfalfa 4 tons etc. From a reference to the rating table and standard yields it can be gathered that on Miami silt loam soil the yield of corn under common practices of management will be 35 (70/100×50) bushels per acre while when managed under the best current practices an yield of 45 (90/100×50) bushels per acre can be obtained. It is obvious how valuable such rating tables will be in advisory work.

Construction of Productivity Ratings: Productivity ratings are arrived at in two principal ways, namely the inductive and deductive processes (1). In the inductive process, the characteristics of a given soil profile are weighed in relation to their effect upon the production of a specific crop. In the deductive process "ratings are assigned to soil types according to yield data that are considered to be representative of the yield of the specified crop on the particular soil" Of the two, the first method of evaluating the soil characteristics is much the more difficult since the correlation of crop growth with soil properties is tantalisingly complex, especially when one considers the influence of environmental factors on a given soil. However some workers have attempted this approach. Notable amongst these is Storie (10) who has utilised information set forth in various soil survey reports to construct ratings for Californian soils. He considers three factors namely, (A) character of the profile (B) soil texture and (C) other modifying factors such as drainage, stoniness, alkali etc. Each factor is given 100 under ideal conditions and correspondingly less for unfavourable characteristics. The final rating for a given soil type is arrived at by multiplying the factors A, B and C. He prefers to multiply the factors to adding them as is done in the score card system, which, he shows, leads to misleading conclusions in comparing soils.

Weir and Storie (12) have determined ratings for each of the 59 California soil survey areas based on Storie's index and have prepared maps showing the location of the various grades of soils.

A similar inductive process has been reported to be used in Germany (3). Two factors, one relating to genetic soil type (to which values are given ranging from 10 for Chernozems to 4 for Podsols with hard pans) and the other relating to the texture (to which values ranging from 10 to 8·8 for loams, 8·8 to 6·5 for sandy loams, 8·4 to 6·0 for clays and 4·1 to 2·0 for sands are given) are multiplied to get the productivity rating of 'Bonitierung'.

In contrast to the inductive process, the deductive process offers a more feasible approach, since the collection of yield data for known soil types is easier and since yield can be taken as an expression of the sum total of all the environmental factors as well as soil characteristics for a given soil type. It is very important to bear in mind that the procurement of yield data should be for individual soil types under specific management practices. This method has been widely used. Bruce and Metzger (4) utilised data from available soil survey reports, yield data from experimental farms and observations of yields on different soil types over a period of many years to construct productivity ratings for Maryland soils. Two different ratings in terms of numerical values ranging from 1 to 10 are used to denote (1) the rating of a given soil type in comparison to the other soils of the state and (20) ratings for production of specified crops under defined management. A classified table showing all the soil types occurring in the region is also provided. The individual farmer can get the identification of the soil type occurring in his farm done by the county agent and then he is in a position to get the rating for that soil type from the productivity rating table and based upon that change or modify his farm planning suitably to get the best out of his soil.

Since collection of data on crop yields is a prerequisite for the construction of productivity ratings, various sources of information usually tapped for culling crop yield data are listed below :—

(1) *Field observations :* During the course of soil survey, the field worker obtains information relating to yields on individual soil types from as many sources as possible, such as, oral interviews with farmers and agricultural extension workers and reference to farm records and experimental station records.

(2) *Experimental results :* Crop yields from various experimental plots, beside the primary objective of the experiments, can be utilised for estimating averege yields of soil types.

(3) *Field samples :* Data from crop cutting experiments, if available, can be made use of, provided the soil types on which the crop was grown can be identified and management practices can be recorded. Alternatively, data obtained from harvesting sample areas can be used.

(4) *Farm record books :* Probably, the best source of data is a well-kept farm record book, showing not only annual yields from year to year, but weather conditions, management practices and

other allied information as well. To this end, it is even worthwhile to contact individual enlightened farmers, who can be persuaded to maintain such records. Smith & Smith (9) describe how farmers in Illinois were requested to keep continuous records of crop yields on specified fields in their farms for a period ranging up to 15 years and how the data after sorting out the unreliable items, eliminating the differences due to climatic factors and considering the management levels could be used for working out productivity ratings.

Whatever be the source of data, it is very necessary that as stressed by Simonson & Englehorn (8) and Albeiter (1), the procurement of crop yields should be for individual soil types under specific management practices.

Discussion: The inductive process for the construction of productivity ratings is looked upon by some workers as an extremely subjective way of assessing soil productivity and has not been as widely used as the deductive method. However it is recognised by many that where yield data are lacking, the inductive method can be made use of for comparing soils. We feel that it will be worthwhile to construct prodnctivity ratings both by the inductive and deductive processes for the same soil types and utilise the results as mutual check. By such a method, as data on various soil types accumulate, it should be possible to work out a reliable method for making yield predictions from soil characteristics alone. That such a correlation is possible can be appreciated from the results of Storie's later studies (11) on the effect of clay pan on the production of apples in California, where he shows that the crop production curve for apples parallels the soil rating curve set up by means of Storie's index.

Since most soil surveys are made for practical purposes and are expected to serve as the connecting link between agricultural research and specific tracts of land, it is very necessary that soil survey reports should contain productivity ratings in terms of predicted yields, for the soils shown on the soil map. Such yield predictions will provide the basis for using the soil map and report for farm planning. As Kellog (6) points out, "the development of soil productivity ratings for each mapping unit for adapted crops under defined systems of management offers the most promising opportunity for the final analysis of the data of soil science in specific terms".

Suggestions: In the light of the above considerations, the following suggestions are offered to the end of making the best use of the soils of our State.

Reconnaissance soil surveys of the districts of the State should be taken up immediately. The soil surveys should be conducted on the lines worked out by the Soil Survey Staff of the United States Department of Agriculture and soil maps on the scale one inch to a mile should be prepared. If possible, yield predictions in terms of productivity ratings for each mapping unit should be included in the soil survey report. In case available data are not sufficient for the purpose of working out ratings the following procedure is suggested. On the basis of the reconnaissance soil survey report, observational plot experiments may be started in large numbers on ryots' fields with the co-operation of willing and progressive farmers who should be responsible for keeping accurate and detailed farm record books. Data from such experiments, yield data from various experiments in Agricultural Research Stations and from other experiments which might originally have been started for some other purpose (such as crop cutting experiments, fertiliser demonstration trials and simple manurial experiments which are being conducted all over the state) should be studied carefully and utilised to work out productivity ratings for differrent soil types, after eliminating unrealiable data and giving due consideration for climatic and other regional environmental factors.

The construction of productivity ratings may be done by both the inductive and deductive processes so that the possibility of arriving at a satisfactory and dependable procedure for rating soils can be explored.

As the work of recconnaisance soil survey gathers momentum, it should be possible to select specific areas suitable for intensive development and take up detailed soil surveying of these regions. The ultimate objective of such detailed soil surveys will be to establish the much desired close liaison beeween soil research and farmer's prosperity, in that the detailed soil survey report will serve as the basis for making recommendations for farm planning on individual farms.

Acknowledgment: Our thanks are due to Dr. A. Mariakulandai, Government Agricultural Chemist and Professor of chemistry, Agricultural College and Research Institute, Coimbatore, for his valuable suggestions in the preparation of this paper.

REFERENCES

1.	Albeiter, J. K.	1937	Soil Sci. Soc. Amer. Proc. 2: 415–422.
2.	—	1940	Miss Agr. Exp. Sta. Bull. 421: 13–24.
3.	Anonymous	1942	Soils and Fert. 5: 183–184.
4.	Bruce, O. C. and Metzger	1933	Maryland Agr. Exp. Sta. Bull 351.
5.	Fitzpatrick, E. G.	1937	Soil Sci. Soc. Amer Proc. 2: 483–487.
6.	Kellog, C. E.	1938	— — 3: 253–259.
7.	Pohlman, C. G.	1937	West Virg. Agr. Exp. Sta. Bull. 284.
8.	Simonson, R. W. and Englehorn, A. J.	1938	Soil Sci. Soc. Amer. Proc. 3: 247-252.
9.	Smith, G. D. and Smith, R. S.	1939	— — 4: 375–377.
10.	Storie, R. E.	1933	Calif. Agr. Exp. Sta. Bull. 556.
11.	—	1938	Soil Sci. Soc. Amer. Proc. 3: 317–322.
12.	Weir, W. W. and Storie, R. E.	1936	Calif. Agr. Exp. Sta. Bull. 559.