THE MOST EFFICIENT USE OF WATER AFTER IT HAS BEEN DELIVERED TO THE FARM

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For this discussion we will assume that, "delivered to the farm," means delivered to the point of contact with the soil, where the beneficial use of water actually begins.

We will assume also that the following statements are true:

1. Efficient use of water means the most profitable production of useful crops per unit of water.

2. Production of crops is dependent upon soil, air, (or weather,) and water of a quality suitable for irrigation.

3. The use of air or weather consists in adjustment to it.

4. The amount of water available for irrigation will probably not increase and may be considered as the limiting factor.

5. Great improvements in the suitable condition of soil for efficient water use can be obtained by tillage methods, including those calculated to control depth of water penetration; and the proper kind and amount of additives or fertilizing elements. These elements generally consist of:

   a. Commercial fertilizers. These are readily available and their need can be accurately ascertained both as to kind and amount through analysis of the soil.

   b. Humus, which is derived from disintegrated plant material, that is, organic material, either directly or indirectly and must be produced from or by the soil-air-water combination.

6. Quoting from a textbook on soils, (The Nature and Properties of Soils, Lyon-Buckman-Brady) "With a given amount of water, the productivity is dependent upon the low element of soil fertility." Now, since we are dealing with a fixed amount of water, and since the supply of chemical elements is readily available and can easily be brought to the optimum amount, we must look for ways and means of supplying an adequate amount of organic matter, or humus, if we are to improve the soil-water-plant production efficiency.

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The plowing in of crop residues is almost universally practiced and should be satisfactory when enough plant material is left and time is allowed for disintegration. This will take from one to two years and there is no sales return from the plant growth so used. The growth and plowing in of green manure crops is also satisfactory and the organic material becomes available as humus more quickly, but the amount of water required and the cost involved in the production of a green manure crop are almost as great as in the production of a marketable crop, with no cash return for the green crop. The incorporation of livestock into the farm program offers a way for rapid disintegration of whatever residues the cattle or sheep will eat. This can include field clean up grazing and all forage production, and besides returning to the soil the greatest possible amount of organic material, in the best possible condition for quick integration into plant nutrients, there can be a market return through the sale of the livestock, which should be greater than from the market return for the forage crops sold as such. It is a way of selling the crops and the residues and having their soil improvement benefits in addition.

Referring again to the reports of soil scientists, we are told that it is the amount of organic matter, or humus in the soil which more than all other elements combined, determines the penetration, the distribution and the retention of soil moisture as well as much of the presentation of the plant nutrients to the roots of the plants in an available condition.

Mr. Robert B. Kennedy, Soil Analyst of the Western Soil Laboratory at Roswell, reports that the average organic matter content of the Pecos Valley Soils is 1¼% as determined from the many analyses of Pecos Valley soils in that laboratory. He says that this could and should be brought up to 2¼% and in his opinion the additional 1% of organic matter with suitably balancing commercial fertilizers should increase the water use efficiency by 50% and reduce the amount of water required by 25%, or present production could be maintained with 25% less water.

The course followed by one farm on which it was necessary to try to find the Most Efficient Use of Water After It Was Delivered to the Farm, may be taken as an illustration of one way which met with reasonable success. No claim is made that the greatest possible production was reached, nor that the greatest possible profits were realized, nor that greater production and greater profits might not have been attained with the availability of more water for irrigation, the claim is simply that the farm operation was profitable and was conducted with the limited amount of irrigation water.

On this farm of 320 acres, irrigation was begun in 1934 with water pumped from the shallow sands. About ten years of gradual addition to the cultivated portion was required to bring the entire half section into production, although clean up grazing and full feeding of livestock was begun as early as 1936.

Land leveling was begun about 1945 and was sufficiently completed by 1960 that permanent concrete lined ditches were planned. The farm program of crops was, during the last ten years, about ¼ cotton, ¼ alfalfa and ½ forage crops of various kinds, chiefly silage sorghums with occasional barley or grain sorghum. All the production of this farm was fed to livestock either sheep or cattle and even the cotton was fed, indirectly, through an exchange, by selling the cotton and buying an equal number of dollars worth of feed grain.

During the last eight years, soil samples were taken from each field, each year and according to the analyses the amount and kind of commercial fertilizer to be used was determined. This was not an expense; from the first the amount and kind of commercial fertilizer needed, as shown by the analysis, to be added to what was already in the soil, was either less in total or of a different kind from the estimate, so that the analyzing actually saved money, as compared with the cost of the guess method. Manure from grazing livestock was, of course, naturally dropped on the fields as grazed, and the manure from feedlots was spread as produced. Upon advice of the laboratory, the manure was treated with a nitrate fertilizer in a small amount. This had the effect of making the nutrients in the manure available in good proportion in the year of application; without this nitrate addition the benefit for the first year was slight.

The Western Soil Laboratory was installed in Chaves County in 1954. From that time it was possible to calculate a balanced fertilization program based upon what was in the soil and what was needed to balance with the organic matter. The later analyses show this farm to have built up its organic matter to a level ranging from 1.7% to 2.00% while the average for the general area was 1.25%.

This farm was sold in May of 1961 at which time it was definitely in the best productive condition of any time since 1936 and the meters which had been in continuous operation on the three wells for five years, from 1956 to 1961, showed an average metered pumpage of 2.99 acre-feet per acre per year.

Actual measurement of the water loss by seepage in a half-mile of open ditch on this farm showed a loss of 22% and since the average length of ditch for the whole irrigation system was three fourths of a mile, the estimated loss for all ditches by seepage would be fully up to the engineers and hydrologists estimate of 30% per mile--in this case 33%. This, of course, means that only 67% or less of the

pumped water was ever applied to the soil for beneficial use and that the amount of pumped water used for production was actually slightly over 2.09 acre-feet. Since being sold, the new owner has lined almost every foot of ditch and so most of this loss has been eliminated and it should now be possible to have the same production -- a reasonably profitable production with a little over 2 A. F. of pumped water, actually 2,093.

So far as I know, this program of balanced fertilization based on the adequate supply of organic matter, which it seems can best be accomplished through the addition to livestock to the farm program is the best answer to the question, How to Obtain the Most Efficient Use of Water After It Has Been Delivered to the Farm -- a circumstance where you can eat your cake and have it too, in this case the crops are sold through the livestock and the fertilizing elements are kept where they can do the most good.

The question naturally is asked, "If this is so good a program, why have you only twenty eight feedlots on farms with as many as 100 cattle when your county agent gives as his opinion that there ought to be a hundred such feedlots?"

There have been two principal hindrances, both of which are rapidly disappearing; one is the hesitancy on the part of the eligible farmer to borrow the necessary funds for the purchase of the livestock needed; this because he doubts that the necessary credit is available to him. This is being corrected as he learns that credit agencies are not only willing, but anxious to add this part to his farm operating loan. The second is the erroneous information that elaborate feed preparation equipment is a requirement and that to justify this elaborate equipment there must be rather great volume from the start. Both are fallacies. For a safe and sound operation one must start small and grow in numbers as well as in equipment, and in both, additions can be made as needed.

In summary, to reach the Most Efficient Use of Water After It Has Been Delivered to the Farm, we conclude that a program of soil management must be followed, one that is capable of producing the most profitable continuous supply of useful plant growth per unit of water.