

Economics of Long-Term vs. Short-Term Soil Fertility Management

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Crop fertility programs should be developed as long-term strategic plans. Unfortunately, economics, land tenure arrangements, and other factors sometimes preclude long-term planning. However, the relative merits of a long-term fertility plan must always be compared with the limitations of a short-term plan.

CROP PRODUCTION is filled with uncertainties in the short-run. Weather conditions, crop prices, input prices, and pest problems vary from year to year, causing profitability to vary as well. Focusing on the uncertainties of annual yield and profit variability translates to overly conservative management decisions that decrease efficiency and limit profit potential.

Short-term fertility management, focusing on the next season's needs and potential response alone, can be a costly strategy. Farm operators with short-term plans find it difficult to commit to the investment of building soil fertility levels. Under the best conditions for uptake, less than 30 percent of the phosphorus (P) and less than 60 percent of the potassium (K) fertilizer applied is recovered and removed by grain crops during the first crop year after application . . . the rest remaining (in most soils) in available forms for future crops. It is difficult to justify the cost of buildup fertilizer in annual budget analysis. Yet, when **amortized** over a period of years, fertilizer costs necessary to build soil test levels to the higher productivity range are relatively **inexpensive**.

Consider Goals

The interests of the landowner and the tenant may not be the same when it comes to building fertility levels. Land tenure

arrangements often discourage buildup fertility from the operator's point of view. When a farm is operated on a year-to-year cash rent basis, or other short-tenure arrangement, it is difficult for the tenant to justify expenditures for buildup fertilizer application. In fact, if he knows he has limited tenure, it may be to his advantage to hold back on maintenance applications—and to deplete the fertility resources in the soil. The landowner's interests, on the other hand, are best served by building fertility to the optimum soil test level and maintaining it with a sound fertility management plan. To protect both interests, the lease agreement might include details on cost sharing of buildup and maintenance fertilizer applications, such as specific guidelines for soil testing and record keeping.

It is in the landowner's best interest to share in—or even pay for—the costs of buildup fertilizer applications. In a crop-share lease, the landowner will benefit at least as much as the tenant from the higher fertility level. In a cash-rent situation, building soil fertility will result in a more productive farm that will often command a higher cash rent price. Higher yields generate more crop residue which helps improve soil tilth, maximize water and nutrient use efficiency and generally improve the value of the land. Well fertilized farms attract better tenants and help keep them on the land.

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Table 1. Impact of land tenure on net income to fertilizer K at a yield potential of 175 bu/A and initial soil test of 188 lb/A.

Tenure, years	Optional soil test, ¹ lb/A	Yield		Crop ² value \$/A	Amortized buildup cost ³ \$/A	Net income above buildup fertilizer cost	
		Relative %	Absolute bu/A			1 Acre	400 A
1	188	90.3	158	395	—	—	—
2	240	94.9	166	415	14.56	5.00	2,000
5	302	97.7	171	428	14.82	18.00	7,200
10	341	98.6	173	433	12.24	25.00	10,000

¹Calculated as the soil test level at which the last increment of soil test increase is just paid for by the expected increase in yield. U. of Illinois K response curve: % yield = $100 \times [1 - 10^{(-.0054 \times \text{K soil test})}]$.

²Market value (\$2.54/bu) - maintenance cost (\$0.04/bu) = \$2.50/bu.

³(Optimum soil test level - 188) x 4 lb K₂O/lb K test x \$0.12/lb K₂O amortized over the land tenure period at 10% interest.

Buildup Fertilizer: A Capital Investment

Most farmers and landowners consider fertilizer to be an annual crop input investment. But **buildup** fertilizer applications should be treated as a **capital investment** to be amortized over a period of years. For a soil testing in the medium range for P or K, the cost of buildup to the high range will frequently be recovered within the first 2 or 3 years. If the cost is amortized over 5 or more years as a capital investment, it becomes a minor cost on an annual basis, yet the benefits continue to accrue each year the field is farmed. For a landowner who intends to maintain ownership for 5 years or more, there is a strong economic incentive to build soil tests rapidly, and to insist that they be maintained at an optimum level. Tenants who know they will be farming a field for several years also have a strong incentive to build fertility and maintain it at optimum levels.

Both the landowner and the tenant benefit from optimum fertility by being able to produce consistently higher yields, by being able to take full advantage of the above-average growing seasons, and by being less susceptible to yield losses in stress years. For forage crops, optimum fertility may also increase profits by increasing forage quality and stand longevity. Building soil fertility is a costly management decision, but **NOT** building soil fertility may be even more costly in terms of lost yield potential in an average year, increased yield losses in a poor year,

and missed profit opportunities in the good years. Building fertility also may help reduce the risk of soil erosion, reduce costs of pest management programs, and maintain the productivity and value of the land.

Emphasis on Profit

Table 1 illustrates the importance of land tenure in determining the optimum soil test K level. Short-tenure leads to short-term management strategies which eventually reduce profitability. As land tenure period increases, the optimum soil-test K level also increases because more years of crops are affected by the elevated soil test level and the cost of the buildup may be amortized over more years.

Short-term strategies result in lower yields and generate less profit. For a 400 acre farm, the 5-year strategy generated over \$7,000 extra income per year when compared to a one-year strategy. Expanding the tenure period from 2 years to 5 years increased net income by over \$5,000 per year. **Short-term management strategies may be very costly!**

Building to and maintaining optimum soil test levels associated with long-term management strategies offer several additional benefits:

- Increased yield and income stability through a decrease in negative effects of too much or too little water.
- Reduction in yield loss from compaction.

- Greater flexibility in P or K use in individual years as prices and cash flow fluctuate.
- Greater flexibility in fertilizer placement (Table 2).

Table 2. Greater flexibility in fertilizer placement occurs at higher soil test levels.

Placement method	Yield, bu/A	
	Low fertility	High fertility
No P or K	77	145
Broadcast	109	151
Surface band	103	153
Subsurface band	116	154
Chisel system; average of two years. Minnesota		

- Increased potential for success in conservation tillage programs that improve soil productivity through long-term improvements in soil structure, organic matter, water-holding capacity, general tilth, etc. (Table 3).

Table 3. Adequate K is critical in conservation tillage systems, especially with some corn hybrids.

K ₂ O rate, lb/A	Yield, bu/A		
	Hybrid A	Hybrid B	Hybrid C
0	144	165	143
40	152	175	159
80	153	175	165
160	152	175	162
Response	8	10	19
Soil test K=290 lb/A (high) Minnesota			

- Increased rate of plant development leading to drier grain at harvest time.
- Lower grain moisture at harvest time (Table 4).

Table 4. Corn grain moisture is frequently lower at harvest with higher soil test levels.

Soil test P, lb/A	Corn grain yield, bu/A	Grain moisture, %
34	144	29.4
62	143	26.8
74	154	24.9
129	153	22.8
Wisconsin		

- Greater long-term nitrogen (N) use efficiency, especially from improved uptake during stress years (Table 5).

Table 5. Potassium fertilizer rate increases N use efficiency; raises optimum N rate.

K ₂ O rate, lb/A	Corn yield (bu/A) at various N rates (lb/A)				
	0	60	120	180	240
0	49	63	77	77	61
40	60	81	88	115	112
80	55	82	110	120	125
120	41	83	118	135	152

Based on Illinois data.

Sharing the Benefits

The residual value of P and K fertilization makes short-term planning a costly practice. While the short-term tenant who invests in building fertility might be making a land improvement that will benefit someone else, the tenant may also increase the chances of renewing his lease by improving productivity. On the other hand, the tenant who allows soil tests to become depleted is limiting his profit potential even in the short term. The tenant, the landowner, and other interested parties will share in the benefits of improved fertility, not only in the short-term, but as long as the land stays in production.

Tools Adapted to the Long-Term

Soil testing and buildup and maintenance application strategies work best with a minimum of 5 years in the plan. The variability of soils and the lack of precision in sample collection and fertilizer application systems make conclusions drawn in the short-term very risky. For the farmer who is in financial trouble, there may be no alternative to short-term management. Unfortunately, farmers forced to think short-term are often those who can least afford to do so.

Long-term management plans including long-term soil tests and records of fertilizer use and crop yields are essential tools for making use of new variable-rate fertilizer application systems. Without the detailed soil tests and records, a farmer cannot take full advantage of this technology. With this information available, the variable-rate approach can mean further savings and increased profits.

Computerized mapping and application systems are not necessary to take advan-

tage of variable-rate fertilization. They help make the job easier, but conventional systems can be used to fertilize different parts of a field with different rates and get many of the benefits. Site-specific management will become more common in the next few years as economic and environmental concerns continue to be an important force in management decisions.

The time and expense of site-specific management make it essential that it be a part of a long-term strategy. The farmer, landowner, dealer, and other advisers must make the commitment to follow the plan. All of their interests will best be served with a long-term plan.

Business Opportunity

Helping farmers and landowners work out long-term fertility management strategies can be a business opportunity for fertilizer dealers or crop consultants. It is usually part of their business to help work out fertilizer recommendations, but not always on a long-term basis. Projecting the costs and returns over a period of years—both in terms of agronomics and economics—is helpful in strengthening customer commitment and loyalty to the dealer. It is important to emphasize the value to customers of a long-term plan. They can use it to project expenses and income over time and work out the most acceptable program for building soil tests in fields needing improvement.

Environmental Benefits

Farmers, landowners, fertilizer dealers, and everyone else involved in fertilizer

management decisions must consider the environmental impact of their recommendations and actions. There is an unfortunate perception that the environment can best be served by cutting back on fertilizer use. **That is not necessarily true!** When soil test levels are not adequate to support optimum crop growth and yields, soil losses are likely to be higher. Optimum P and K levels help to improve N use efficiency, reducing potential for nitrate movement into surface and groundwater. Higher yields from optimum fertility allow more options for removing less productive, more erosive fields from production and yet maintaining the same overall crop output.

Summary

Long-term management strategies for soil fertility are important for protecting the interests of both landowners and tenants. Building and maintaining soil test levels high enough to ensure optimum productivity will produce highest yields and greatest profits over time. Amortizing buildup costs as a capital investment over a period of 3 to 5 years can help justify the economics, because the benefits of the buildup will continue to accrue beyond that amortization period. Developing a long-term fertility management strategy helps maintain customer loyalty.

Long-term plans for optimum fertility also protect the environment through better N use efficiency, better soil tilth and improved erosion control. Sound fertility management pays big dividends to the farmer, the landowner, the dealer, and the environment. ■

New Publication Examines Spring Wheat Cropping Systems

GROWERS of spring wheat will find extensive information to help refine their crop input decisions in a new publication just released by the North Dakota State University Extension Service. Dr. Ed Vasey, Extension soils specialist, served as senior editor of the publication, titled *A Closer Look at the Spring Wheat Cropping System for More Efficient Yield (MEY) and Sustainability*, EB no. 58.

The guide is about 100 pages, with 48

illustrations in color. The 30 major headings in the publication range from developmental stages of the wheat plant to summaries for increasing profits in various yield ranges. There are also lists of additional resource readings and computer software support items.

The bulletin is available from Extension Distribution Center, NDSU, Box 5655, Fargo, ND 58105; cost is \$5.00 plus \$2.00 shipping and handling. ■