New Types of Decisions Require New Tools

Farm managers need tools that can help them weigh the economic impact of choosing feed ingredients that vary in price and nutrient content against the environmental impact of those decisions. They need tools that can help them compare scenarios for bringing different by-products onto the farm to feed methane digesters for improved energy conversion and what impact this will have on the transport costs of using the resulting manure as a fertilizer on their land base or a neighbor's cropland while following environmental regulations.

We have some of these tools now, but they each only help with a slice of the issue.

Components of a whole farm evaluation system exist that can help farm managers and advisors start to understand these complex scenarios. Tools are available such as an annual Mass Nutrient Balance, multi-year soil test nutrient change summaries, soil test P-Level maps, annual farm business summary etc. However, to date these components have been individual, discreet tools that often do not "talk" to each other to offer a full picture or evaluation. So managers must make inferences and large logical jumps to decide on a direction to take.

How do nutrient levels change over time?

Can we project how nutrient levels will be changing in the future if we keep the same management schemes? There are at least two ways to approach the question. One is to total the Phosphorus (P) and Potassium (K) brought on to the farm, and the P & K exported off of the farm, and presume that difference between the two will be reflected across the farm's fields (the Mass Balance concept). Every farm is increasing the "bank" of nutrients on their farm, holding it steady, or depleting it. So the Balance could give a gross measure of direction, and level, of change of nutrients. Another approach is to quantify the changes in the farm's soil tests over time to evaluate how the field's fertility is changing and project forward with the results. Both approaches may have their practices. We want to summarize how those practices are changing the overall farm's fertility.

It is not possible to look at a stack of soil test reports and summarize a farm's nutrient balance, (determine how the levels of nutrients are changing across all of the farm's fields in a given period of time). But if we rearrange the information and summarize it in a meaningful way we can start getting a sense of how nutrient levels are changing. (See "A different way to look at Soil tests.")

Part of the difficulty in answering this question is that we typically only sample a portion of a farm's fields each year and so must look at multiple years' data. The more time we must look across to summarize changes, the more likely the management has changed which means we have to be careful about projecting the changes we measure from the past into the future.

One Practical Application

It is common for a farm to apply manure to a field more heavily when it is growing corn, building the field's fertility, and then use that built up fertility in years when the fields are in hay. How do you determine if the balance is right in the corn years to get through the hay years? Should we consider transporting more manure to further fields to take advantage of the nutrients, or should we apply more to the closer fields in order to maintain the fertility through the entire rotation cycle?

A different way to look at soil tests

If we match a field's recent soil test, with its previous soil test we easily calculate how values have changed over time. Suppose the previous soil test was three years ago and reported 15 pounds of Phosphorus (P) per acre (based on a Morgan extraction) and the soil test we just got back for this Fall was for 18 lbs of P. We could take the difference 18 lbs – 15 lbs = 3 lbs and divide that change by the number of years between tests 3 lbs / 3 years to get 1 lbs of P increase per year. Looking at one field's change in soil test would not be helpful for concluding a trend, but if we put the results of many fields together we may see a pattern.

The Nutrient Change Summary report takes all of the fields that were sampled in a defined time period (that have a previous soil test) and then averages the change per year of the selected nutrient. Because we know farms typcially apply manure differently when a field is in corn, than when it is in the hay portion of its rotation, we also break the results out by crop and rotation year of that crop.

Nutrient Changes - Annualized
(Morgan P) - Crop Year 2015

Base Crop	Rotation Year	Total Acres	# of Soil Samples	Average Morgan P	Average Change	# of Soil Samples Decreased in Morgan P	# of Soil Samples Increased in Morgan P
Corn	1	45.05	10	12.32	0.72	2	5
Corn	2	98.33	10	18.40	1.02	4	5
Corn	3	21.4	4	18.86	1.07	0	2
Corn	4	68.6	9	9.76	-0.26	2	1
Corn	5	57.5	3	23.10	3.70	0	3
Corn	6	49.7	7	13.04	2.42	0	5
Corn	7	22.7	1	27.00	5.00	0	1
Corn	8	30.2	4	33.00	2.00	0	4
Corn	9	48.8	9	21.34	1.97	0	9
	Crop Totals	**442.3**	**57**	**18.2**	**1.7**	**8**	**35**
Hay	1	90	15	8.50	-0.24	6	0
Hay	2	49.5	12	18.80	2.10	1	5
Hay	3	110.3	12	5.41	0.40	1	3
Hay	4	49.5	6	5.44	-1.15	2	0
Hay	5	65.15	10	8.29	-1.04	4	0
Hay	6	24	4	2.90	0.00	0	0
Hay	9	37.2	6	5.49	0.40	0	1
	Crop Totals	**425.7**	**65**	**7.9**	**0.0**	**14**	**9**
	Grand Totals	**868.0**	**122**	**13.2**	**0.9**	**22**	**44**

Table 1: The Nutrient Change Summary Report uses soil test information to help us understand how the farm's fertility is changing. The report above shows an increase in Phosphorus (P) levels during the corn portion of the rotation and a flat to decrease in P during the hay years.

Looking at averages can lead a us to a wrong conclusion if just one or two fields had large changes in a nutrient level. So we added the count of fields that increased vs. those that decreased. In the example there was an average of .9 lb of P increase per year for the fields included with 44 of the fields increasing and 22 of the fields decreasing. We can further understand the changes by seeing that in the Corn portion of the rotation 35 samples increased and 8 decreased with an average change of +1.7 lbs of P per year. In the Hay years, 14 fields decreased and 9 increased with an aveage change of zero lbs per year.

Building a field's fertility is good but if the level is high enough and still increasing we might want to look at what practices we can change. Phosphorus (P) and Potassium (K) are each certainly of interest and it is helpful to understand how they are changing. Additionally we can use this report to look at how pH and Organic Matter is shifting across the farm.

Break out the time intervals for more confidence

We can choose to run this report for just the fields sampled this year – which for farms that test their fields every three years would mean we are evaluating the management practices for the last three years. We can also choose to look at samples taken the last two or three years which would extend the period of time we were evaluating to include management from 5 or six years ago. Looking at the results for different periods of time can help us understand how consistently the identified trends hold true.

The Nutrient Change Summary report is available in the Fields & Crops Manager program, as well as to Consultants that run the Fields & Crops Advisor program.

In order to be able to create data like the Nutrient Change Summary its important that the farm had very good field identification that can be used precisely each time a field is sampled.

For future articles we will talk about using Nutrient Level Maps and the Mass Nutrient Balance as tools to help make the best decisions of managing a farm's resources.

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