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The Value of an Acre

The newest numbers for Kansas Land Values have recently been published. Unsurprisingly, land prices rose again last year. Here in southeast Kansas, the average cropland price increased by 12.6% to around $4,400 and the average pasture increased by 4.7% to around $3,200. This comes to about a 60% increase in land prices over the past few years. However, this article is not about unsustainable land prices, it's about what was technically purchased in that acre of land.

What's in an acre? It's 43,560 square feet of soil. The value of that acre to a farmer, however depends on what's in those 43,560 square feet of soil. Knowing what is in this soil becomes of great importance when spending great sums of money on its purchase. The discrepancy in fertility and production between field crop acres can be great, but so can the fertility of pasture acres. Let's first look at what is really purchased, physically and scientifically, in one acre of soil.

Removing all water and organic matter, the weight will be around 3.6 million pounds in an acre foot of dry soil. There is a lot of variation, but it's around 45% oxygen, 30% silicon, 8% aluminum, 6% iron, 5% calcium, 2% potassium, 2% magnesium, 1% sodium, and 1% everything else. Our old soils have a lot of clay. Clay being microscopic sheet layers of oxygen and silicon complexes mixed with aluminum and iron. These sheets can have ions of calcium, potassium, phosphorus, and lots of other stuff mixed in. When inside the clay complex sheets, little of it is plant available. Fortunately, the frayed edges of clays and within the sheets are exchange sites where basic ions can be adsorbed and desorbed. Percentage wise, our soils are more silt than clay. Silt is composed of the same elements, though the particle sizes and structures within are larger.

When we add 3 tons agricultural lime to the soil to adjust the pH, we are only adding 2,000 lbs of calcium to the 100,000 lbs already there. When we add 100 lbs potassium, we are just throwing that into the 30,000 lbs potassium already within the soil. There is around 3,000 lbs of phosphorus within our soils as well. Our soils have hundreds of thousands of pounds per acre of iron in them. This is also why adding non-chelated iron to high pH soil is pointless because there is already a lot of iron, but it's all complexed and unavailable to plants. As well, calcium is not a fertilizer or a soil conditioner in our calcium-based clay soils. Since the vast majority of elements are locked into the soil matrix, only the much smaller plant-available fraction is changeable in the short term and only for certain soil nutrients. This is all to show that every soil test is merely an attempt to quantify nutrients in the plant available pool. It is not, in any way, a total nutrient test.

Value of P and K

Of all the nutrients and adjustments, building phosphorus and potassium from the soil test category of “very low” to the ideal “agronomically optimum,” will be by far the biggest direct and measurable cost. Extremely low soil test P can be in the ‘not detectable’ range, effectually 0 ppm, while agronomically optimum is around 20 ppm. To move the soil test P from 0 to 5 ppm will take 30 lbs P per 1 ppm, and it takes 10 lbs per 1 ppm from 15 to 20 ppm. However, the average over the range comes to around 20 lbs of P per 1 ppm moved, or 400 lbs P to move from 0 to 20 ppm. At the current cost of $0.70 per lb of P, that’s $280 per acre. This is similar to potassium. Very low soil test can be around 50 ppm K while agronomic optimum is 130 ppm K. If it takes on average 8 lbs K to move the soil test 1 ppm, and current cost of K is $0.40 per lb, it would come to $256 per acre. This means that in comparison a few years ago, land prices have gone way up and fertilizer cost have come down. This is ignoring spreading cost, but means that farmers and ranchers might not be able to buy more land, but they can increase fertility and be more productive.

Value of lime

The cost of lime is actually fairly cheap by comparison to fertilizer nutrients. While highly variable from acre to acre and depending on soil buffering and acidity, liming can cost $50-$150 per acre for most acres. It is well worth it for any soil below 6.1 to 6.4 pH. Nearly every nutrient becomes more plant available (or less toxic, as with iron) in a well-balanced soil and gets the biggest yield benefit for that fertilizer cost.

Value of organic matter

Organic matter (O.M.) is much harder to calculate due to a number of intrinsic values. It is hard to determine the money value of microbes, water infiltration, less compaction, and increased nutrient and water retention. Some direct value can be made with nutrient turnover though. 1% O.M. mineralizes 20 lbs N, 6 lbs P, and 2.5 lbs S, plus a handful of micronutrients. This means the difference of 3% O.M. is the difference of around $100 in direct fertilizer cost every year. The storage of 20,000 gallons of water per 1% O.M. per acre (a commonly stated but yet likely overestimate) and the prevention of nitrogen losses is easily more than the direct fertilizer difference. Keep in mind that low O.M. value is not a cost like fertilizer and lime but a loss in benefit that occurs continuously and every year. Considering 1% O.M. in an acre contain 800 lbs N and 100 lbs of P, the overall value adds up to far more over time.

Of course, every acre has a limit of its production capability, even with high fertility numbers. There are parts of your fields that will never grow good corn, at least not in your lifetime, no matter the inputs. However, the opportunity costs between the low fertility and acidic soils vs the optimal fertility and well-balanced soil have more and more to do with loss of production as land prices continue to increase. Effectively, right now it is much cheaper to maximize output through fertility and management, than it is to purchase more acres.

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