Biodynamic Agriculture: How I Made the Transition

by Dewane Morgan

Although biodynamics is an enormously popular and successful form of sustainable agriculture practiced throughout the world, its acceptance has been more gradual in the United States. Dewane Morgan discovered Rudolph Steiner's Agriculture lectures in 1974 and was drawn to the holistic vision and ecological soundness of the method they envisioned. Here he details his personal struggle to learn, apply, and adapt biodynamics to the specific conditions and needs of his farm — at a time when there were few, if any, U.S. practitioners of the method to whom he could turn for advice. His experiences taught him many valuable lessons — often learned the hard way — and the insights he has gained over the years should prove invaluable to growers considering a similar transition, as well as fascinating for anyone who is curious about this increasingly influential approach to agriculture.

During the 1970s, before he began the transition to a biodynamic system, Dewane Morgan's hay fields were full of hary alyssum, the tall white-flowered weed, with sorrel in the bare spots.

For many years, beginning around mid-June, I would experience periods of intense envy followed by severe depression. The cause? I was very envious of everyone's else's hay fields. Their alfalfa hay, either standing or mowed, looked so lush compared to the thin weed patches on my land, with its mineral-poor, worn-out, eroded soils where quackgrass, hoary alyssum, wormwood and sorrel flourished. There would be a thin scattering of red clover, timothy and orchard grass mixed in with the weeds, and as I mowed around the hay fields I could see an occasional alfalfa plant. Depression would raise its ugly head each fall when I realized I faced another winter short of hay and grain to feed our milk cows. Being short of feed meant I would have to borrow more money from the bank to make it through the winter. I was already deep in debt, having started farming with no equity, so the money I borrowed was added to the existing operating loans I had acquired in the past. What made the whole situation worse for me during the early 1970s was the fact that I knew nothing about chemicals used in agricultural production. Nor was I about to use chemical fertilizers or herbicides. As a young, beginning farmer, I was very idealistic and firmly committed to organic farming methods without having a practical working knowledge of what that meant, except what I refer to now as "organics by default" or "no inputs of any kind."

In 1974, however, I discovered and read Rudolf Steiner's Spiritual Foundations for the Renewal of Agriculture, and my whole farming situation began to change. Today, anyone can walk across my farm and see very dramatic results from our use of biodynamic preparations and methods. On my now-lush hay fields, which once yielded ½ to 1 ton of hay per acre in a good year with adequate summer rain, I now harvest 2½ to 3 tons of hay per acre even in a relatively dry summer. On my poor sandy-loam and loamy-sand soils with their low natural inherent fertility levels (low C.E.C. soils) I have watched the topsoil more than double its depth in a period of seven years using little or no compost.

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I was particularly impressed in my first reading of Steiner by a passage in Lecture 2:

"Now, a farm comes closest to its own essence when it can be conceived of as a kind of independent individuality, a self-contained unity. In reality, every farm ought to aspire to this state of being a self-contained individuality. This state cannot be achieved completely, but it needs to be approached. This means that within our farms, we should attempt to have everything we need for agriculture production, including of course the appropriate amount of livestock. From the perspective of an ideal farm, any fertilizers and so forth that are brought in from outside would indeed have to be regarded as remedies for a sick farm. A healthy farm would be one that could produce everything it needs from within itself."

This statement expressed the inner conviction I had always had when I thought about how I should be farming.

The transformation was not immediate,

Rotational grazing of cattle in the background. Hay being rolled up in foreground.

however, nor was it easy. Although I had a strong inner conviction that biodynamic preparations and methods were the only way for me to care for my cropland, I was unaware of anyone else in North-central Minnesota with similar soil and climate conditions to whom I could look for help and guidance. As any beginner would do without the benefit of experienced advice, I made many costly mistakes, with corresponding failures, year after year.

In addition, I could find no information in English explaining how one applies the methods on a farm that, due to its regional location, cannot generate enough animal manure to make compost to cover all crop and hay land with several tons of compost per acre each year. From what I had read, this use of massive amounts of compost was done on all biodynamic farms to promote a healthy, self-sufficient, sustainable farm organism.

Another factor warranting consideration was the history of agriculture and land use in the area where I live, especially in the past 100 years. A University of Minnesota survey conducted from 1929 to 1933 in Hubbard County, Minnesota, where I live, found the leading crops raised on farms at that time were tame hay, oats and corn. No commercial fertilizers, lime or gypsum were being used. The entire county could have been considered "natural organic" by today's standards, but none of the farms were biodynamic. At that time, on what we now consider our heavy soils — that is, sandy-loam topsoil with a sandy-clay-loam subsoil (as compared to loamy-sand topsoil with sugar-sand or gravel subsoil) — the average farm was 160 acres, with 126 acres devoted to crop and livestock production. The following crops were raised: 4 acres, corn; 3 acres, barley; 8 acres, oats; 3 acres, potatoes; 12 acres, red clover/timothy hay; 1 acre, alfalfa. Unplowed land averaged 5 acres of wild hay and 88 acres of low wetland and pine/hardwood forest used for continuously grazed pasture. On these farms the average number of animals raised was: 7 milk cows, 7 sheep, 1 hog, 2 horses, and 7 head of "other cattle."

The farms were managed in such a way that all winter-collected manure was used to raise corn and potatoes. A typical crop rotation was potatoes grown on newly cleared land, followed by corn, small grains underseeded with red clover/timothy grass, then hay, hay. The farms' milk production was separated on the farm with the skim milk being fed to calves and pigs. The cream was sold to local independent farmer-owned cooperative creameries located in the small towns. Seasonal milking was practiced. From late fall through winter, when the cows were dry, farmers worked in the woods clearing more land and sold logs for winter income. This sustainable system of low-input, subsistence farming lasted for about four decades, and then collapsed due to the introduction of small tractors and the availability of gasoline after World War II. Before then, all farming was done with horses. Many rural farms did not get electricity until 1950. Compounding the problem was economic change in local farm markets, as well as attempts to farm nutrient-deficient soils.

Generations of farmers before me had worked the soil to the point of exhaustion One could say they mined the fragile soil of almost every available nutrient and etheric life force, putting virtually nothing back. The question I asked myself many times was, "How am I going to create a self-contained sustainable farm organism with the kind of independent farm individuality Steiner was suggesting, when past generation of hardworking people with good intentions failed to maintain their once-sustainable system of regional agriculture?"

One answer lies in a grounded, practical understanding of the fundamentals of how one makes the transition to biodynamic agriculture. A transition to biodynamics must be based on the natural biological activity in the individual nature of various soils. Experience has taught me that there are five requirements to be met before one begins to make the conversion to biodynamic agriculture in the upper Midwest:

1. Know your farm's soils.
2. Start with a balanced or unlocked soil fertility.
3. Establish a nitrogen cycle suited to the individual nature of the farm's soil and crop rotation.
4. Gently fracture the hardpan and compacted soils. Follow with roots of grasses and legumes working with BD 500 to re-establish granular soil structure.
5. Incorporate cattle or some combination of ruminant animals in the farm.

KNOW YOUR FARM'S SOILS

I had to accept the fact that, due to the parent material left by glaciers as they moved ice and soil across this area thousands of years ago, not all soils in Minnesota were created equal. Either I could move to an area with much better soil or accept that I had what Steiner refers to as "a very sick farm." I chose to remain in an area that receives 25 inches of annual precipitation, snow and rain. Our winters are long and very cold, with little or no weathering of minerals from the frozen glacial till and sandy outwash soils found on my farm. During the short growing season

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the temperature is warm, with periods alternating between moist and very dry. The rate of evaporation is about equal to the rate of precipitation in most years, so leaching of minerals and nutrients is not a major problem unless one uses irrigation. The problem lies in the ability of the soil and dead roots of plants to take advantage of the short periods of time when temperature and soil moisture conditions support optimum biological activity for the decomposition of raw organic matter and the annual weathering and exchange of minerals. The parent glacial till is non-calcarious, so very little calcium is available from annual weathering. Old soil tests show the soils I work with had a low pH of 5.9 to 6.1, low organic matter levels of 1.2 to 1. 5 percent, and very low calcium, potash, and sulfur levels.

During the early days of my farming activity, our county agent strongly recommended that I start using lime, spread at the rate of 5 tons per acre every five years, to raise the soil pH. He also recommended that I sign up for a government cost-sharing program that would cover 75 percent of the total cost of liming. Over a three-year period of time, I had lime or marl spread on 40 acres of hay and pasture ground that was planted with a mixture of grasses and legumes. Right after this initial spreading of lime, I ran into a problem. I completely misunderstood the biodynamic information I had been reading: It basically said that, after one starts using the biodynamic spray 500 along with compost treated with BD preparations, one did not have to add lime.

I was confronted with two extremes. The county agent represented material science at its finest and his recommendation had to be treated like the word of God if one wished to take advantage of cost-sharing programs. The other extreme was a method espousing the virtues of no lime, yet it did not seem to take into account the composition of and biological activity in individual soils, implying instead that the biodynamic sprays and preparations were a cure-all. As I will explain later, the biodynamic preparations have the potential to cure the ills of soils found on a farm and take the individual nature of the soil far beyond what Nature can do on its own, even over a period of many years.

I was of the strong opinion that all fertilizers, especially synthetic nitrogen compounds, were poison and unnatural, thus were to be avoided and considered harmful to soils, plants, animals and people, an opinion that was reinforced by the biodynamic literature I read and the few biodynamic conferences I was able to attend. Yet I began to realize it was going to take me two or more lifetimes to improve my soil if I continued as I had in the past, trying to conform to abstract ideas. I was still faced with low yields that did not come close to county averages. The only exception was the number of acres I needed per cow for grazing; I was above average there. My low crop yields meant that I was able to carry only a small herd, which meant I could only produce small amounts of compost from within the farm organism.

Dolomite lime being spread at 1½ tons per acre on one of Morgan's fields.

About this time, during the early 1980s, many more companies were starting to advertise and market organic soil amendments and fertilizers, all of which I considered useful products. But at that time all of them were cost prohibitive, as I needed such large amounts for my poor soils. I would end up paying two times the amount per acre for these fertilizers that I originally paid per acre for my farm — and I was still trying to pay off my original mortgage. My main crop was grade-B raw milk, which I sold to Land O' Lakes. The price I received did not justify the added expense of using premium-priced fertilizers, no matter what increase in hay and grain yields I might get. For 10 years I had been working to create a biodynamic farm individuality that showed improvement, but overall the situation looked pretty hopeless.

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START WITH BALANCED SOIL FERTILITY

What I began to realize, through years of trial and error, was the following: The law of the minimum always applies. The mineral nutrient in lowest supply or availability will determine what the overall plant growth will be. This brings us to the second requirement in making the biodynamic farm conversion: balanced soil fertility. One needs to raise or unlock the soil's fertility at the beginning of the conversion process — this is not something one hopes for in the future.

I do several things on any land on which I intend to raise crops. First, I take a soil sample and have a complete audit done. It costs more, but I feel it is worth it. With my crop rotation, a field will be tested every five to six years. Second, I conduct a complete weed inventory. I get very concerned if I do not see weeds growing — bare soil spots in one's fields where nothing grows are dead soil spots, so I am always happy to see a few weeds. Weeds growing out of control, however, indicate a major problem generally caused by imbalanced soil fertility and/or by compacted soil with no structure, a result of previous tillage or cultivation practices. Third, I take a spading fork

Rotational grazing of steers on permanent warm-season tall-grass praire pasture. From this pasture, steers were moved to graze a second-cutting hay field in preparation for chisel plowing for corn.

and slender steel rod and physically check for hardpan, soil structure, and depth of topsoil.

After I have completed this process, I have lime spread at the rate of 1½ to 2 tons per acre. The need for lime is based on the weed association, and the amount used is based on Dr. William A. Albrecht's work, which recommends that the soil colloid have 65 percent calcium, 15 percent magnesium, and 3 percent potassium. This saturation level of base elements in relation to the soil's Cation Exchange Capacity is very important in creating the soil individuality that Steiner refers to.

In fact, I highly recommend that the soil research work of Albrecht be incorporated with the spiritual-scientific research that Rudolf Steiner presents in the Agriculture lectures. Then include the 50+ years of research that James E. Weaver, professor of Plant Ecology at the University of Nebraska, did investigating the tall grass prairie and Great Plains grasslands of the Midwest. The work of these three men gives one a total picture, a blending of material and spiritual science.

After much thought and debate, I decided to experiment with chemical fertilizer. I wanted to use small amounts as a medicine for my sick soil. I reasoned that light applications of fertilizer could be incorporated into my soil's earthy humus content for slow release. If I used large amounts of fertilizer per acre, as is the custom around here, I would overload the natural ability of my soil to hold minerals and would end up feeding the plants through the soil's water. I realized the first time I talked to the local Cenex/Harvest States manager to order fertilizer, he would never understand what I was trying to do, so I felt very content to proceed on my own and started experimentation with different rates of application of small amounts of fertilizer. I found that what worked best on my particular soil was to mix 50 pounds of 18-48-0 with 100 pounds of 0-0-60 and spread this amount per acre the first year on already established hay fields or spring planted oats. The oats were underseeded with a mixture of alfalfa and small amounts of red clover, plus smooth brome grass, orchard grass, and timothy. The lime I mentioned earlier was spread the previous fall where the oats underseeding were growing. I never used nitrogen fertilizer other than this one-time application of 9 pounds of N in the 50 pounds of 18-48-0.

I was relying on legumes to supply all the nitrogen needs of the soil. The second and third years, I applied 100 pounds per acre of Sul-Po-Mag, which works out to 23 pounds sulfur, 23 pounds potash and 18 pounds magnesium. After the third year, no other fertilizer was used. My cost was $14 per acre each year for three years. It was top-dressed in early May, following a surface application of BD 500 in April (once the soil temperature had reached 40 to 42 F); BD 501, the silica foliar spray, was applied when the alfalfa was in the prebud stage of growth and the seed stalks of the orchard grass were starting to emerge above the level of the leaves.

Much to my amazement, after the third year, when I stopped the fertilizer applications of Sul-Po-Mag but continued spraying BD 500 and BD 501, I began to notice a new life and vitality taking over the fields. My neighbor's hay fields were starting to show a decline after three years, but on my fields after six years there was still no winter-kill or gradual thinning of alfalfa or grass, nor was there any decline in yields. Soil tests taken after the sixth year would show an increase in pH to 6.5 to 6.7. The calcium and magnesium levels would be close to or exceed the saturation levels determined by the C.E.C. of the soil. What I also noticed was twice the level of trace elements compared to earlier soil tests.

I take all my soil tests at the same time each year, at the end of August. They are quickly dried and sent to a lab for testing. In the past I have split the same soil sample and sent them to different laboratories for testing. When the results were mailed back to me, they would show the same highs or lows of nutrients, but there were major differences between the tests as to the actual pounds per acre of a mineral type, such as potash. As a result I question the materialistic thinking of modern-day science coming from land grant universities over the past 25 years.

ESTABLISH A NITROGEN CYCLE

Rudolf Steiner referred to nitrogen in a context few people ever use, as in this quote from Lecture 3:

"It is not a bad thing, you know, when a farmer can meditate and thus become even more receptive to the revelations of nitrogen. Our agricultural practices gradually change once we become receptive to what nitrogen can reveal. Suddenly we know all kinds of things; they are simply there. Suddenly we know all about the mysteries at work on the land and around the farm. . . . Take a simple farmer, someone an educated person would not consider educated. The ed-

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ucated person would say the farmer is stupid, but in fact that is not true, for the simple reason that the farmer is actually a meditator. He meditates on many, many things during the winter months. And indeed he arrives at a way of acquiring spiritual knowledge; he is only not able to express it. As he is walking through the fields, it suddenly is there. He knows something, and afterward he tries it out."

Regardless of what one's fanning methods might be, all soils need nitrogen to grow crops. Often this is achieved on farms by total reliance on massive amounts of synthetic nitrogen compounds or heavy applications of liquid or raw manure. Other farmers use legumes and compost in the crop rotation. Reintroducing a natural nitrogen cycle into the farm organism that can meet the individual needs of a specific soil's biological activity, enabling it to grow crops, is the third requirement for converting a farm to biodynamics.

A question I had to ask myself was, "How and to what degree does nitrogen flow through the sustainable farm organism I was trying to create?" One of the traditional examples I see most often is monoculture of straight alfalfa or straight red clover being grown for hay. Occasionally, a field of yellow or white blossom sweet clover will be used as a green manure plowdown. This reliance on the growth of a single legume to supply soil nitrogen and restore soil structure is very misguided. Nature, when left alone without human interference, does not allow a single species to dominate as soil cover.

I am a grassland farmer — not so much by choice as out of necessity, because I listened to the needs of my soil and my farm landscape. I was shown that the local naturally inherent physical and biological limitations of the soil and climate cannot maintain soil structure, organic levels or fertility if I till the same land every year to grow annual crops. So, I try to insure that legumes and grasses are always growing on every square foot of farmland with the exception of woods, farm lanes and where corn or vegetables are grown as part of my crop rotation. Recently I counted 15 different wild and domestic legumes and 12 different domestic and native warm season prairie grasses growing on my farm.

I use the following as a basic crop rotation, with different hay fields used each year in conjunction with my warm-season tall-grass prairie pastures as part of a rotational grazing system. I started rotational grazing 29 years ago.

A 120-gallon stirring machine with reversible motor, designed to mix BD 500, 501, prepared 500 and horn clay. All of these preparations are stirred for a period of one hour.

Year 1: Oats underseeded with grass/legume mixture.

Year 2: Hay. First cutting, hay; second cutting, hay.

Year 3: Hay. First cutting, hay; second cutting, grazed.

Year 4: Hay. First cutting, hay; second cutting, hay or grazed.

Year 5: Hay. First cutting, hay; second cutting, hay or grazed.

Year 6: Hay. First cutting, hay or grazed, then chisel plowed.

Year 7: Corn or Oats.

Please keep in mind that I chisel plow hay fields that are lush and well established, showing no signs of thinning, with no decline in yields. I till hay fields as part of my crop/cattle grazing rotation because I want to, not because I have to due to low productivity. The amount of manure my cattle produce from late fall through early spring is used to make compost, along with old hay and straw. Each year in late September this compost is spread lightly on fields where corn or potatoes will be grown the following season. The amount of compost produced determines the number of acres of corn or potatoes.

I started to get serious about nitrogen's role in my crop rotation early one spring day 28 years ago. I went into Wilkins Feed Store in Park Rapids and asked to buy alfalfa, red clover, timothy and orchard grass seed. I was promptly told orchard grass would not grow in this area because it winterkills. I then asked the owner if he could order me a 50-pound bag anyway, which he said he would do. Later that same spring, the Hubbard County Soil and Water technician told me that, on our local soils, alfalfa would not form nitrogen-fixing nodules on their roots, even if I used inoculated seed. He suggested I start top-dressing 50 to 60 pounds per acre of nitrogen fertilizer on my hay fields.

That spring I planted the mixture of legumes and grasses on my fields, but omitted the nitrogen fertilizer. Sure enough, two years later everyone was proved right but me. It was very discouraging during the spring after green-up to see all the dead crowns of orchard grass among the timothy and the few alfalfa plants, which did not have nitrogen-fixing nodules on their roots.

The first time I had plowed the fields, I noticed a complete absence of earthworms, which concerned me. My oldest daughter, Monica, was very young then and was scared to walk around earthworms that

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Subsoiling a hay field after second cutting has been removed. This is loamy sand glacial outwash soil with a very tight natural silt hardpan 16 inches below the soil surface.

came to the surface near our house after a thunderstorm, so I made up a game to help her overcome her fear: anytime we had a heavy rain, we would pick up earthworms and place them in coffee cans. Then we walked out into the hay fields and scattered them around the dead orchard-grass crowns. Those earthworms loved the dead orchard grass so much, they began to multiply on their own in the fields. Because the earthworms loved to eat the roots and crowns of orchard grass, and the cows liked the young, succulent, rapidly growing orchard grass leaves, I have continued to plant orchard grass every spring for the past 28 years. (Now, however, my soil's condition has improved so much that I have a hard time getting the large crowns of orchard grass to die.) Earthworms thrive around their extensive mass of fibrous roots that serve to hold the soil together. In addition, the alma I grow now has nitrogen-fixing nodules on its roots, even though I never plant inoculated seed. There is a personal moral associated in this story: The nitrogen in effect said, "Don't give up. Be persevering."

FRACTURE COMPACTED SOILS/ REESTABLISH SOIL STRUCTURE

The fourth requirement for consideration when making the biodynamic transition should actually be one of one's first concerns, since the soil's full biological potential will never be fully achieved when using the BD preparations until the hardpan and soil compaction is gently shattered. Depending on the depth of the compacted layer, one uses either a subsoiler or deep chisel plow without wide sweeps. None of us would place a plastic trash bag over our head and shoulders and pull the string tight and expect to breathe very long, yet we expect to raise crops year after year on soil that cannot breathe because of compaction resulting from using wide sweeps or from plowing and disking the soil when it is wet. Then we begin to wonder why we have fields full of severe weed infestations.

Perhaps the following example will help illustrate what I am trying to say about hardpans that come from years of plowing. My first tractor was an old WC Allis Chalmers that I used to pull a two-bottom 14-inch plow. I was plowing one morning, slowly turning the earth, thoroughly enjoying the smell of freshly plowed soil, when I noticed a county employee grading the gravel section road next to the field where I was working. The operator of the road-grader and I waved to each other as I approached the headland to turn. On the next round I had a vision that the grader operator and I were doing the exact same thing to the earth: He was packing the earth through the smearing action of a big horizontal blade that left the road smooth and level, while I was doing the same thing on a field with two small horizontal blades.

In fact, I was doing a better job of packing the field down, because I was driving with one wheel in a 5-inch-deep furrow that I had used a horizontal blade to smear and smooth on the previous round. This pressure on the soil was being replicated every 14 inches across the entire field. Then I imagined all the years during which my predecessors, with their small tractors and plows, packed the same field I was working. I finished that day knowing I would someday have to break this annual ritual if I ever wanted to see an improvement in soil structure and yields. Years later, when I could afford to buy a tractor five times larger than my old WC, I sold my collection of old moldboard plows, with their poor design, to a scrap-metal dealer — so no one would ever be tempted to use them again to plow the earth.

It takes much longer for a naturally high-fertility soil or high-CEC soil to collapse when compared to the poor, fragile earth I started off with, but the symptoms of decline are the same. On low-CEC soils, the mineral nutrients become exhausted; on high-CEC soils, the mineral nutrients become locked up in compacted clay particles. This soil becomes as dead as a brick.

I had the opportunity to observe this phenomenon several years ago, when I was invited to visit a farm located in the southeast corner of South Dakota. A friend showed me around a very beautiful area that was rich in history from territorial days, as he explained the many changes he had witnessed there over 80 years. Eventually I met the farm operator, who began to explain how he got started farming, the history of his crop rotation, and his fertilizer and tillage practices.

He was faced with farming on very challenging soils, which were either a heavy gumbo on river-delta silt or clay loam on higher ground. He began with a 4-bottom moldboard plow and raised corn, beans, alfalfa wheat, and oats underseeded with sweet clover, which was used as a green manure plowdown late in the fall. Along with this crop rotation, several hundred steers and hogs were fed out each year, and a brood cowherd was kept on-farm year-round.

Slowly, his fanning operation changed, as he stopped feeding out steers and hogs

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As the earth inhales at sunset, BD 500 is sprayed on the hay field.

and made the transition to raising more corn and soybeans, which meant using more herbicide and chemical fertilizer to compensate for the lack of animal manure. His soils became more compacted each year, and when he could not get a large moldboard plow to stay in the ground, he switched to a chisel plow. He raised more corn and soybeans because the fields could no longer sustain their yields of oats, which had dropped from 110 to 120 bushels per acre to under 40 bushels per acre. Since sweet clover was always underseeded in oats, this green manure crop was no longer part of the crop rotation. The soil became harder and harder to work each year, and it became impossible to get a chisel plow into the ground. All of the farmers in the region share his problem: they are using big V-rippers as their primary tillage implement, working the soil to a depth of 16 to 18 inches.

This decline in soil structure, lack of biological activity, and locked-up fertility is nothing short of a tragic situation for a rural community. This region used to be the alfalfa capital of the upper Midwest. Now, there are thousands upon thousands of acres where no one can raise alfalfa, as year after year newly established stands die after the first cutting is removed.

Herbicides hide the problem of rapidly declining soil structure, chemical fertilizers give the illusion of soil fertility, and GMO plants both hide and give the illusion of a healthy soil and plant environment as one drives by the field — but where does one go after the annual subsoiling, done as one's primary method of tillage, doesn't work anymore? I will give several examples of what is possible when biodynamic methods are used to unlock soil fertility in high-CEC soils, reestablishing biological activity at even higher levels than would occur naturally. On low-CEC soils, one applies the needed nutrients and holds the restored fertility level until the biological cycle of weathering and exchange of minerals is in balance with a reasonable, sustainable crop yield.

My first example is a small permanent pasture that was seeded down in 1976 after 3 tons of lime was applied. Before seeding this pasture down, I used a moldboard plow to work up an old alfalfa/grass field that had been seeded down in 1968 — so this field had been plowed twice in 32 years, and had a grass/legume mix growing on the soil for 30 years. This pasture has good soil structure, with the topsoil being a uniform depth of 8 inches, but it still has a hardpan from moldboard plowing, which I assumed the roots of the pasture plants — working in conjunction with the biodynamic sprays and rotational grazing — would eventually break up. I subsoiled the pasture late last summer because root action alone is a very slow process for eliminating hardpans. Annual mechanical fracturing of the subsoil is not the solution until a diverse growth of legumes and grasses, working in conjunction with BD 500, is allowed time to restructure the earth.

Decaying roots of grass crops act as a major source of humus. Young roots decay more rapidly than older ones and also have a higher nitrogen content. The nitrogen is released as ammonium, which is quickly changed in the soil to nitrate. Large amounts of plant food material are released after a period of several years, as the deep underground roots gradually decompose following plowing. Of course, the usefulness of grasses in preventing erosion is well known.

In summary, the soil needs a gentle mechanical fracturing of the compacted soil structure, followed by a sowing of a mixture of legumes and grasses — legumes with their deep tap roots to keep the newly fractured subsoil open, to bring minerals to the surface soil, and to supply nitrogen to the grasses, and grasses with their fibrous roots structuring the soil through the growth and decay of fine root hairs. Immediately before or after sowing the grass/legume mix, BD 500 is sprayed on the bare, moist soil. This spray promotes root development, humus formation, and the activity of microorganisms, plus other influences.

There is one major exception to this approach: There will be times, because of crop rotation and wet weather conditions, when one has to reverse the order I just gave. Keeping in mind that dry soils shatter, while wet soils smear and compact, the sequence would then be: spray 500, seed down grasses and legumes, subsoil when dry, then spray 500 again when soil becomes slightly wet.

This period of resting the soil for restructuring is greatly needed and is absent on almost all farms in the upper Midwest. Resting land that has been used continuously, year after year, to raise annual cash crops is not the same as leaving the land idle. "Resting" in this sense means not disturbing the soil by tilling — it does not mean that forage cannot be mowed for hay or grazed. I highly recommend alternating both activities.

The amount of time to allow for rest varies by soil type, fertility levels and climate conditions. Allow a minimum of two years

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Field #1: Land left idle in grass cover for 17 years. The stone marks the transition line from topsoil to subsoil. Topsoil depth is 8 inches.

Field #2: Land farmed biodynamically for seven years. The shovel tip marks the transition line from topsoil to subsoil. Notice the roots of orchard grass and smooth brome grass.

for the expansion and contraction of grass roots to restore the granular soil structure. A portion of the total cropland must be rested each year, as I have factored into my farm's program of total crop rotation.

When I discuss biodynamic agriculture, I try to be careful to speak only from my personal experiences. I do not want to mislead a listener or represent biodynamic agriculture as being some abstract spiritual philosophy. As I said earlier, I am a grassland farmer because I listened to the landscape of my farm, which is located on some of the poorest soil in Minnesota. If I lived 60 miles west — for example, on the rich silt loam soils around Lake Park, Minnesota — the results would be much more dramatic than the following examples of two separate fields I rent from neighbors.

These fields have the same soil type and are located one mile apart as the crow flies. Field #1 has a long history of being organic. From 1963 to 1976, all the winter-collected manure from a small dairy herd was spread annually on this field. In 1977 it was limed at the rate of 5 tons per acre and seeded down to alfalfa and smooth brome grass. The dairy farmer who owned the field then bought a much larger farm several miles away. He moved his family and cows, but retained ownership of this small field. Each year from 1978 until 1982, he would put up the hay on this field, and then he sold the property in 1983.

The present owner is not a farmer, and he let the land sit idle, with no forage being removed other than what was eaten by wild deer. The first thing I did after renting it was to put up a fence — one strand of barbed wire and one strand of high-tensile electric wire. When I began using the field as pasture in 2000, I found that it had a much lower carrying capacity for grazing cattle than I had become accustomed to. Using a spading fork, I found that topsoil depth varied between 8 and 8.5 inches. (See Field #1 photo, with small stone marking the transition between topsoil and subsoil.) For many, this may not seem like much topsoil, but in the woods next to this field, where a succession of trees has grown for thousands of years, the topsoil is only 3.5 inches deep. In this area, where farmland was cleared years ago and there is no soil erosion, the topsoil depth in fields varies between 6 to 7.5 inches.

So, this soil left idle for 17 years — after annually receiving tons of manure per acre for many years — was able to increase its topsoil depth by little more than 1 inch above the average for this region. This field still had a hardpan from moldboard plowing in the early 1970s.

I started renting Field #2 in 1993 from my neighbor to the south. It is located on a 5 percent slope and had sat idle for several years when the rest of the cropland was enrolled in the Conservation Reserve Program. The topsoil depth varied from 6 to 7 inches.

It was early June when we reached an agreement to rent. Since it was so late, I decided to spend the summer getting the land ready for use the following year. I deep-chisel-plowed under the light growth of grass, weeds and volunteer red clover, and let this slowly break down.

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Then, in early July, I planted millet. It was dry that summer, but in late August I mowed the millet, let it wilt, and chisel-plowed it under. In September, 2 tons per acre of lime was spread and worked deeply into the soil. The following spring, I sprayed BD 500, planted oats with the underseeding I have mentioned, and spread the fertilizer mix of 50 pounds of 18-48-0 and 100 pounds of 0-0-60. Later, BD 501 was sprayed on the oats, which I harvested for hay. I spread 100 pounds per acre of Sul-Po-Mag for two years and used the BD sprays on this field every year. Each summer I have taken one cutting of hay off this field, which averaged 2.5 tons per acre, and left the second cutting because I could not graze the field.

After taking off the first cutting of hay in 2000, and before chisel plowing, I checked the topsoil depth of this field. I found it to be between 12 and 14 inches. (See Field #2 photo on page 17, with shovel point marking the transition between topsoil and subsoil.) Soil tests taken in late August 2000 showed no need to have lime or fertilizer spread for oats or for establishing the underseeding of grasses and legumes this spring.

What I consider interesting is that the amount of cash rent I pay each year is slightly less that what the landowner receives per acre from the U.S. government for land enrolled in CRP. I am harvesting enough hay each year to cover my expenses and make a small profit at no government expense, although there are restrictions on the

rest of the farm because of CRP.

I really wonder why the farm bill was called "Freedom to Farm." I feel it should be called "Restrictions to Farming." What isn't an illusion in the meaning of words is that I am helping the environment by using the soil as a carbon sink, cleaning the air of carbon dioxide at a much greater rate than would land left in grass cover, as indicated in the two photos showing topsoil depth.

The difference in the increase in humus in the topsoil depth between Field #1 and Field #2 is very dramatic, considering the soil type and climate where the fields are located. So what is the explanation for this difference?

Once the four conditions I have discussed have been met and adjusted to the individual nature of the soil, and one starts using biodynamic sprays 500 and 501 and prepared 500 consistently on the land each year in conjunction with good organic fertilizers, including rock dust, something new happens in the soil. The "farm individuality" that Steiner refers to is born in the soil and begins to grow to maturity as the topsoil depth increases far beyond what nature can do if left alone — just as each of us, as soul and spirit, is born with an individual ego and grows to maturity.

In his Agriculture lectures, Steiner was trying to get us to recognize the possibility of this new phenomenon in nature. This infusion of our farm's soils with a kind of ego consciousness is the new impulse for the 21st Century — Steiner predicted that this goal was possible if each of us does our part. Nature cannot do it without our help. The act of creating a living physical/spiritual entity that gives the soil an individualized ego specific to the individual farm is a new impulse that one has to experience for oneself — not as an abstract concept or intellectual theory, but through a real, inner, personal experience with the soil of the earth.

Much has been written in various books, biodynamic literature, etc., giving directions as to how the BD preparations are made. My advice is to learn to use the biodynamic preparations first, before attempting to make them. Use them consistently on the same land every year, even if it is only a small portion of your total acreage. Then, slowly expand the acreage each year, always using the BD sprays on previously sprayed land. Get physical, visible results that leave no doubt as to the inner experience you have with your soil. Your personal inner strength will evolve, and in time you will have the will to spray all your acreage and see results, which will show up in soil, crops and animal health. I use the compost preparations 502 through 508, BD 500, BD 501, prepared 500, and horn clay each year on my farm.

INCORPORATE RUMINANTS

One of my greatest pleasures in life is to travel alone on backroads through some region of what was once the original tall- or mid-grass prairie region of the Upper Midwest. Although the ancient prairie-grass sod was broken long ago, I see thought pictures in my mind of the landscape slowly evolving after glaciers reshaped the countryside. I see once-lush grass land being grazed by vast herds of bison on distant rolling hills. Then I realize I could ride a horse from the U.S.-Canadian border to the Gulf of Mexico on tilled soil, with very few fences to obstruct my travel. This brings me to the fifth consideration in making the transition to biodynamic agriculture: cattle. Cattle, bison, or some combination of ruminant animals are needed on a farm in order to make a successful conversion to biodynamics.

Cattle can have an extremely beneficial or very destructive influence on the land. It all depends on how we choose to use their influence, or if we think cattle have a role to play on a sustainable farm at all. When I purchased my first 160 acres in 1972, 1 did not realize how abused and rundown the property was. I was determined not to continue the trend for the next generation — I wanted to leave the land in better shape than when I got it.

For example, to use the woodlots in north central Minnesota as pasture gives one neither a productive pasture nor healthy woods. When I started farming, I was advised by neighbors to buy some milk cows and to continue using the woods as pasture. The reason they gave was that cows were meant to utilize the non-productive waste areas that could not be plowed. This reasoning is true to some degree on the short-, mid- and tall-grass prairie grassland regions, providing one does not practice continuous over-grazing year after year. But the woods on upper Midwest farms should never be continuously grazed from early spring to late fall by large herds of cattle or other ruminant animals.

I decided to buy a few milk cows and ignore the advice about grazing the woods. In fact, I broke an area tradition by putting up fences to keep my cows out of the woods. I did this for several reasons. First, the cows of previous owners were slowly killing the forest by their continuous eating, rubbing and stomping of young tree seedlings. The cows were also compacting the shallow 3-inch-deep topsoil. This fragile topsoil found in the woods did not have the benefit of thick, deep-penetrating grass roots to keep the soil open to receive air and water. I also felt, by over-grazing the woods, a half-year's worth of valuable cow manure was being wasted on low-carrying-capacity woodland pastures. This manure belongs on cropland to grow future crops in a hay, crop, pasture rotation.

Next, I put up permanent electric wire around the perimeter of the farm's fields. This was done so that fields could be grazed after the first cutting of hay was removed. I subdivided these fields with temporary electric wire and started rotational grazing the second cutting. I also established permanent warm-season prairie-grass pastures that I use in conjunction with the hay fields as part of a total rotational grazing system.

Five livestock watering ponds are located around the farm, so the cows have easy access to water no matter where they might be grazing in the rotation. The biodynamic sprays are most effective in promoting the granular soil structure and healthy nutritious plants where rotational grazing is practiced, and least effective on continuously overgrazed land, which will have grasses with much shallower roots. I no longer milk cows, but I have a beef brood-cow herd, which I still allow to graze as I did the dairy cows.

If one already has cattle or other ruminant animals integrated into one's farm operation, a major hurdle has been crossed. If not, creative ways need to be explored to slowly reintroduce ruminant animals back onto the farms of the upper Midwest and northern Great Plains. I am not suggesting that someone without cattle go out and buy a herd of brood cows or feeders. What I would advise is putting up a double strand of high-tensile electric wire around the outer boundaries of one's fields, so that smaller portions of land seeded to grasses and legumes can be incorporated into the total crop rotation. This smaller

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portion of seeded-down land can be grazed or used for hay until the soil's granular structure and fertility is restored with the aid of the BD sprays 500 and 501 and prepared 500.

When the soil structure is restored and fertility levels unlocked because of dramatic increases in biological activity in the soil, the land can again be tilled to raise cash crops. Once the soil structure is lost and the soils start to become compacted, this process of rest/grass/grazing is repeated and becomes part of the total crop rotation. One suggestion: If one does not have experience working with cattle, then consider renting the land to someone with cattle. We are all a pretty self-reliant, independent group of people, or we wouldn't be farming — but I strongly believe that we must develop new levels of cooperation and trust between farmers and work together in new partnerships, where everyone, including the land, benefits from the good deeds of others.

The system of conversion I have described will work on any farm in the Upper Midwest or Great Plains. The key to success lies in making this conversion field-by-field as part of a systematic rotation, until the entire farm has achieved a revitalized state of dynamic activity. The first year one sets up the fields, rotation, and fencing. The second year one starts spraying. The third year one starts seeing results. Carrying capacity and yields increase as the soils take on a new life. The land is able to withstand and recover from the extremes of weather. The biodynamic farmer can orchestrate a slow, dramatic, successful change in the soil and the farm, and permanently sustain these new levels of fertility.

Please note, however, that I would not recommend making the conversion to biodynamic agriculture on your own, as I did. An initial farm survey needs to be done by an experienced biodynamic farmer who can see and understand the individual nature of the farm and can meet the individual needs of the farmer and his crop rotation using available resources.

Dewane Morgan can be contacted at 11059 County Road 14, Park Rapids, Minnesota 56470. He especially encourages those who live in the upper Midwest or northern Great Plains and sincerely wish to start the transition to biodynamics to contact him — please explain why you want to make the conversion, include your phone number, crop rotation, latest soil test, and aerial photograph of your farm.