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# THE SOCIAL LIFE OF SOIL:

# FOUR CASES OF SOIL HEALTH IN THE CHESAPEAKE BAY WATERSHED

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by

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#### THE SOCIAL LIFE OF SOIL:

### FOUR CASES OF SOIL HEALTH IN THE CHESAPEAKE BAY WATERSHED

The four cases presented here highlight how particular networks, or guiding 'logics,' influence soil management decisions, and in turn, soil health outcomes. The purpose to these case presentations is to textually depict the complex networks creating soil health at four intentionally dissimilar farms across the Chesapeake Bay watershed. Each network is signaled by a label called a 'logic.' Logic is used to denote an overarching system, in which the head farmer is enmeshed. Unlike a traditional network where parts are simply connected, this kind of logic is about all the parts co-creating themselves and the network.<sup>1</sup>

Like any representation, these logics are imprecise and partial—they cannot give the whole story. Nonetheless, they are useful heuristics for grasping the range of elements—historical, physical, biological, familial, collegial, economic, etc.—that produce or impair soil health on a given parcel of agricultural land in this region. The logics are presented in the following order: Innovation, Privilege, Experimentation, and Observation. The basic farm characteristics for each of these cases is outlined in the table below, and detailed in the case studies themselves and in the Cornell Soil Health Test reports in the appendix.

Logic	Product	Tillage	System	Acres	Soil health score	Organic matter content	Number of serious soil constraints
Innovation	Feed Grain Eggs	No-Till	Conventional	1,200+	55.4	4.0	4
Privilege	Grain	Lo-till	Conventional	10,000+	61.1	2.3	4
Experimentation	Diverse	Tillage	Organic not certified	~200	66.8	4.2	1
Observation	Feed Grain Dairy	Tillage	Organic certified	~500	84.7	7.8	0

 Table 1: Basic case attributes

The cases also briefly consider the issue of farm-level sustainability—social, economic, and environmental—as an effect of the logic and its soil health consequences. Sustainability here means the ability to persist and thrive, and is akin to 'health,' as discussed in more detail in the full dissertation from which this is extracted. The issues supporting or detracting from sustainability are highlighted for each farm within the context of its logic.

While the consideration of sustainability and the presentation of each case are empirically grounded, they are, like all presentations, the subjective result of the researcher's interpretation. In light of this, to ensure credibility, the cases were reviewed and approved by each of the head farmers represented in the cases. Pseudonyms have been used and trivial aspects of each case have been altered to protect the identity of all participants and their farms. All photographs where taken by the farmers. Full Cornell Soil Health Test reports for each farm are available in the appendix.

<sup>&</sup>lt;sup>1</sup> For an understanding of the theory supporting this approach see: Latour, B., 2005. *Reassembling the social: an* 

#### **Case no. 1 Innovation**

#### **Art Byron Farms**

Just before the Susquehanna River splits in two, a substantial creek heads off to the east, following one of the many secondary roads that connect the small and mid-size grain and dairy farms strewn throughout this hilly and wooded agricultural landscape. The creek's bitter iron-orange color signals its inability to support aquatic, or other, life. As it flows along concrete channels, under bridges and through faded post-industrial towns, the remnants of the region's anthracite coal mining heyday are on display. This creek water eventually drains down to the Chesapeake Bay, bringing with it a not inconsequential dose of heavy metals.

A few miles south of the creek, an old oak tree sits in the midst of gently sloping hills

etched with crop rows laid out along the slope contours. The small clear streams running through wooded farmland buffers here tell a different story of the region's history: this area is also home to one of the earliest agricultural conservationists in Pennsylvania. While Art Byron Farms' neighbors may not be aware of it. Art Sr. was a noted soil conservationist in the 20<sup>th</sup> century and his legacy lives on across more than 1200 acres of soy. corn and barley that continue to be managed with an eye to improving the soil and protecting water quality.



The rolling farm fields, with their contour strips and wooded stream buffers, produce feed for laying hens. Several very long, metal chicken houses sit between the road and the fields. Low to the ground, exhaust fans quietly humming—from the outside it is difficult to imagine that in each house over 100,000 birds sit in cages perched above an automated system that delivers feed and removes eggs and manure. The farm now houses almost a half million laying hens, shipping eggs throughout the region and occasionally as far away as Asia. Given the density of chickens here, Art Byron Farms falls under regulations regarding confined animal feeding operations (CAFO).

The soil on this slopping land is mostly Hartleton channery silt loam, with some Berks channery silt loam. It is comprised of about ten percent clay, thirteen percent sand and threequarters silt loam. The flatter sections are designated prime farmland by the USDA, and those with a greater slope are still considered statewide farmland of importance. The soil health rating of a typically managed field here is 55, out of a total possible score of 100 (see appendix B). This mean score is thrown off by very high levels of phosphorus in the soil, resulting from years of spreading chicken manure. The soil health score without the phosphorus would be much higher. The USDA Web Soil Survey suggests that an average or expected organic matter content for these soils is between 1.37 and two percent, with a pH around 5.0. The actual organic matter content is much higher, at four percent, and the pH is 7.0, both reflecting the benefits of soil health promoting practices employed on this particular farm.

Cornell's Soil Health Test (see Appendix) suggests that there are four areas of serious constraint to soil health: aggregate stability, which affects aeration, infiltration and rooting; surface hardness, which also affects rooting as well as water transmission; nitrogen supply capacity; and, as mentioned, a danger of phosphorus loss to the environment. The highest scoring physical and biological aspects of the soil are good available water capacity and a good root health rating.

Three crops are grown here: corn, soy and barley, all within a roughly contiguous three-mile radius. The fieldwork across all 1200 acres is geared toward producing all of the feed needed for the hens. The land here has not been tilled at all for nearly two decades now. No-till, coupled with precision agriculture technologies—such as management zone mapping and variable rate application—allow for greater efficiency as more land, needed to feed more hens, has come under the management of only two field workers.

The farm, and its related businesses, have been owned and operated by the same family for more than one-hundred years, having started as a small grain farm, then becoming a 150 acre dairy, to today's 1200 acre integrated egg operation, alongside other related family-owned agri-business enterprises. Art Byron Jr. now runs the business side of the egg operation, while his children run the other, related businesses. While there are many people employed in the operation, only two men handle all of the crop work; Jim Scott, a thirty-plus year employee, manages the field operations with the help of one other full-time field worker and occasional seasonal help.

While Art Sr. passed away in the early 2000s, Jim and Art Jr. are both quick to point out the lasting influence that Art Sr. has had on this enterprise. Jim worked alongside Art Sr., and is noticeably impressed by the scope of change that happened in agriculture during Art Sr.'s lifetime. Jim is also clear on what Art's legacy means to him and ultimately to the land here, as he says:

All the way from a horse to pushing one button and the marker goes up in the corn planter and the planter goes up and you turn it around and just do all that stuff. I mean that was what all he saw in his lifetime, and it was right there in the field by that oak tree, so... he's kind of the inspiration for a lot of this stuff we do. Working for him for that long, you know, he kind of taught us a whole... he taught me a lot of things about this stuff and passed on his concern for the environment.

Art Jr. wholeheartedly trusts Jim with all field related decision-making on this farm, which is essentially Jim's backyard. He commutes the half-mile from his family home on an ATV across the fields that he has managed for most of his life. Jim and Art Jr. are both affable and mild mannered, seeming a little surprised at their good fortune, but recognizing that they both have Art Sr.'s legacy to thank in creating the groundwork for the booming enterprise that is Art Byron Farms today.

#### The logic of innovation

The hilliness of the land here demanded that some attention be paid to the soil early on, lest erosion took hold. Art Jr. recalls that his father learned about no-till farming when attending a conference in the mid-West; he brought the nascent idea back to his farm in the 1970s. Wanting to waste no time waiting for commercial equipment to become available, he welded together a no-till corn planter and began a great experiment in keeping the soil in place. As Art Jr. remembers it:

People thought he was actually pretty crazy. And that's when he started notill farming, and we've been doing it here ever since.

This enthusiasm to get out to conferences, learn and try something new, has extended to many conservation minded practices—from contour strips and terraces in the 1930s and 1940s, to no-till in the 1970s, to today's cover crops, integrated pest management, precision agriculture technology and even a reluctance to accept everything the marketers insist on. For instance, Jim only switched some acreage into Roundup Ready corn when generic glyphosate became available and he is now questioning the commonly used systemic insecticide-treated soybeans in light of new understandings that this may lead to slug proliferation. It seems on this farm that Jim makes decisions in much the same way as Art Sr. did, through a logic of *innovation* in the context of soil conservation. It is a mix of the specificities of the land here and past and present social support that buoys this logic. As Jim says:

We talked about early adoption, some of that is a mindset that gets shared right on through, and if one's accepting, the other one will be. It's the same with if one generation's against it, the other one will be, too. If the old man didn't do it that way, I'm not going to do it that way, you know.

The conference attendance that led to the initial no-till switch at Art Byron Farms is part of Art Sr.'s lasting legacy—he encouraged Jim to learn from leading edge farmers across the country. Partly as a result, Jim is now a very engaged member of the farmer-to-farmer Pennsylvania No-Till Alliance and he attends the National No-Till conference most years. This group of like-minded farmers from across Pennsylvania is on the forefront of soil health issues in the conventional context. While they do hold traditional field days, they also stay in touch remotely to informally discuss their particular farming issues. They encourage one another to trial and share their experience with new techniques and technologies within the notill system of management. They are keen to learn from those they perceive as the best, and while they had thought that extension and university research was necessarily a bit behind-thetimes, they are now finding ways to work with those researchers to push the frontier for Pennsylvania farmers:

Basically we try to, it's an unconsciously done thing, we try to search out other like-minded farmers, find out where these guys are. You read something or you hear something you get an idea and then you pursue it to see if it's something that fits here. The National No-Till Conference is a really good place that we go to for the ideas to keep us—if we are the leading edge guys—keep us out there. We do a little homework and we're maybe more accepting of a sales pitch with a little bit of proof, will it actually work? Then searching out others who have tried it to find out does it work? Run these guys down in extension or run down some of the researchers at some of the other universities, I mean we've chased down a fella by the name of...can't remember it, who did research work on this crop sensor. I mean we've emailed those guys and run those guys down and talked to those folks about this stuff.

Jim's peer group of like-minded farmers are not his neighbors. He believes that the level of openness and sharing within the group is only possible because their farms are located far enough apart to overrule the competitive mindset that has many farmers reluctant to engage deeply with their immediate farming community. The Internet has certainly aided the group's formation and level of knowledge exchange. For instance, the social media platform called AgTalk figures into Jim's daily management regime:

I've got lots of questions answered on there [AgTalk]. I learned I should have had questions about things that I didn't—from both the conferences and the website. A lot of leading edge stuff... You kind of have to do this, some of this networking with guys that will give it up. There's the family secret that you don't tell anybody, but we're stretched far enough apart, we're not competitive for rented ground, and you know, we've got that relationship and so on, and we talk about anything and everything.

Another member of the Pennsylvania No-Till Alliance agrees that the group members encourage each other to push beyond farming-as-usual to find ways to work with technology and nature in a system that is as efficient and responsible as possible. He also remarks that this drive toward innovation is not all socially motivated, but that the land continues to demand special attention in Pennsylvania:

I think that's what makes us forefront of some of this and really the innovators, because look at a lot of Pennsylvania soil—they're ridges, they're the side of mountains, they're considered... we farm here in Pennsylvania, what the Mid-West wouldn't even bother putting in as pasture. And we don't have the advantage of that deep sub topsoil, not many places in Pennsylvania do. But on a lot of this marginal ground that is deemed agricultural in Pennsylvania, we do everything we can to at least try to maintain that, let alone improve it. And with our steep hills and reducing erosion, reducing nutrient loss, increasing the soil life—which is actually building soil—I think that's what, don't take this wrong, that's what makes us better farmers. We don't have the advantage of screwing up.

No-till was an early innovation at Art Byron Farms and it is a practice that has gained great traction across the state of Pennsylvania, which now has more acres in no-till than almost any other state. However, even today, many farmers who describe their management as no-till continue to use tillage occasionally. Jim's commitment to 'never till' has grown over the years as he learns more about the complex of soil life and the myriad interactions that tillage disrupts. The land under his management has not been tilled at all for the past eighteen years. In itself, this style of never-till management continues to be innovative:

After knowing everything we know about the no-till, we now know we don't want to disturb it at all. That's what we call these guys that go out and plow and everything, we call that 'recreational tilling'... Their big thing is 'we gotta get this in the ground so we can save the nitrogen.' But the reality of it is, if they look at what it's costing them through the tillage, and then what it's doing to the soil with no-till, tearing that up and wrecking that, why? You know? Take a look at that and not even do it. Just put it on the top of the ground and let it rain in, or put it on top of the ground, spread it into a cover crop, and let that cover crop do it's thing, and you're better off afterwards.

Jim continues to seek out new knowledge and related technologies as they evolve, and, in some cases, to help create that knowledge by participating in research trials when it makes sense. He has recently equipped his sprayer with variable rate nitrogen application technology that uses remote sensing with a vegetative index to target application of nutrients only where needed. This complements detailed management zone mapping that allows Jim to track year-on-year how small sections of each field are faring, what their soil tests say, what the plant tissue tests say, and what the yield differences are, all from an iPad that goes into the fields with him. The recent results of his innovation logic have been an increase in yields, mostly by increasing the corn populations in the healthiest zones; an increase in land, by widening the strips because erosion has slowed; and harnessing new technology to support the no-til system as soon as it becomes available.

While the market may provide new technology and researchers provide new knowledge supporting their development and use, Jim relates how the farmer who first tries to implement the ideas and technology often runs up against some practical considerations in the field. Regarding the implementation of the latest precision agriculture technologies, he says:

A lot of this precision farming doesn't talk... So, this optic system's from AG Leader, which is an independent company, and they're more diverse and they'll talk to a lot of different things, where John Deere is basically, you know, 'if it's not green, I don't want to hear about it.' But we're putting this Ag Leader system in here and that's a learning curve because we're controlling the John Deere with it. We talked to the guys from Ag



Leader, 'oh, yeah, yeah, we can do this.' Well, we start to get this thing ordered and start putting it in and we have to have special cables made, so we get all the electronics hooked together, and the fella from Ag Leader, the local guy I talk to, he said, 'I don't know, I'll find out.' He said, 'I think there's another one, I know a guy in Saskatchewan that's got one of them.' So they sell it to you, you think, oh, they've done this a lot, and it turns out, you know, there's like, a handful running across the nation. Essentially, the pieces of equipment he purchased had not been used together before, so troubleshooting falls mostly on the farmer. In this case, Jim needed to have cables made and went through some time-consuming information gathering with his salesmen, to enable the system to work. Jim explains this problem patiently and with a good nature. The way he sees it, it is worth the bother:

I mean, by doing that, yeah, you might pay a little more up front, but you have the advantage of it, to get the payback longer before everybody else gets it, and the playing field gets level again.

While Art Jr. encourages Jim to purchase and implement novel technologies, Jim is careful to point out that although he enjoys learning about and trying new technologies and ways of farming, he can only do so as far as the economics make sense. Especially as a hired manager, he has to show that an innovation is sensible for the business and that it can be implemented with the field staff of only two. However, he recognizes that the economics on this farm are different than most other farms in the region. The unusual level of integration has resulted in a lucrative egg business. As he says:

Some of us, it's the excitement of being able to do some of this stuff, but the reality, but the bottom line is—we've got to get it done. Because we're diversified with the crops and the eggs, there's been some good years, as far as the egg business goes, that we've been able to make some moves with some of this stuff, that possibly the crop farmers wouldn't. Now the crop farmers, if they're on the ball now, the past couple years they've been able to do some things with the grain prices being where they're at, to be able to advance this. But you know, at the end of the day, the thing's gotta pay for itself.

As depicted here, the logic of innovation on this farm is a product of several key actors: the land demanding it; the founder's legacy of conservation; the current land owner's support; the lucrative CAFO finances; and the social network that has grown up around the Pennsylvania No-Till Alliance.

## Innovation and soil health

While soil health results from a wide host of interactions, in general, soil health on farmland benefits from: diversifying crops and the crop rotation; reducing tillage and pesticide use; and incorporating organic matter through compost additions, green manure, cover crops or residue. The innovation logic at Art Byron Farms has been a boon for soil health promoting practices here, where the rotation has been diversified, tillage has been halted, and residue management are part of a system intentionally seeking to build soil health.

Even the term soil health (as opposed to the traditional 'soil quality), which is only now coming into popular lexicon, is a familiar one for Jim. Unusually, he has gone as far as to send soil samples to Texas where the Haney Test for soil health, one of only a handful of such soil health tests, is available. The results from that test showed that in the management zones with the best soil health, yields were greatest. This information has Jim eager to improve soil health across all the acreage. As he says:

The soil health was better in the higher yielding areas than it was in the lowest yielding areas. So that told us that there was a correlation there so we've got to strive to make it better everywhere, if we can.

He is working to improve soil health in several ways beyond the no-till and improved crop rotation. For instance, he has shifted his pesticide schedule to encourage soil life:

We're finding out more and more about the things that live in the soil, and the beneficial insects that are out there, to allow just a little extra chance for the beneficials to take over before we go out and apply insecticide. By doing that we're helping everything out because if you go out there with insecticide, there go the beneficials, there go the ones you're trying to get rid of. And so, we're trying to allow nature to do a little more of what it's meant to do.

Soil health is important to Jim, partly because it was important to Art Sr., but more so because he has learned through his social network that soil life allows for less inputs, healthier crops and less time managing the fields. The later issue is very salient here; with only two people working on more than 1000 acres, Jim is very conscious that an extra pass through the fields is a time-cost that he cannot concede. This particular issue—too many acres and too few to work them—is a common complaint among neighboring farmers. During a focus group conversation with other conventional grain farmers in the county, the topic of time constraints looms large in many management decisions. When asked why many of them choose to do no-till, this is the response:

R1: Time.

R4: Time and fuel costs and things and it's just mainly time. There's just no way to ... I couldn't ever dream of going back. I wouldn't.

R3: I don't know how I would get it all done now like I did before.

R4: That's exactly right. Because, you know, a lot of us have other enterprises going on, and you know, we're farming, but we're also doing other things, and there just isn't enough time. It's a financial thing. And I go off and said to cover the acres that you need to cover to be profitable, it's, there just isn't the time that there used to be. It's a different world.

I: Is that because the farms have gotten bigger?

R4: It's because the margins are tighter. Even, I mean, over all...

R1: The windows and planting time in the spring has gotten shorter.

R3: I think we're trying to do more acreage.

R4: Right, yeah.

R3: And you know, you're trying to do a lot more in the same amount of time.

R4: It's efficiency.

Efficiency for Jim often correlates with the least-time option. In some ways this is a boon to soil health. For instance, when asked what technique he uses that has the greatest positive impact on his soil, Jim is quick to say:

No-till... because we can go out and become more efficient that way.

Never tilling is beneficial because it increases organic matter, reduces erosion and allows for soil life to thrive undisturbed; it also means less field work, compliance with conservation regulations and widening of the contour strips on which they farm, which has allowed for larger equipment that covers more rows at a time, and hence enables Jim to be more efficient.

In other instances, the time crunch is problematic for the soil and disrupts the innovation logic. For instance, Jim keeps current on the most recent advances in cover crop understandings, he is using a particular mix because of the soil health benefits the mix imparts. However, as much as he would like to get the cover on, it doesn't happen across much of the acreage. Do to the climatic seasonal shortage of time and not having enough labor. He explains the benefits, and hindrances, of cover crops and his constraints using them like this:

The rye holds the soil and builds up the biomass, the tillage radish helps to penetrate any compaction layers, it helps loosen the soil, plus it brings nutrients from down in the soil up, and crimson clover provides nitrogen... It may be 150 acres and that's about it. There's been years we've had 250 acres out, but the issue there is being able to get the crop harvested and getting time enough to get the cover crop in to allow some growth in the fall. They're finding out that the mixtures of the cover crop are better than cereal rye, which is really easy to put out. We had some we put out after Thanksgiving, we didn't see it and then you do, it started to grow. You don't have the soil conserving aspect when it's put out so late.... It builds the soil up plus if we let it get big enough, it'll shade the soil out and keep the soil temperature down and cut the evaporation rate down. So that's another thing that we need to do more of it, but it's just finding the time to get it fit into the rotation that's the problem. But I mean the rye has an effect on the weeds, and we have a chance to cut the herbicide rates back a little bit more.

In addition to the lack of cover, one of the legacy factors negatively effecting his operation now is the high phosphorus load in the soils, which is problematic from an environmental standpoint. Phosphorus runoff in ground and surface water leads to hypoxic zones in waterways. Being in the Chesapeake Bay watershed, and being designated a CAFO, Jim is highly aware of the environmental and social concerns around conventional agriculture and is careful to follow best practices, comply with regulations and try to move beyond simple compliance to find novel ways to address the problem. For instance, when he explains the rotation here, he mentions how a new crop is helping address the phosphorus concern:



It's corn and soybeans on a large portion of the acreage, but it's also wheat, and we raise two years of corn, and this is kind of a systematic approach – two years of corn, a short season soybean planted early so we can harvest it and get our barley out in the fall and allow it time to have that growth in the fall that it needs, and then take the barley off and bale the straw with the idea that we take the straw off and we're removing phosphorous from the soil, and then going into a double crop soybean.

He employs this rotation strategy with an eye to removing enough phosphorus so that at some point they are able to begin using the chicken manure nutrients on the fields again.

Additionally, the logic of innovation was very much in play when Jim thought to begin auctioning off chicken manure. Knowing that their high soil phosphorus levels were tying up other nutrients, and realizing that new CAFO regulations were going to disallow any more manure application, the copious amount of manure from the egg operation had become a liability. Jim's friend half-jokingly sent him a link to an eBay auction for manure in a plastic bag, which led to discussing the possibilities of running an auction for the chicken manure. Jim called several auctioneers who would not consider taking it on before finding one who would. There had been a similar auction on the opposite end of the state, so while this was not totally novel, it was for the region. The auction has since turned into a successful enterprise in its own right. Part of the success is due to accurately communicating the nutrient benefits of the manure to other farmers, as he says:

We pull a sample so we know what the nutrient value is, and we've kind of expanded that because it was tough to get guys to realize what it was. It's always been a by-product, and so we've taken micronutrients in the sample. We've also taken a calcium carbonate equivalent test, which says, all right, in that CCE number, you know, is equal to how they get lime out of different quarries. It has a CCE equivalent and so



the guys can look at that and say, oh, well, there's this much calcium in it. So it's kind of a marketing thing...We went from needing to sell the manure for just getting our money out of it and putting it on a truck, to this year we had the best auction we've ever had. Out of 48 hundred tons, the average was almost \$20 a ton. (Interviewer: Is that good?) That's real good, because we used to get two or three dollars a ton for it, and then have to hunt for people to take it. By aiding this sort of farmer-to-farmer nutrient trading, soil health, and water quality in the region may be improved by removing excess phosphorus from overloaded farms and delivering the many soil health benefits of manure to livestock-free crop farms.

Jim's evolving understanding of soil health related issues and his concern for these issues is clear in his management decision making. He is conscious of his concern for soil health, and the influence this has on the kinds of innovation he employs on the farm. When asked to list the five things that most influence the way he makes management decisions that affect the soil at Art Bryon Farms, Jim writes the following:

·LEADING EDGE SOILEDU. - SOIL HEALTH ENCOURAGEMENT FROM PLER GROUP · RETURN ON INVESTMENT NJ (ROPPING MGT · LEANING SUIL IN BETTER CUMULTION THAN WE HAVE IT ٠A NOW

The logic of innovation plays out in many ways at Art Byron Farms, and mostly it seems to be a boon to soil health here. While Jim works to stay out on the leading edge through education and technology, and CAFO regulation has spurred some novel marketmaking, it is the legacy of Art Byron Sr.'s conservation-mindedness that may provoke the underlying care on display when Jim lists "leaving the soil in better condition than we found it" as one of the motivating factors for management decision making here.

### Innovation and sustainability

Sustainability on the farm encompasses, at a minimum, three interconnected realms: social, environmental and economic. In terms of the social sustainability at Art Byron Farms, two issues present themselves most clearly: labor shortage and social acceptability.

Like most farmers, Jim accepts that his time is consumed by farming. However, the reality of only having two people working on this much acreage is hard to call sustainable, not least of all because of the time-saving efficiency issues discussed earlier. But also because part of the personal fulfillment he finds in this work is the continuous improvement aspect that fuels his innovation logic. As Jim says:

It's definitely not a 9 to 5 job, and I wouldn't be happy with a 9 to 5 job doing the same thing over and over. Doing something like this, you don't do the same thing every day and it allows you chances to expand your horizons with a lot of different things, and you can delve into certain things as much as you want to, or have time to.

Not having enough time to learn about new things or attend conferences, field days or meetings to talk with other leading-edge farmers would shift the driving logic at Art Byron Farms. In addition Jim admits that he perhaps 'owes' some time to his family and might like to begin slowing down on the farm in years to come, but without additional skilled and reliable labor, it is unlikely that he will be able to. Noting the lack of time as a potential issue, both Art Jr. and Jim say they plan to hire extra field labor. This would enable Jim to pursue his interests at the leading edge of no-till farming while ensuring that best practices, such as cover cropping, are implemented across all fields.

An additional social sustainability question arises from the kind of operation this is it is a conventional CAFO—and the public sentiment towards genetically modified crops and caged laying hens has generally become less tolerant. Jim and Art Jr. both mention that they are prepared to adapt to any new animal husbandry requirements or best practices as they always have, but Jim is concerned about what he sees as a disconnect between farmers and eaters:

All the issues of the herbicide and grow organic—at what point in time do people set up and realize what they have in the US of A, with the food supply that we have and the cost of it, and a lot of things. It's just like they talk about GMO foods and now they're discussing in Harrisburg about do we want GMO labeling? They ought to allow people choices, but the other thing is, where do we draw the line? Do we become like some of these African nations where they won't let GMO foods in? So do you die at 40 or 50 of some supposed GMO poisoning, or do you starve to death at two years old because of no food. In my mind, that's one of the issues that you have to think about. When we think about growing crops with herbicides and everything else, it's all going to play in here, and where do you find the laborers if everybody goes back to a hundred acre farm? Where do you find the people that are going to be willing to work to do that? (Interviewer: Do you think that's, in your mind, the big issue?) I think that's something to discuss, yeah, to get people aware of, accepting what we do and not having problems with it.

While the long-term acceptability of this kind of farming is in question, it seems that the long-term financial sustainability of the enterprise is secure. All of Art Jr.'s children have come back to the farm following college to make their living alongside a host of employees in the office, chicken houses, and other agri-business spin-offs. Art Jr. and Jim chalk this financial success up to the level of vertical integration here, which is unusual. Art Byron farms, and its related businesses, produce and process the feed, raise the chickens, market their eggs and now even sell the manure. This integration is a kind of diversification as Art Jr. sees it and, along with a "commitment to high quality and service," it is the way they have managed to be so successful. His advice to his children, who will eventually take the business on without him: I would say that I would encourage them to continue to diversify in a way that we have over the years and to continue to protect the environment and be stewards of the soil, and to—we're very, very quality conscious here in terms of our product and part of that is mandated, but beyond that it's something that we take pride in, and I know my children have a certain amount of pride in the products that we sell. The quality is important to us, so I think we've instilled that in one another. And the service, you know, a long time ago somebody said that if you want to be successful in the business, in any business serving the public, if you have the quality and if you have the service you will be successful, and I think that's happened.

As Art Jr. hints at above, environmental sustainability has been on the agenda here since the farm's inception. Tillage was one of the major contributors to the Dust Bowl crises of the 1940s in the U.S., which Art Sr. lived through. No-till, as a technique, and later as a system that includes improved rotations, cover crops and manure, was initially promoted and supported by government erosion prevention programs. While the practice of continuous no-till, or 'never-till' has spread, it is still not the norm in most states. The soil health and environmental benefits of never-tilling are important, however, the environmental concern over no-till has been its reliance on greater herbicide use to kill weeds that would otherwise be plowed down. Greater herbicide use selects for resistant weeds and eventually renders heavily used herbicides ineffectual. In fact, Jim says that it was a nearby Pennsylvania county that reported the first triazine resistant pigweed and lambsquarter in the 1980s, so the problem of resistance is well known in the region. But Jim is working to reduce herbicide use with better rotations, as he says:

We're finding out things about this continuous no-till now, within the past four or five years, that we had not a clue of before it was going on there. And so now the more we know about it, we can do some tailoring stuff, and that was part of the idea of incorporating in the barley, another crop, different rotation, because you know that nature's going to find a way to get around stuff, because we've got all these resistant weeds, and so if you can throw something different out there, it's better as far as weeds. We know we've got to rotate herbicides. We rotate corn varieties. You don't plant the same corn variety in the field year after year because of disease build-up. You want to rotate the corn varieties around, and also the crops. I mean it's something they did years ago, but, I don't know if they fully understood a lot of the reasons.

Never-till as a system that includes improved rotations, manure and cover crops should allow for reduction of chemical loads and support of soil life, by increasing beneficial microorganisms and reducing weed and pest pressure. Outside of the full-system approach, no-till as a technique demands high herbicide and insecticide rates at levels that work against supporting soil life. In the case of Art Byron Farms, Jim is working toward the systemic approach by pulling excess phosphorus out of the soil so that he can go back to spreading manure in the future and by hiring additional field labor so all the acreage can receive cover crops. He is also consciously trying to cut back on insecticide use by allowing time for beneficials to flourish and cutting back on herbicide use with the rye cover crop on a small percentage of acres, but he is aware that this is one area where he wants to be doing better: Knowing what I know now, the thing that I would want to change the most would be to have more cover crops out. Cover crop on every acre of some type. In my mind I think that would be the ultimate goal, right there. Yeah, it would be nice to have all a tractor or do a few of these things, yeah, but the biggest thing is to have the cover crops increase the soil health because without that where are you going to be?

In addition, the environmental sustainability of this farm has to do a great deal with the egg production. CAFOs are notorious for their manure management problems, which is why they are so highly regulated. Given Art Byron Farm's position in the central Pennsylvania Chesapeake Bay watershed region, they are well situated to re-route nutrients from their chicken manure to farms further north where chicken manure is not as readily available. By creating a market for this manure, receiving farms are benefitting not only from the macro and micronutrients, but also from manure's contribution to increasing soil organic matter. The manure auction is also a form of phosphorus recycling; mined phosphorus is a nonrenewable resource whose depletion will limit crop productivity throughout the world.

Jim recognizes that soil health here is integral to the success of the farm business. Beyond that, when asked how he thinks soil health, or the way he is farming, is connected to his own or his family's health, he jovially says that he still eats eggs a lot, and snacks on corn or soy right from the harvester bins. But he also takes the question in a wider direction and talks about how soil health, economic prosperity, stress and sustainability on farms in general go hand-in-hand:

There's a couple of farms that we farm that someone had tried to scratch out a living on and they were shalier soils and the crops didn't yield as much, and therefore there was not the opportunity to grow the operation. Like it says 'the mission returns' and some things we should do to be able to bring another generation on... So the income wasn't there, that probably caused stress, so they went off the farm for an income and then they would tell the next generation 'you don't want to do this because there's no money there.' Yeah, thinking about it that way, I think that does kind of tie into some [soil health] things. If there's too much stress involved in something—through crop yields or not understanding how things work—you're going to shy away from it and discourage the next generation from doing it.

The logic of innovation at Art Byron Farms is likely to live on past Jim or Art Jr.'s tenure on this piece of land because it has managed to remain profitable enough for multigenerational incomes while allowing the younger generation to innovate off of the core business. With the strong social ties to other innovative farmers and a lasting legacy of environmental concern from Don Sr., it is likely that the system of never-tilling in the nexus of an innovation logic will continue to improve soil health as learning evolves and as it is passed down from crop manager to crop manager.

#### Case no. 2: Privilege

#### **Bay Edge Farms**

First, level rows of corn stubble come into view, then, giant gleaming grain silos next to several squat, long outbuildings and, finally, at the halfway point of the stretching fields, a sign marks a fresh gravel drive that leads to a cluster of structures at the heart of Bay Edge Farms. A pickup truck is parked in front of the small, purpose-built office that faces looming, four-story high grain bins and a new dryer. Looking around from here, a packed machine yard can be seen tucked behind the long storage-sheds, which house bulk seed, pesticides and additional machinery.

The sound of vehicle backup alarms mingles with the chirping whistle of an Osprey overhead, a reminder that this farm meets the water. The land all around here is flat. flat, flat and incised with innumerable waterways that out to the brakish flow shoreline of the northern Chesapeake Bay: this is the Delmarva Peninsula. The few main arterial roads through the area are lined with a mix of conifers and hardwood trees interspersed with miles of farm fields, many of which are



owned or leased by Bay Edge Farms, one of the largest producers in the region. The operation manages more than 10,000 acres spanning over 40 miles.

The Delmarva Peninsula, bordered on the west by the Chesapeake Bay and the east by the Atlantic Ocean, is carved up with political boundaries that claim some of its mostly rural land for Maryland, some for Virginia and the rest for Delaware. But the landmass, culture and main industries here are not so divided. While tourism, crab shacks and strip malls buoy the economy of the small bay town that anchors this particular farming enterprise, it is corn, soy, wheat and Perdue chickens that power much of the Peninsula's economic life.

The soil here, so close to the Chesapeake Bay, is sandy and only about thirty inches from the water table. It is classified as prime farmland by the U.S. Geological Survey. The flat fields surrounding the main office at Bay Edge Farms are almost entirely a Mattapex fine sandy loam. The soil's basic physical composition is nearly half sand, forty-five percent silt and a small fraction clay. The soil health rating for one of the office farm fields is in the low 60s, out of 100, which is a mid-range score indicating deleterious effects of past management practices. Poor aggregate stability and low organic matter content are both limiting factors. The organic matter content is low, at about two percent. The Cornell Soil Health Test flags this as a limiting factor, earning a standardized score of only 30 out of a possible 100 (Appendix B). However, this is above the USDA Web Soil Survey expected organic matter range for this type of soil, which is 1.75 percent. The expected pH for Mattapex is 6.0 and the actual pH is about that, at 6.3.

The Cornell Soil Health Test reveals four areas of serious constraint: aggregate stability, which affects aeration, infiltration and rooting; organic matter content, which affects energy storage, water retention and a host of other biological activities; low soil biological activity in general; as well as low nitrogen supply capacity. The areas of physical and biological soil health are in available water capacity, subsurface hardness and a good root health rating. What is most obvious when looking at the soil health report is the high scores for chemical components, which are in stark contrast to the very low scores for biological components.

Almost all of the vast acreage under Bay Edge Farms management is used to grow corn, soybeans and wheat for the broiler industry, cooking oil manufacturing and flour or pet food, respectively. The land is cash-rented and share-cropped under agreements with more than fifty different landowners. The enterprise is run by a fourth generation owner, Ben Morris, in partnership with his father. Forthright and easy to talk with, Ben says a typical day here means throwing out last night's intentions, deciding on a new game plan early in the morning and then sending out the ten or so full-time employees to get the right equipment and supplies out to farms distant and close. The vast acreage means management has to be simplified and well directed, as he says:

It's actually getting easier... Today we'll spray a thousand acres; we'll do two hundred acres of chicken litter, and this is a pretty slow day. When we start planting, we'll plant, four hundred to five hundred acres of corn in a day and while we're doing that we'll simultaneously spray it, and we'll probably plant three hundred to three hundred and fifty acres of beans that same day. So, I mean, we can cover seven to eight hundred acres a day... And we've gotten so fast that we really don't have that much field work, or not as much as we used to... Fall is long; it's a long process cause you're dealing with so much stuff. You know, we're harvesting a thousand loads of corn, and four or five hundred loads of beans, so it's just a lot of stuff to move. It's just a lot of work.

Ben will spend the day driving between farms, making sure everyone has what they need to get their jobs done, his cell phone and iPad at the ready to usher the days activities along. With so much ground to cover and such large sums of money moving around, Ben says this enterprise benefits from being a family affair; his wife and mother keep the finances and run the office while his father remains heavily involved in equipment and supply purchasing. Ben grew up working on this farm and returned from college to marry here and start a family in a bayside house just walking distance to the office.

Bay Edge Farms is part of a small group of large farms that are financially successful, engaged in wider debates over the future of farming, and looked up to as role models by many other conventional farmers. The size of this enterprise alone makes a strong impression on the conventional farming community here. For instance, the following exchange among nearby farmers reveals the high regard other conventional farmers have for enterprises like Bay Edge:

R1: I see some of these guys and it's all jealousy because they can afford this big equipment and I can't. [Conventional no-till farmer]:

RF: Oh, stop it. [Pasture-based dairy farmer]

R1: It's gotta be, I see them with these four-wheel drive tractors, holy Christmas, it really looked like it. And the cost of doing it, I don't know how they afford it, I really don't, because I mean pretty much... [Conventional no-till farmer]

R2: They do it smarter. They're subsidized or a little bit of both. Some combination of all of the above. [Conventional row-crop farmer]



RF: But it becomes a chasing your tail, they get the big equipment, they gotta get more ground, they get more ground, they gotta get the bigger equipment. [Pasture-based dairy farmer]

R3: When I made that decision, I wasn't going to do that. [Organic cut-flower farmer]

R1: You're not considered much. If you don't have 10,000 acres you're not considered very much. [Conventional no-till farmer]

RF: I know I have an inferiority complex. [Pasture-based dairy farmer]

With its size and prominence, it is no surprise that Ben takes pride in the operation. When asked if he would change anything about the farm, his satisfaction in the business' success is apparent:

I'm happy with the way it is. My uh, pride and hubris comes into play when you talk about scale backs. I would much rather be big. I would like to grow and till more acres. The only thing I would like to change, in addition to my five or six percent that's out of production and in native vegetation, I'd like to get one to two percent that wouldn't involve me but that I would sublet to young people doing different things. I think that we need more diversity but I don't want to be the one that does it. Even though I'm not old, I think I'm stuck in my ways enough that I don't want to go back. I'm not gonna go out and pull weeds. I'm too 'ritzy' for that now (laughing).

While Bay Edge Farms is clearly a conventional operation, the above quote hints at some of the more unconventional views held by its head farmer. He is outspoken about integrating sustainable aspects into the industrial farming system and believes that the future will include both farms like his and smaller farms producing organic and sustainably grown specialty crops, side-by-side. Unlike many farm operators of his stature, he believes these two types of farms are not in competition and he would like for his large farm to find ways to support smaller, sustainable farming enterprises.

### The logic of privilege

On the surface, it seems much of this farm's management strategy is directed by cost-benefit calculations and scale-necessitated simplification. Scratching a little deeper, this seeming business-mindedness is guided by Ben's maintaining, and enjoying, a fairly unique status as a lucrative industrial farmer that engages in public conversation about environmental sustainability. The size and stature that set this operation apart from so many others are also the qualities that allow Ben to receive a certain amount of privilege in both supplier relationships and in regulatory circles. The key then to understanding how soil management decisions get made on this farm is in Ben's low-key maintenance of the enterprise's *privilege*. Maintaining this privilege influences how the farms' soils are managed.

While the crop rotation, machinery and inputs are fairly typical of a large, financially successful row crop operation, there is one aspect of the farm that is surely not typical: this farm is often touted as the wave of the future, mostly because the Morris' are outspoken about creating an industrial agriculture that is sustainable. Bay Edge Farms has been featured in various media, recently even in a public television documentary on the future of farming. The segment introducing the farm begins like this:

[Ben Morris] represents a new wave of sustainable farming. Like so many others who work the land, he belongs to local and environmental groups and has taken really bold steps towards green farming. Farming is hard enough with new technology, costly seed, regulations, fluctuating prices, not to mention the weather...

While Ben does talk about sustainable farming, healthy food, and a clean Chesapeake Bay regularly, sometimes in public, and with genuine enthusiasm, it is debatable just what aspects of his enterprise are in line with this rhetoric. Two media-cited examples of the farm's sustainable practices are a 200kw solar array, which powers the grain system, and a small parcel that is rented to an organic community supported agriculture (CSA) group. Also cited as part of the sustainability equation is the leading edge technology used here—in terms of seed genetics, no-till equipment, and precision agriculture technologies. Other sustainable aspects to the farming system, such as a strict nutrient management plan, use of cover crops and buffers with native plantings, are either required, or supported and subsidized, by government programs. Otherwise, Ben suggests that much of the acres he covers are a "normal monoculture of corn." Ben is aware of the slipperiness of the term 'sustainable' and also of how unusual his views are among his peers, as he says:

I try to be as—to use the word that I dislike—I try to be sustainable, which my interpretation of that is as unique as anyone's cause there's no true definition that I can find and everyone disagrees. If you're organic it's very different than what I would say, and if you're me (laughing) it's very different than what a normal conventional farmer would say. I think it just involves leaving everything at least as good as you found it, if not improving it.

When discussing soil health, a topic he is interested in, Ben reiterates how this kind of interest is outside the norm:

Nothing that I do or anyone that I deal with ever talks about soil health.

While Ben's forthright, and often public, discussion of issues regarding agricultural sustainability may be unusual for a farmer from an enterprise such as Bay Edge farms, he nevertheless continues to involve himself in public discussion of agro-environmental issues.

Ben's sense of the distance between himself and "normal conventional farmers" is not confined to the issue of sustainability. He is well educated and expects that his children will spend time at Ivy League equivalent schools, perhaps even boarding schools before university, as a way to ensure they do not fall in with the wrong crowds in what he sees as a parochial rural community. He feels that his family has worked hard to be in the prestigious position they now occupy and he intends to sustain it. When asked if he attends many local or regional farmer meetings, his response is illustrative:

I don't really hang out in that crowd that much. Um, just not my, not my thing. I'm different than a lot of farmers, in my personality and just what I do for hobbies and stuff. So I go to a few meetings but usually only if it's—I usually require a one on one meeting with the person that would be hosting the meeting. Or if it's like a big meeting, like a national meeting, I'll go to those, where it's other people in my, what I would consider my peer group or similar.

However, while Ben recognizes that his professional community is found at the national scale, he is also keenly aware that his views on sustainability are unorthodox with that group as well. He talks passionately about healthful food and is pleased with the organic community supported agriculture (CSA) that is being run on a farm he recently bought. His family belongs to that CSA and has pledged to allow it to continue to operate on the small organic parcel within the larger conventional landscape that he is now managing. This kind of arrangement is unusual, as he says:

The groups I go with are—my peer group which is, you know, these elite farmers that are all just pushing production, pushing this, pushing that, pushing profits. And the thought of having an organic CSA on your farm is just (laughin)—I mean it's, it would be a slap in the face.

This unorthodoxy extends to his involvement in local and regional environmental groups, where he is often called on to be 'the farmer's voice' in environmental and regulatory discussions. Ben is concerned with the quality of the Chesapeake Bay because he lives on it and feels an obligation to keep it healthy. As a child he boated, swam and fished in the local rivers and he wants to be able to continue to enjoy these pursuits with his family. At the same time, regional farming norms for amending soils with phosphorus-laden chicken litter, stemming from the prolific broiler industry here, coupled with a high water table and farm fields that directly meet the Bay, mean that farming is exceptionally regulated here as compared to elsewhere in the vast watershed. As a nearby no-till conventional farmer on about 1200 acres says:

I've been keeping a record of the amount of time I spend on regulations for the state of Maryland. It has, in the last 17 years, it has increased 27 percent more time on regulations and nonsense like that, and that's non-paid time. When you're a small operator, you do everything yourself. Just trying to keep up with them is a full-time job. It's time that you spend that you're not putting in on your operation that brings return back. Ben sees this kind of regulation as inevitable and also as an opportunity for policy makers, environmental groups and the agricultural community to come together to find appropriate compromise. He has even played a role in drafting legislation to define upcoming phosphorus load rules, which include a temporary exemption for farmers who have a proven track record of good management.

The path that Ben at Bay Edge Farms walks is self-made and unabashedly outside the norm, but the privilege that enables this unorthodoxy is built on conventional success. The logic of privilege, which both drives soil health decisions and enables this farm's participation in policy, sustainability and wider debates in agriculture, results from traditionally defined agri-business success. Key actors in this privilege network include: more than 10,000 acres under cultivation; a large yard of specialty field equipment including top-end brand new tractors; a full-time staff of skilled, year-round employees; special relationships with seed, machinery and input suppliers; vast amounts of corn, soybeans and wheat produced; sizeable profits; and the power and prestige bestowed by other conventional farmers on such an operation. This success gives Ben a platform that allows him to be outspoken about regulations and sustainability while maintaining the respect, and his position, among the "elite" at the top of the conventional farming community. Ben maintains privilege by remaining successful, and in being successful, he benefits from a privileged position.

#### Privilege and soil health

Most of the fields managed by Bay Edge Farms are cover cropped and no-tilled most of the time. Reducing tillage is a conservation best management practice that helps increase soil carbon while decreasing erosion and phosphorus loss, among other benefits. Ben is a pragmatist when it comes to his tillage regime; much of the decision to till depends on the weather conditions, which influence the level of soil compaction. He says that compaction is his biggest "yield-limiting factor," which he addresses with a mix of avoidance and force depending on what he feels is the right thing for the day's work. The push and pull between the weight of the equipment, which must be large to be efficient for the scale of this farm, and the compaction problem is evident:

In order to get the chicken litter on you run these spreaders that carry so much weight that you get compaction, even if the ground is dry. So if they do compact the ground the only way to truly get rid of compaction, for me, is steel and fuel. You know, take a plow, dig it as deep as you can drag it, and get a great—the biggest tractor you can buy and you drag it through the field—I'm so used to big tractors, I mean we've got lots of big tractors. They say that you can break up compaction with mother nature; I don't think it works. (Interviewer: Have you tried it for any length of time?) Yeah, I mean we've got farms that have been no-till for twenty years, but they're my highly erodible soils that we don't spread chicken litter on...

A tour through the machinery yard reveals a zest for equipment that Ben's father has clearly passed down to his son. While they no longer use all of the equipment in the vast yard, there is a lot to see here: strip till, field cultivator, Landstar, ripper, spinner spreader, no-till ripper, alter till, turbo tills, fertilizer trailers etc. with planters and harvesters in a nearby building and more tractors out in the fields. As Ben describes it:

Everything you see here is tillage, so as I've told you how much no-till we do, and how much we're a soil hell (joint laughter). This is my tillage yard. We basically have any piece of tillage equipment you can imagine. We try it, we use it...

Each piece of equipment has a specific use, and many of them are not used that often. The 18-inch plow might be put into action only when a



very rainy fall harvest that creates compaction instigates deep tillage in the spring. Many of the machines have tracks on them to distribute weight more evenly. The German corn header is better able to handle the newer corn varieties that leave almost indestructible corn stubble in the fields. This machine shreds the corn stubble down so that a bean planter can come in without tilling a field first. Most of this machinery is controlled with GPS and touch screen monitors in the tractor cab. Ben's father has a longstanding relationship with the owner of the equipment dealership. Ben explains that often Bay Edge Farms buys the newest, largest equipment, which the dealer is then able to sell-on a few years later, lightly used, to a much wider regional market for used equipment.

A tour through the chemical and seed storage buildings reveals the wide range and large quantities of commercial inputs required to run this kind of operation. Ranging through the large pesticide shed, Ben equivocates between what he suspects may be harmful to soil health, and perhaps to his own health, and what has proven over the years to be innocuous, or necessary, regardless of the perceived consequences. Ben says the amount of fungicide used has increased in recent years, partly enabled by high corn prices. The use of Avatel, a seed treatment to discourage birds, is necessitated by no-till planting equipment because the seed is not tucked into the soil as thoroughly as it used to be. Glyphosate resistant weeds have necessitated a switch to older herbicides, even through the bean and corn seed are genetically modified to be glyphosate resistant (among other genetically modified traits). Ben says they use pyrethroids on everything, and a pumped up pyrethroid, Endingo, specifically for stinkbugs. There are a few cases that stand out as being difficult decisions, particularly the pesticides needed to deal with a slug problem. Next to the soil compaction issue, slugs loom on Ben's mind:

Lannate is a real nasty chemical and trying to—it's really poisonous. We used it for slugs; they came out with a label on slugs last year. Like I said, look: slugs are my enemy. They are like the only thing I can't control in the world...

The five sources of fertility used here are local chicken litter, mined phosphorus and phosphoric acid, mined potash, ammonium sulfate and urea ammonia nitrate (UAN). The cost of these nutrients is considerable; in 2013, over a million dollars was spent on potash alone.

Ben does not store fertilizer on the farm, but rather has an agreement with a regional port that holds it until it is ready to be applied. These fertilizers are used to grow soybeans, wheat and corn. The corn seed is interesting because he has to buy "triple stack" which is genetically modified to include Bt genetics (an insecticide), glyphosate resistance (to survive herbicide dosing; also known as Roundup Ready) and root worm resistance; but Ben says they do not have rootworms here and they have stopped using glyphosate as it is ineffective due to the prevalence of resistant weeds. However, in the large quantities required at Bay Edge Farms, it often happens that the variety of seed desired is only available with the triple stack of traits from his Syngenta dealer. Ben explains some of the seed like this:

This is our corn, like I said it's all genetically modified. It's all Roundup Ready, most of it's Bt, eighty percent of it's Bt—we adhere to the refuge rules, which keeps us from running all Bt. I might have some triple stack here; I've got some refuge in a bag. Sometimes they make me buy triple stack if it's the family of variety that I want. Sometimes you can only get it in one with rootworm. (Interviewer: What's triple stack?) Ah, triple stack would be Bt, Roundup Ready and rootworm resistance. (Interviewer: Ok.) We don't have rootworm. But if they have more seed that's only rootworm, basically they say, 'Look, if you want 35F44 family, you've gotta get triple stack or, you know, you can't get it.' Um, just based on their supply and demand...

With the vast array of equipment and supplies here, Ben says his management strategy is to "keep things simple." He has an understanding of the tools necessary to sustain such an enterprise, and the tacit expertise to adapt their use given specific field conditions. Much of this knowledge originally came from being raised on this farm and then studying agricultural management in college. But it is less clear how he manages to keep up with the advances in agricultural technology and best management practices. When pressed on where he gets his information from, his reply exhibits an unintended reading of the question that is revealing:

People have asked me this many times because that's the big thing, everybody wants to know how to deal with me because I'm big. They want to know the big farmers, this big mass that everybody views as the—we're the final frontier. Everybody wants my business because they come to me and get ten farmers worth of business in one visit. I mean honestly the margins are tighter but the profits are higher because how do they capitalize on my—how do they obtain my loyalty? How do they get me to be loyal to them? And I never know the answer. It comes down to people and then you develop relationships, it's like anything in the world. You develop a relationship with someone, you get it, then you become loyal to that person, then you become loyal to that company—and then it builds from there.

He does attend national meetings put on by companies and organizations such as Pioneer, Syngenta, and the Fertilizer Institute. He presents at some of these meetings. He also admits that while he does peruse traditional, conventional agricultural media, he is more apt to read literature on health and nutrition and more organic type agricultural publications. He likes to expand his understanding by getting outside of the conventional world as often as possible, meeting with non-farmers and reading materials that seem opposed to the way he runs his enterprise. When asked if he reads any conventional agricultural publications he says: I mean I've got those too, but they don't really teach me anything. I mean, you hear the latest and greatest in equipment, well, I probably own it. You know, I mean there's not much to it. Precision Ag stuff, I've got it. I usually try to set up meetings with—figure out who knows the most, set a meeting up with them. And, fortunately, due to my size and relative importance to the companies that I deal with, I'll get someone at a higher level than most, so I'll go talk to the teacher essentially, rather than learning from the students who are usually the ones teaching farmers and I'll usually figure out a way to talk to the teacher. Set up a lunch with them or something like that, or take them out to dinner and bring the wives or something like that, and then just kind of glean information that way.

When talking about soil health, he mentions reading Acres USA, an organic and sustainable farming publication. About it he says:

There's Acres, do you get Acres? (Interviewer: No I don't.) Oh, it's fascinating. (Interviewer: Really?) Now... there's tons of snake oils and stuff, but they talk about soil health in there... I get a lot of my information from the other side, from the left.

When asked to list the five things that he thinks most affect the health of the soils he manages, Ben first good-naturedly insists that he writes like a child and then scribbles the following:

Chemicals

Fertilizers

Compaction/Equipment

O.M.

Microbial activity that I know nothing about

Ben makes decisions around these five arenas that implicitly maintain his power, privilege and position as an elite farmer. He does this by having the newest and biggest equipment, working exclusively with the most senior people at seed, chemical and equipment dealers, trialing leading edge technology in genetics and machinery,

Chanicals Fortilizers Compaction/Eschiphon

?M and vity that I trow nothing about

working with policymakers and watershed groups and maintaining a good public image while keeping things on the ground as simple as possible across this vast acreage.

### Privilege and sustainability

Bay Edge Farms is seen as a sustainability leader in terms of environmental sustaiability; Ben is certain to comply with all mandatory, and some voluntary, conservation measures, including nutrient management planning, set-asides, buffer zones with native plantings, cover crops and best management practices like conservation tillage, variable rate fertilizer application and other data-intensive precision agriculture techniques. The cover crops in particular are one way Ben believes they have promoted soil health, and their use was spurred by regulations and a government cost-share. Another boon to soil health is no-till, which Ben sees as being the new social norm in large-scale conventional agriculture, and, while there is an economic and environmental benefit to it, he believes the social norm, coupled with the properties of the land here, are greater factors driving the farm's no-tillage. As he says:

The no till was basically an economic decision, now it's more of a social decision. I think it does make the soils healthier, but is that a big issue? Probably not. It's more just a lot of our soils you can't do conventionally, I mean, they just have too much run off.

To manage this kind of enterprise, there are many costly inputs to acquire, store and utilize appropriately; keeping abreast of the latest science, technology and environmental impacts of these inputs is complex and time-consuming. While Ben is publicly an advocate for sustainability, he is also outspoken that his style of farming is not environmentally sustainable in the long run. However, he is plainly skeptical of agricultural researchers due to the extreme complexity of environmental issues and their intersection with agricultural inputs and management. He distrusts much of the knowledge around best management practices or new techniques that claim to have environmental benefits. For instance, when talking about the synthetic chemicals he uses he says:

In terms of chemicals, I don't know, I choose not to think about it. It just makes my life easier because if I go into each chemical that I use and think about it, it just would be overwhelming, because there's just-there's too much information and not enough where I can clean out the actual truth, because I don't think that anyone really knows. Um. is Atrazine bad for the environment? I don't know.



Have I handled Atrazine all my life? Do farmers have a higher rate of cancer? I'd say, 'yeah, probably.' I mean all the farmers I know that are old have cancer. Um, so I'd say that is it directly related? Is it Atrazine, is it the dust, is it mold? You know, what is it? Or some combination of all? But does the Atrazine that I use cause a detriment on society? I don't think so. Is a little bit of Atrazine in your ground water worth cheap food? I'd say it probably is. As far as the insecticides and stuff, I don't know what the alternatives are. If I have a stink bug issue I've gotta spray Pyrethroids. Are Pyrethroids bad for the environment? Or even for the soil? Yeah, they kill everything. I mean I'm using two ounces to cover an acre and it kills every bug on an acre, so is it bad? It probably is. I mean is the Lannate bad? Yes, I know it is; but do I need to kill my slugs so I can grow a crop? Yes. So does the end justify the means? Yes. But do I know what I'm doing to the environment? I don't think anyone does.

While the science and ecology behind conventional farming practices may be too complex to warrant one person's grappling with while running a business, mandatory regulations are not. The regulatory environment in this part of Maryland has Ben, and many other farmers, convinced that at some future date, environmentally motivated regulations will begin to impinge on the economic viability of this kind of agriculture.

Because Ben's products—corn, wheat and soybeans—are commodities, he is keenly aware of global competition; heavy regulation that drives up cost or limits yield may make his product less competitive on the global market. For instance, Ben says that in recent years, Brazilian corn is being fed to chickens on the Delmarva Peninsula, putting his farm's future economic sustainability in question.

Ben's privileged status in the agricultural and environmental communities and his economic stability means that he is able to participate in some rule-making at the state level and makes himself available to speak on behalf of farmers during public facing debates over environmental issues. This economic sustainability is no small advantage since the regulation and public perception will affect the future viability of his enterprise. Other farmers in the areas lament that they are not able to attend such meetings because they are often scheduled at times when they cannot afford to be away from their farms. Moreover, there is a shared feeling that regulators do not want input from everyday farmers. This exchange among a group of farmers from Ben's county highlights the issue:

I: Does anybody know of a situation where farmers have been included in some kind of rule making?

R1: I'm not going to say there isn't. That's not what we want to do and that's our fault. We think we gotta be out there in the field getting this job done.

RF: But if someone asked you?

R2: Here's the problem, every time the main meetings are, when are they? They are always in the middle of the fall harvest or the spring planting. Every time when they have open forum meetings where the public can come in, and unfortunately, you can be on all kinds of boards, but you've got to make a living at this. Nobody pays me when I go to a board somewhere or whatever.

R1: It comes back to if you don't get your work done, you're pockets are what's going to be cut short.

R2: You don't send your kids to college, you don't feed your family or whatever.

RF: Most recently with this PMT—the phosphorous management tool—that they just developed at the University of Maryland, the dairy farmers got screwed in that deal. So a group of them got together recently and got their ducks in a row and then they went over and talked to MDA about why it wasn't going to work. That was after there was a huge ruckus, a lot of letter writing we had to do during the comment period to get the secretary's attention, and we sort of did it backwards, but maybe they didn't, let's give them the benefit of the doubt, they didn't know what they didn't know. They write this not knowing that they're being ignorant.

R3: You can tell by the tone of the conversation, the direction that it's taking, the feeling that the farmers have towards administrators and...

RF: And vise versa.

While Ben laments poorly timed meetings as well, he has a reliable staff that can operate in his absence. He will take time away from 80 or 100-hour workweeks to attend policy and public oriented meetings regarding agriculture and the health of the Chesapeake Bay. He is typically invited to speak by local or regional environmental groups. As he says:

I speak... several times a year on different bills and stuff and usually it's with the—actually the environmental groups recruit me to speak as a farmer. Here, the environmental groups have much more power than we do. So if they need funding for a cover crop program—I think the cover crop program in the state of Maryland's like fourteen million dollars—so the people that get the funding for the cover crop program are the environmental groups. So the environmental groups don't want to just go speak for farmers, they want a couple of farmers to say we actually agree and it's not just environmental group BS... it's the farmer actually going up there and saying, 'We need the cover crop program because I can't afford to...' I'm not gonna plant cover crops without getting paid because there's no money in it... So I'll get asked by them, and then, I've tried to bridge the gap between the environmental community and the farm community.

Beyond environmental and economic sustainability, the social sustainability of Bay Edge Farms is only recently arrived at. After many years of tenuous family relations and struggles to keep staff, Ben is now very careful to actively manage relationships and avoid conflict when possible. His staff are well paid, trained and employed year round. He has college-educated workers who are able to take on more of the responsibility which he hopes will enable him to enjoy a better balance between his work and family life in the future.

While Bay Edge Farms continues to enjoy its privileged social status in the national agricultural community, which is derived from success at this scale alongside the rare hallmark of being dubbed 'sustainable,' there is one aspect of social sustainability that is uncertain. Ben is currently at ease with the cognitive dissonance apparent in the juxtaposition of his health conscious family lifestyle—where he is passionately concerned with fitness and healthy eating, choses to drink organic milk and belongs to an organic CSA—with his conventional production regime that results in industrial food products. He heartily rejects the 'farmer as god feeding the world' trope but, at the same time, he is adamant that the food he

ultimately produces, such as chicken, is healthy; he puts the onus on eaters rather than growers for any health impacts of this kind of production. As he says:

Well, I worry consistently about my personal health and the chemicals dust etc. that I've been exposed to and am currently exposed to and will always be exposed to given my profession. Um, my propensity to get cancer, I think is much higher given what I've done, hence my obsession with health and nutrition now. In terms of my family's health, I don't see any detriment to that whether, depending on whether or not my—obviously if one of my kids starts to farm then it becomes more of an issue. Beyond that as far as what I grow, I don't view what I grow as being unhealthy. I view the way it's consumed to often be unhealthy.

There is also cognitive dissonance around Bay Edge Farms being heralded as environmentally sustainable, in the context of the actual practices employed across the majority of the acreage here. Yet, as he has said, the term 'sustainability' is itself part of the problem, since there is often no clearly articulated or shared definition. Given these forms of cognitive dissonance, and his expressed interest in soil health and sustainability, it is likely that Ben will seek ways to further support soil health and sustainability on his farms in the future. Right now, as he says, he is locked into a very integrated system of global production that leaves little room for change:

I don't have an alternative. Before I come up with a problem I like to have the solution. I'm more of an answers type person than a question type of person and I think that that makes for a much healthier environment. Given my job, you have to be the one that answers the questions. So to say that what I do is bad, without a solution for global food production, I think would be inherently wrong, because there is no solution to the problem. It's a, it's a 'wicked problem' to use a business term, that's unsolvable.

Currently, it seems that the many privileges derived from farming in this style trump any cognitive dissonance. However, Ben's willingness to regard and value issues of sustainability, suggest that Bay Edge Farms may be managed in novel, soil health promoting, ways in the future, especially if environmental sustainability itself becomes a means to maintain privilege.

### Case no. 3 Experimentation

#### **Comeback Farm**

Follow a nondescript slip of a creek west a few miles from its origin in the Susquehanna River and you find one of its branches terminates in a deep cold pond marking the entrance to a mostly wooded 160-acre farm dotted along the base of the Appalachian Mountains. Comeback Farm's neighborhood is an enclave of small farms and residential lots bounded between the river and the mountains, tucked into an elbow-like crook of the formidable mountain range with only one road in and out near the river. The land on this farm is strewn with hard wood trees, tangles of brush, a gravel road, crops in neat rows, a stream or two, animals of many kinds out on pasture, a few small barns, various ramshackle outbuildings, a new poly-high tunnel, piles of decaying scrap metal, a charming adult tree house and summer kitchen perched above the deep pond, a few family homes and, tucked out of site in a gully, a large compost pit where a rooster walks gingerly over what was, recently, a cow's head.

The soil here should be good, not great, for farming. The pasture and crop fields are mostly Calvin shaley silt loam, described by the U.S. Geological Survey (USGS) as a moderate quality soil for agriculture. There are some smaller tracts of Albrights silt loam, a prime soil for farming, alongside some poor agricultural soils including very stony Andover silt loam and very shaley Klinesville silt loam. The soil's basic physical composition is about half silt, forty percent sand and the remainder clay. The soil health rating for two of the fields here averages in the low 60s, out of 100, which is a mid-range score indicating deleterious effects of past management practices. Aggregate stability and available water capacity are both limiting factors, as well as the slopes of the landscape. The USDA Web Soil Survey suggests that the expected organic mater content for these soils is between 1.25 percent, for the Calvin, to 2.5 percent for the Albrights. The actual organic matter content for two Calvin dominated fields is much higher than expected, at around three and a half percent. Expected pH for these soils is 5.5; the actual pH is more hospitable to most crops, at 6.8.

The Cornell Soil Health report suggests just one area of potential constraint to the soil's optimal health here, which is the score on potentially mineralizable nitrogen, or the nitrogen supply capacity of the soil to support soil biology (see Appendix B). Otherwise, the physical and biological components that scored highest were organic matter content; root health rating; and subsurface hardness.

Most days, cows, sheep and goats are out grazing, some sharing a pasture with chickens, geese or turkeys. If its summer or fall, a veritable cornucopia of crops will be growing in the fields: spring wheat, oats, peas, tomatoes, lettuce, peppers, corn, beets and more. While



DAIRY & BEEF LOWS

many small farms are diversified and family-run, the extent of diversity and the number of family here are uncommon: eleven kinds of livestock, six different grains, an innumerable variety of vegetables, four marketing channels and ten multigenerational family members—including four school-age children and a long-term 'intern' who is treated as part of the family—all working and living on less than 60 tillable acres. With this kind of motley crew, it is no surprise that the fourth generation head farmer, Kim Gehrig, has a hearty sense of humor about the enterprise, calling it, at times, "bat shit crazy."

While there are many unique aspects to this farm and its land, their story is not uncommon. Kim and her brother grew up here at a time when the farm was not so diverse; it was a 300 hog farrow-to-finish operation that Kim calls "a monocrop." In the 1940s, her grandfather started a small dairy using horsepower and no commercial inputs, by the time Kim's father came into his prime in the 1970s, "mechanized farming" was the new norm. So, when a barn fire destroyed their milking parlor, Kim's father went into the hog business, invested in some tractors and began "using sprays heavily." Kim describes his farming disposition like this:

He's like, that farmer that's just: 'this is the way.' He was always bigger, better... bigger tractor, blah, blah, blah. And even though he never had those things, he just always saw the better farmers were the ones who were getting those items. You know, they're in debt in their wazoo. But he still sees that they're the better farmers.

When twenty-something newlyweds Kim and John took over the farm in 1994, they kept things as they were, hogs, sprays and all. Both had learned how to farm by working alongside Kim's father, so they continued raising hogs and feed, switching to Roundup Ready corn and soy when it became popular in the nineties and following whatever the normal farming conventions around them seemed to be. But, by the early 2000s, it became apparent that the economics were not panning out. The high cost of pesticides and fertilizer was a particular concern. Kim's parents had been paying the property taxes from their savings to help the young couple who could not keep up with the bills on the farm income alone. The farm was not financially viable and the choice was obvious to them both—find a way to pay the taxes themselves or get out.

#### The experimental logic

While Kim, like her mother, had taken a traditional, passive, 'farmer's wife' role, the looming catastrophe of losing the farm spurred her to become more involved in finding a way to make things work. With a new seekers mindset, she began talking to a goat farmer at one of her children's 4-H club meetings. Kim describes that chance discussion like this:

So we were up there, and I was just talking to her that I wanted to do something different with the farm, and we needed it, and telling her we needed to do something different, and we were thinking of trying to get in selling our products directly through the farmers market—right to the consumer—but I didn't know which avenue, who to go to, or anything like that. So she suggested just start making some contacts, and I wrote it down on the palm of my hand—I'll never forget it—I wrote 'PA WAgN,' because those letters were like so foreign to me. And then from there I just started getting interested in food, definitely to be more

concerned about what's in our food, and I was very concerned when I found out what our kids are eating and ingesting.

PA-WAgN, which is the acronym for the Pennsylvania Women's Agricultural Network, helped Kim to transition away from a conventional operation to a sustainable, integrated croplivestock system with multiple direct-marketing channels. The group has helped many other women farmers seeking to do the same. A fellow WAgN member, who transitioned to an organic goat dairy from a conventional grain farm after her husband unexpectedly passed away, explains the support she found at WAgN like this:

I didn't realize how hard it was, or how seriously these people, the salesmen and the men who were running these companies, when I would call to get advice on how to go about putting this equipment in, they, I don't know, they just—you can tell. You can tell when they don't take you seriously. Here's some woman who thinks she's going to milk goats, and what does she know? And she's not a dairy farmer, and blah, blah, you know, just on and on. Um, I saw a PA WAgN advertisement, and they had a event out at [nearby woman-run farm], and I thought 'I think I'll go to that, maybe I can find some camaraderie with other women.' And I'll tell you what, it was one of the best decisions I made, because, you know, the gals seemed to all be determined to start their own business, or continue a business, and the support from them was great, and I just sort of picked myself up, and said, okay, you know, these people that I'm dealing with are going to take me a little more serious, and it seemed to work. So I think what WAgN did was give me the confidence to believe in myself, and know that there are lots of other women that were in the process of starting their own business.

It turns out that PA-WAgN was a key influence on the farm's turnaround. The turnaround proved not only to be financially important but it also changed Kim's role from a more passive 'farmer's wife' into an active head farmer. The dramatic shift away from conventional hog and feed production would also improve the soil's health, livestock health and the sustainability of the whole farm enterprise. The key to Comeback Farm's turnaround was in Kim's new approach to the farm, which is also her unstated approach to soil management: work with nature, keep it cheap and above all else *experiment*.

Her experimental logic is firmly rooted in the social relationships and peer-networklearning that arise from becoming involved in the women's agricultural network and, to a lesser extent, other farmer-to-farmer networks. Because the financial instability of the farm was the catalyst for change, Kim initially sought ways of farming that would decrease expenditures. This outlook led her to closed-loop and sustainable farming methods, where purchased commercial inputs are avoided in the interest of building soil health using materials on hand as the bedrock of long-term farm viability. By entering into these kinds of social networks of sustainable farm practice, Kim become concerned with the interconnected issues of environmental and human health that are inextricably linked to agriculture for many sustainable farmers.

Being that the catalyst for change was such a dire one: either give up the farm or find a way to make it work, and because she had taken more of a passive role in the past, Kim's new social network emboldened her to experiment and take non-monetary risks. There was little more to lose. She stopped using pesticides and commercial fertilizer, let the livestock out of the barn to graze, began diversifying crops, and charted some novel direct-marketing avenues. However, her old social network on the farm was not so supportive in the beginning. As she remembers:

[John] just was a city boy, so the only farming that he knew was what my dad taught him, or what I taught him. So he was kind of set in the one way he only knew how to do it and he just wasn't as willing to adopt new ways.

John himself admits to being very skeptical about transitioning to these new ways:

I started gradually giving in and letting her try it mainly to see her fail so I could tell her it didn't work. It sort of back-fired on me. The only thing that failed or didn't work was her trying to pasture pigs—pigs are a whole different animal.

Like John, Kim's other family members have been slowly acknowledging the benefits of her spurring them away from conventional farming, as she explains:

My brother was dead set against us. He just was so against us pasturing the cows, and he was so against that, but now he sees how well we're not feeding them. Our beef cows get no grain whatsoever, and that right there is like you would not believe how much cost is involved in getting beef cows grain, and he just sees that they can maintain, and he sees that they're healthy and they're doing very well, and you know, we haven't lost any, since we've been having them out, the mothers, we haven't lost any to calving. They've just been healthy, healthy calves that we've been having out there. So I think he's definitely coming around.

Kim's experimentation has also led to some novel marketing avenues, for instance, a great deal of their income now comes from a "whole diet" community supported agriculture (CSA) program that feeds six families for the entire year, supplying them with not only the conventional CSA fare of a wide array of vegetables, but also all of their meat, bread, grains, and dairy products. The farm also supplies flour to high-end local-foods restaurants in a regional city, runs a meat-only CSA, sells wholesale cut-flowers, and runs a small on-farm store, with plans underway to expand to an off-farm store on the local highway in the near future.

Comeback Farm's driving logic of experimentation emerges from the interaction of many the many influences touched on here: financial instability and a turn away from the norm; women's farmer network for social support; necessity of working with what is on hand and not buying inputs; the diversity of animals, their manure and pasture-based management; the diversity of crops and composting of crop residue; the diversity of marketing channels bolstered by support for local foods; and non-monetary risk taking. The role of gender also figures prominently in this nexus of soil management, in that Kim, being a woman, was necessarily already an outsider to the conventions and norms of farming in this region. This outsider status has the advantage of allowing her to think very differently about the possibilities for the farm, even as it has the disadvantage of not being taken seriously by suppliers and the traditional farming community. The importance of the women's farming network to support Kim as she personally stepped from a traditional 'farmer's wife' role on a conventional hog farm into an active 'head farmer' role on a diverse sustainable direct-marketing farm cannot be understated.

#### Experimentation and soil health

While soil health results from a wide host of interactions, in general, soil health on farmland benefits from diversifying crops and the crop rotation; reducing tillage and pesticide use; and incorporating organic matter through compost additions, green manure, cover crops or crop residue.

Comeback Farm is a clear example of moving toward more healthy soil through management decisions that support soil life. Over the past decade, the farm has gone from a conventional corn soy rotation using commercial pesticides and fertilizer for a confined hog operation to a very diverse rotation of sustainably raised vegetables, grains, and pastured livestock, using compost, cover crops and intensive grazing for fertility, and diversity for pest and weed control, judiciously using conventional tillage as needed. Kim and John are both interested in improving their soil's health after many years of seeing it deteriorate, as she says:

The land is, it was conventionally farmed, and we are trying to—for a lack of a better word—to bring back the soil. Bring it back to a state that nature intended. I like that term, yeah, that was good [Laughs]. And just work with, um, quit working against nature and work with it more: use the bugs, the good bugs, use good nature practices, good ethical farming methods to try to bring the soil back without using a lot of money, because we don't have money to do that. So using our animals to bring that soil back. Ideally we'd like to, you know, put a shovel in and see tons of fishing worms, and yeah, just see some healthy soil that will grow a lot of good stuff for us. Keep our animals healthy, keep our vegetables healthy, just have healthy soil all around, so that's our goal.

When asked what the most important management change has been in terms of impact on the soil, Kim immediately responds:

> I definitely think our mob grazing is benefitting our soil. Just in the two and a half short years that we've been using it, we can see, definitely see improvements.

Mob grazing is a form of highintensity livestock management where cattle are corralled in small pasture paddocks with portable electric fencing that is moved daily, or even more



# MOB GRAZING

frequently, as determined by the number and size of the animals and the height of the grass being grazed. The management logic is based on the herding, predator-prey movement of wild herbivores and has, at its heart, a goal of building soil organic matter through highly managed grass tramping and manure additions. Kim and John were introduced to mob grazing at a workshop session at the Pennsylvania Association of Sustainable Agriculture's (PASA) statewide winter conference a few years ago. With Kim's experimental fervor, she quickly became a mob-grazing enthusiast. They now run about 40 cows, beef and dairy, together in their mob-grazing

program, which has gone from experiment to full-fledged farm management technique in short order. This past year they recognized that they had more land than could adequately be grazed by their cattle and decided to add ten cows to the herd to ensure the ground would be covered in their new grazing plan.

Kim does not get as technical as some mob-grazing enthusiasts, but she is fully convinced of the benefit to the soil that this technique has provided. As proof, she admiringly points out a green line in one of the pastures: the left side of this line is green, spongy, covered in clover, and noticeably plush when stepped on—it has been mobbed; the right side is harder, more sparsely covered and duller in color—it has never been mobbed. She considers leaving this line to show visiting farmers and friends the fast-acting benefits of mob grazing. She was able to do just this by hosting a WAgN field day in the early spring to introduce her



network to this livestock management strategy that has soil health and whole-farm sustainability at its core. As the soil health improves, the grasses grow thicker and higher, clover seed is spread and, in all, the pasture yield is greater and more nutritious, this then supports more grazing animals in a beneficial cycle. As Kim says:

As the fields get healthier with the mob grazing, the hay fields are actually thicker, and so we'll actually get more bales off of them, and last year we had fields that we didn't even use because we just did not have enough animals to mob graze them, or even get the hay off of them or anything.

Kim has also begun using cover crops on some of her acreage, in particular she has seeded the annual crop fields with rye cover for the winter so that she can save the seed to have enough to cover all the tilled fields next year. Kim says she has taken this strategy because cover crops can be expensive but she knows she wants to use them; by planting a smaller area this year, she will be able to harvest enough seed to use in the years to come. Cover crops are becoming more common in this area of Pennsylvania, although they are not the norm. In a focus groups discussion with farmers from across Kim's county, the trend towards more cover crops was clear as this exchange demonstrates:

R1: One of the things we done this fall, and which we've learned from going to meetings, and I don't know how you can measure whether it really helps or not, but like I've been saying, soil health is on the forefront of a lot of the meetings that we go to, maybe we go to the wrong type of meetings, I don't know. But they're saying, have a living, growing crop on your land as many months out of the year as you can.

R2: Yup, yup.

R1: So we had planted cover crop on all our acres this year.

R2: That's the bottom line.

While Comeback Farm is in the Chesapeake Bay watershed, like many of the other farmers in this county, Kim is not really aware of regulations that apply to her due to this proximity. She is hopeful that there might be grants or other aid to help with some conservation projects she would like to tend to on the farm. As she says:

When we were talking about getting some grants and stuff, one of the major things for me is actually getting permanent fencing installed around our streams, and just getting it that our animals are not grazing right up to our streams, and that there's that buffer. So that is one of actually our goals, is to get more permanent fencing set up. (Interviewer: Is that because you have to?) No, no, there hasn't been anybody around here having any regulations on us at all. I think we're far enough away right now at this point, that they haven't got on us or anything.

As attested to bv her management practices, Kim now makes decisions that seek to integrate the livestock and crops in a low-input system that is sensitive to the surroundings but also sensible for her multi-pronged business model and for her family labor. When asked to list the top five influences on how she makes soil management decisions, Kim scribbles this across the iPad screen:

FAMILY-food NATURE - the way it should PASA MOB GRAZING track FARM ANIMALS (OMMON SENSE FARMIN

Kim's experimental logic has led to what would have been, just over a decade ago, a surprising concern for soil health and a desire to get in balance. As she describes:

We need to be more in tune with nature, and I think the soil health should be at a time whenever the humans weren't screwin' it up, and when the animals were just on it, to me that would be optimum soil health. And so that's what I would like to achieve with our animals on it. And I think they're doing it, I think they're getting it back there, so to me that's what soil health means, just more of the way that nature intended it to be.

#### Experimentation and sustainability

In terms of social sustainability, WAgN was the foothold Kim needed to begin experimenting more with the farm, and finding novel, often alternative, ways to make the enterprise work. In WAgN she has found a network of other women farmers who are open and willing to share their lessons learned. The group is a social support network for Kim, and a key aspect of the farm's social sustainability. WAgN hosts field days that regularly bring together a group of farmers that Kim now stays in close contact with through Facebook and emailing. Most of the farm management tips, marketing trends and food system reading that she finds helpful comes from this network of women farmers sharing resources on the internet or in person at field days. Now that her family is, mostly, on board with the new route the farm is taking, they are more supportive of her experiments and more willing to learn about and try something new. Kim's full-time, live-in intern is an important addition to the social sustainability of the farm, both the intern and Kim's brother provide additional adult labor, while Kim and John's children are invaluable for moving the mob fencing and innumerable other farm tasks.

Regarding the economic sustainability of this farm, they are on a path to sufficiency now. However, while often the financial sustainability of a small farm can be bolstered by organic certification, Kim and John are firmly against pursuing certification, even as their practices are wholly in line with the National Organic Program standards. They both say the amount of paperwork is the main deterrent to certification, but there is also a sense that the government-run standards and inspections may not be a comfortable fit for this farm. Even without the organic label to bolster retail prices, financially, Kim and John are doing better than they ever have before. As she says:

If we didn't have the debt from before—from the conventional farming—we would actually be making a very comfortable living... Yeah, so now we are actually, I can't say that we're totally, you know, I still drive my old Subaru, we're not anywhere, but, we're not on the brink of bankruptcy like we were before.

With the multiple marketing channels she has developed, and a new independent farm store in the works, it seems that the financial viability of the farm is secure for the future. If one marketing channel falls short, there is another to make it up. Both Kim and John also credit the 'local food' movement as an important means for making this shift possible and viable in the long run. Whether selling directly to consumers or offering wholesale, the local and sustainable aspects of their farm's production are the major selling point.

A large part of the financial success of Comeback Farm is attributable to the nearly closed-loop system they have generated over the past decade. By reducing or eliminating almost all commercial inputs and feed (save for some seed and livestock nutrients), the farm has become financially sustainable. While John continues to work full-time off the farm, he believes his dream of leaving that job and working in the farm store is nearing fruition.

The environmental sustainability of the farm is also improving. Considering the past history of this land, and the drastic management changes that have recently taken place, it is easy to see how Kim and John's strategy is a benefit to the environment here. As John explains:

She had to prove this to me, but our neighbor sprays Roundup on one side of our lane, and we don't, so at night in the summertime if you go out there you can see all the fireflies and all the things going on on our side of the road, and there's

hardly anything on his side. I thought she was full of crap, but you can really see the difference. It's amazing because we're going in, I don't know how many years without spraying, and there's definitely a difference.

On the same input issue, Kim points out how the shift towards a closed-loop system also has benefits for the greater aquatic system that their farm is a part of:

We've stopped using manufactured fertilizer. The one thing the price was prohibitive and I switched to compost stuff, so we compost the manure during the winter and that makes everybody happy as far as conservation district because we don't have all that running off into the streams.

While both the abundance and diversity of insect life over the fields increases, and the benefits to nutrient retention and aquatic life accrues, Kim is also keen to point out how soil health itself is being affected here, especially given their new mob-grazing program. As she says:

And our soil is in the last couple years that we've been mob grazing, it is actually improving like you would not believe, and we have—like our soil sucked before, we just raped it, and just took all we could from it, and we did not give back to the earth at all. We were poor stewards of the earth, and now I like what we're doing to the soil.

The experimental logic that led Kim to trying these new, low-input, sustainable management strategies has resulted in her going well beyond the initial financial concerns, into new realms of concern where the connections between what Comeback Farm produces, the environmental effects of that production, and the health impacts for her family and her customers is now on her mind:

You know, if you're eating a tomato that you grew in our soil versus Miracle-Gro, I definitely think that there's going to be a huge difference in, not only the taste of that tomato, but probably even the nutrient content of it. I don't know if there is or not, but I would think in my mind that there would definitely be something, and some of those chemicals would have to be spilling over into, you know.... Yeah, so if there's carcinogens and stuff like that in your soil, yeah, hello, I think it's going to go into your food, too. So keep it out of there.

Kim's openness to new, alternative means of farming led her to a group of likewise openminded women farmers who are experimenting together to create a diversity of viable enterprises, often after conventional regimes have failed. Experimentation, born of financial necessity, and bolstered by her gender status as outside the norm, has led Comeback Farm onto solid footing financially, socially and environmentally, so that the outlook for this small farm, and its soil, is better than most.

#### **Case no. 4 Observation**

#### **Holmes Family Farm**

More than 400 miles north of the mild climate and sandy shores of the Chesapeake Bay is a cold mountainous region of central New York known more for its Baseball Hall of Fame than for its claim as the furthest reaches of the Bay's vast watershed. Cradled in a mountain plateau north of the Catskills and south of the Adirondacks, Lake Otsego's waters are cold and clear and deep. The Susquehanna river, the largest tributary of the Chesapeake Bay, begins its journey right here, winding its way down through New York, down the length of Pennsylvania, through Maryland and into the Atlantic Ocean.

Hilly, narrow roads follow numerous small creeks leading away from Lake Otsego, out into a mostly forested landscape hiding a good many small and mid-size dairy and crop farms. The region has long been a dairy stronghold in a state where the dairy industry remains vital; although, even here, disused farms sprouting new woodlands are a common site. Tucked into the woods in a small valley alongside a creek, a sign tacked to a telephone pole lets the few passersby know that here is an Organic Valley co-op member farm. A few dozen feet behind the sign, a modest, well-used cow barn attests to the farm's continuing operation. The sign and barn have, over the years, led some people to stop in and thank the farmer for his milk—many are pleasantly surprised that the very commercial brand of Organic Valley is actually supplied by the likes of Holmes Family Farm. The first impression of the scene here does fit the happy-cow type labeling that is often derided as mere marketing ruse.

This organic dairy is a family partnership between middle-aged cousins Bruce and Dave Holmes with their aging father's help and Dave's son and Bruce's daughter, both in their twenties, working full-time on the farm. The cousins started the farm together on about 200 acres in the late seventies with support from their father. Like most farms in this area, it was a small to mid-size conventional dairy, until the mid-nineties when the Holmes Family Farm was one of the first in the region to transition to certified organic. Since the organic transition, they have picked up more rented land for feed production, bringing the total tillable acreage up to about 140, with additional acreage in permanent pasture. Bruce describes the farm like this:

Self-sufficient dairy farm. By that I mean we grow almost everything that we need... Mixed drainage, hilly, lot of rented ground, organic, which means we have to pasture, so our pastures are home, rented ground is out, harder to get the manure out there. When we started expanding, you're picking up ground that has not been in production. It's a job to get it back producing, just different limitations, different problems... Got a partnership with my cousin, his son, my daughter's decided to come home. We'll be milking a barnful, we haven't been, but we would be milking a barnfu, that's 54... We try to keep between 45 and 50 milking. Probably about 90 head altogether.

They manage pasture for grazing and hay, and grow corn, soy, oats, rye, spelt, triticale and wheat for feed and as cover crops when the season and weather permits. Bruce admits that growing all their own feed is unusual; many organic and most conventional dairy farmers must buy-in feed at considerable cost. Growing their own here allows them to keep costs down and, perhaps more importantly for the cousins, allows them to ensure high quality feed and animal health throughout the winter, which in turn produces a high quality milk that they are proud of. They do buy in some



FUTURE EMPLOYEES

nutrients, minerals and bypass protein to create an optimal feed blend, especially for winter rations. Outside of the winter months, the cows are on pasture and move to a fresh acre-parcel each day to graze.

The soil on the home farm is mostly Herkimer gravelly silt loam, Lima silt loam or Appleton silt loam, with modest slopes, most of which is classified by the USDA as prime farmland. The composition of the soil is more than half silt, about a quarter sand and the remaining twenty percent is clay. The soil is remarkably healthy, with a soil health rating of about 85 out of 100 (see Appendix B). The USDA Web Soil Survey suggests that the expected organic matter content for these soils is three and a half to four percent. The actual organic matter content is much higher, at around eight percent, reflecting years of grazing, organic management and manure amendments. The expected pH is between 6.2 to 6.7, and the actual pH is around 7.1. The Cornell Soil Health Test report suggests that there are no areas of serious constraint to soil health on this farm, and that the physical, biological and chemical properties of the soil combine to produce a healthy environment for soil life and crop production (see Appendix B). Bruce describes the soil and climate like this:

A lot of shale so very good drainage, but a short growing season as compared to further south or even an hour from here.

The organic milk produced here is now marketed through Organic Valley, which is a farmer owned co-operative. Unlike in the conventional milk marketplace where the milk price fluctuates considerably, this co-operative ensures a steady pay price so that member farms can plan their businesses for the year. Bruce is happy with Organic Valley's farmer focus. For instance, when the financial crisis of 2008-2009 led to a drop in demand for organic milk, Organic Valley farmers asked all members to cut back production rather than risk losing farms.

Holmes Family Farm is only able to belong to Organic Valley because they are certified organic. The management of both animals and land is subject to stringent organic standards verified by the Northeast Organic Farming Association of New York (NOFA-NY), their certifying organization. Conservation and animal welfare-minded land and animal management is also incentivized by quality milk pay premiums offered by the co-op. Holmes' Family Farm joined these organizations because they were in alignment with the cousins' values of farming without chemicals and producing high quality food that is free of synthetic chemicals and synthetic hormones.

#### The Logic of Observation

The Holmes' decision to transition to organic in the mid-nineties was early in the organic milk marketing years. Like so many of the decisions made since then on this farm, the transition decision was based largely on *observation*. Observation—of the land, the animals, the milk and the crops—takes precedence over what others are doing, or what the norms are in the dairy industry, or what extension or other researchers might be presenting as best management practices. Bruce's stories from the transition time demonstrate how the logic of observation influences this farm, especially in observing what the conventional chemicals (and hormones) were doing in the fields and to animal health:

In '95, we had a real dry year, and we grew potatoes, a lot of little potatoes. When you harvest them you pick them off. So there were pails of these little potatoes... Dad said instead of throwing them out, we would feed them to the chickens. So he would take a handful each night-we all had like a dozen hens—and he would boil them and mash them up and put it with the feed. Then they came up (on egg production). So we used up all the pails with small potatoes that we had and dad mentioned that he wanted more potatoes so we went over to a commercial vegetable grower and I got their potatoes, brought home two pails and he went through those too.... And the change is slow: 'boy, we're getting soft shelled eggs.' One, two, and then we started getting a few of them, 'boy, chickens aren't doing what they should.' And we got to thinking about, well would it be the potatoes? So we put all the pieces together, the potatoes are sprayed for bugs, sprayed for bugs, sprayed for bugs, commercial fertilizer. Then they spray to kill the vine so they can harvest them, because the vines will clog up the harvester. Now they go into storage... well, 'we've got to fumigate.' So you've got all that spray going into the potatoes and there was enough spray absorbed by those potatoes that bothered the chickens, it absorbed that calcium in their body. But it's all 'FDA approved.'

In another instance from their conventional days, Bruce's cousin, Dave, accidently applied a tiny fraction of the recommended amount of herbicide, with surprising results as attested to below. Shortly thereafter, the introduction of synthetic recombinant bovine growth hormone (rGBH or rBST) as a means to increase milk production quickly became a common practice that the Holmes family disagreed with. As Bruce explains:

Dave came back to the barn and he says 'I read it wrong, and not only that, I mixed it wrong, like a quarter of what it should be.' We had almost as good a weed kill, so then he started playing with it and came down to almost nothing. He says, 'if it's this potent I don't even want to spray.' So we quit spraying, we quit growing corn. And then BST came out, and we felt the consumer should have a choice whether they want milk with BST or not BST. We argued with DHI [their milk marketer at the time] because then they couldn't distinguish in the records who had it, who didn't. We said, well, if some are using BST and some aren't, it's not fair. We quit that and [our consultant] got us a great big red sign: "rGBH Free Farm" put it on the feed bin out front... I mean it's an individual decision whether you want to use it or not, but the consumer should have had a choice.

As this recounting suggests, the Holmes' intensifying questioning of the benefits and drawbacks of pesticides was compounded by the introduction of rGBH. The result was that when an organic marketing route came to their neighborhood, Holmes Family Farm was one of the first to transition and sign up:

We were already getting out of corn because we didn't like the sprays. And just my luck that this [organic co-op route] opened up about that time, because we were getting down to where we weren't growing corn, and just buying the high moisture corn and everything else is paid. (Interviewer: Was it because of the sprays?) Quit a bit. Didn't want to get into that. We didn't like what it was doing to the ground, and just didn't like it. It just didn't seem right. I mean you'd go out and no earthworms, something's wrong.

When they decided to transition to organic and began attending the few organic focused field days and meetings that were available at the time, Bruce relates how he was introduced to a way of farming, based on soil life, that was entirely new. At one of the first organic meetings they went to, Bruce recalls how he struggled even to understand what the researcher was talking about concerning soil microbes:

When we first went organic, there was a fellow that was a speaker from University of California at Davis... and it was one of the very first meetings. And he was talking about balancing soil by microbes, which microbes had which affect on the soils and which nutrients... Way over our heads. We weren't even in that line of thinking. I remember that because it made quite an impression.

Bruce remembers vividly a group meeting and talk with a representative from one of the only organic fertilizer companies operating in this part of New York at the time. At the meeting, the fertilizer representative showed a Japanese video on soil life. That video enabled Bruce to begin understanding the complexity of soil and why soil health was so important to the vitality of his farm. The video enabled observation of a normally unseen underground world. As he recalls:

They put on a meeting, and they had a film strip—it was made in Japan with an electron microscope—and they did soil biology, and they're explaining it, and you got all of this activity here, and all of a sudden here's a mold or whatever it was that's not beneficial, and all of a sudden all these good bugs and everything just attacked it and it was gone. And they had the nematodes and you could watch everything work, and you could watch the root development, you could watch the biological activity around that root and actually open the soil up and the root would follow it, and it was really impressive.

More than twenty years later, Bruce has amassed an understanding of his farm's system and its soil in the context of the agricultural community at large. He notes a difference between farmers that are trying to take care of the soil and those that do not:

There's probably two groups of farmers. Those that are... that value community stability, have a love for the land, and those that, they still value community and love for the land, but they're main goal is production, they want to be first on that chart, or they want everything they can have, or they've been just listening to the wrong advice. We never heard any of this before we went organic; all we heard

was Cornell's. If that's all you hear, you haven't got anything to compare it with. Just as soon as it started to be explained, all of a sudden everything just makes sense why things aren't working. [That's] why we don't listen to their [Cornell's] recommendations, why we question when they come out with all the 'best management practices.'

Over the years Bruce, Dave, and now their children, have learned to observe what is happening in their fields, with their animals and with the weather, to think through how the system is working, or not working, for themselves, rather than accept blanket suggestions for what farmers ought to do. Bruce relates how the soil health affects the milk quality but that even knowing this, they are not always able to do what he feels would be the best for his soils because of time, labor and weather constraints:

As far as soil, you grow what grows better [for your farm/region]. You don't try to fight and grow something that won't do well. And, there's a difference in-my sister could taste it and sometimes my wife can taste it-on what we feed the cows. Like this time of year, sometimes the milk will taste a little bit different than when they first go out to grass. Then if you've got soils that don't have the nutrients that the cows need, then you wind up adding more vitamins and stuff and that flavor comes out of the milk in time... In terms of soils, you have to watch the calendar more than the soil. If the soil is a little bit damp and it's getting late, you've got all this other stuff to do... It would be nice to wait a day or two 'til it dries up a little bit more. So you can't do things the way you want to... if you get spread too thin, then there's too much to do. You can't do what you want to do. It would be nice to not have the feeling that you have to have all the land in productivity every single year, and it would be nice to take a field and grow a crop for the soil and turn that down. That's something I've wanted to do for a long time. Usually we're short some component somewhere to where we can't really, don't feel we can ... which is crazy because it's probably a downward spiral, where if you could do that you would gain it back, but it's the hard part to get started.

Direct observation is important here, but it is certainly not the only means by which the Holmes' make soil management decisions. While a history of promoting conventional agriculture has made Bruce wary of his local cooperative extension, he is keen to seek knowledge and support from trusted sources, especially when it comes to soil health. His crop consultant, who is a fertilizer salesperson, is adept at visual interpretations of soil health from crop and field inspection and has taught Bruce a great deal about soil life and the web of interrelations that start in the soil and span out to crop, field, and animal health. Because the web of life in soil is not easily observable, Bruce has come to rely on his fertilizer representative and the fertilizer company's extensive soil testing and nuanced recommendations. As Bruce says:

We've only dealt with two fertilizer companies. The first one coming out of conventional when we went to organic they seemed to help us up to a level, but we knew there was more there and we just couldn't get past that level. And then we found Lancaster Ag, and they're doing more with biologicals and we can see improvement again, rather than just hitting the level and just staying there. So I think that gets back to soil biology and the soil actually making the nutrients available, because if you take soil that doesn't have phosphorus, and you grow

buckwheat, you all of a sudden have got phosphorus because it frees it up. So I think they're a little bit more on the ball.

Both of the organic fertilizer companies that Bruce has dealt with champion soil biology as the bedrock of soil health and successful organic farming. They advocate three-year rotations, cover crops, residue inclusion, manure and compost amendments and they sell micronutrient blends tailored according to a field's and crop's particular needs as determined by soil testing. The first organic fertilizer company the Holmes' dealt with were early pioneers in the then nascent market. The fertilizer company representative that showed Bruce the Japanese soil life video has seen the industry develop over 25 years, pointing to how more attention is now being paid to cover crops than ever before and that more diverse rotations are becoming the norm again, at least in the Northeast. He recounts how attention to specificity is paramount for organic farmers:

There's a lot that goes into organic farming, and actually you have to be a better manager for organic farming to some degree than you are with the chemical side, the conventional side. The chemical side will override a lot of mistakes that you make, with your timing and things like that. Farmers have to pay attention to the seasons and the times of year that they apply organic fertilizer... For years I talked about biology in the soil, and how important and significant it is for all aspects of growing. In other words, let me say, that the biology in the soil continually produces nutrients and makes them available as plant demand is there.

The fertilizer company that Bruce works with now is known for its field-specific micronutrient blends that can give organic farms that already have good soil health an extra boost. Bruce's soil falls into that category, and his work with the fertilizer company is a partnership that he values considerably. Bruce has a high regard for the knowledge and the systemic-view that the fertilizer company and its representatives have. The representative for this company notes how so few organic farms in this area of New York are putting into practice all of the measures that create robust soil health. For instance, he laments that it is easier to sell certain fertilizers than to convince a farmer to incorporate corn residue immediately after harvest—even though they have the same beneficial effect and the latter would cost far less than the former. As he says:

So many farmers are not managing manure properly, they're not doing the cover crops, their soil doesn't have the life in it that it needs...

However, there are a handful of farms, like the Holmes Family Farm, that are managing to improve soil health. For these farms, the fertilizer specialist works with micronutrients to bring the soil health to a level that might not be possible without these particular additions. He explains it like this:

I do know some farmers who are doing a really good job with their farm, and they just really didn't see much difference [from the organic fertilizer]. I can understand why, because the thing that the fertilizer is promoting, those things are already working on their farm and the little additional shot in the arm didn't make that much difference because they were already moving on a very good track, if that makes sense. If somebody's running just a stellar system, we can provide the micronutrient package, they can buy lime and sulfur, but they can buy those things locally by the truckload at reasonable prices. We can help those guys with seed or stuff like that, but they're doing a good job, they don't need nearly as much. But there are very few people who are educated enough and are disciplined enough to do those things, from my experience.

In many ways the Holmes' have become even more observant farmers because they are in an organic management system that they believe demands their attention. It is, of course, possible to operate in an organic system with a conventional-input mentality, as the fertilizer specialist above attests too. However, for Bruce and Dave, being under the organic umbrella has increased the educational and social opportunities that enable better understanding of the complex, systemic interactions on their farm.

When asked how he stays current, Bruce mentions Acres USA magazine, organic dairying books, and most of all talking with his organic crop consultant/fertilizer specialist and other organic dairy farmers in the area, and beyond, often facilitated by some aspect of the dairy co-operative. The logic of observation is supported by these kinds of interactions as well as by the animals themselves, including their manure and attention to their feed needs and health outcomes; observation of the potency of herbicides and affects of agri-chemicals on food products; the availability of an organic co-op route in the area; and love for the land and community. In the final equation Bruce believes that this kind of farming requires a lot more from the farmer as compared to conventional-chemical farming. The kind of organic farming practiced here is more time consuming, requires careful observation of animals and crops, and demands that the farmers be more adept, than when they were managing the dairy conventionally.

#### **Observation and soil health**

While many factors contribute to agricultural soil health, there are a few management practices that stand out as highly beneficial, such as conservation tillage (no-till), cover cropping, enhanced rotations and amendments such as the incorporation of residue, compost and manure. Because Holmes Family Farm is a pasture-based dairy, there are a number of acres here in permanent, no-till pasture, which are managed with rotational grazing and occasionally harvested for hay. On account of their being organic, the more than one-hundred acres of annual cropland used to produce feed, is tilled; organic no-till is a very rare practice, because no-till typically requires synthetic herbicide use. However, the mixed rotations here, which include small grains, cover crops, fresh and composted manure amendments, and attention to soil biology have meant that the soil health tests high, despite the tillage regime. Bruce considers soil health important and makes management decisions, when possible, that will improve it. As he says:

I think that we're making a lot of effort to help the soil in terms of: we spread manure, we mix the minerals into the manure so that when we spread it, some of those minerals are also down through the soil. We do cover crops. I think anything that puts an organic matter back in the soil can only be a step in the right direction. In terms of minerals, it's like there's always that question of is it just making us feel better that we're trying or are we actually accomplishing something? But we're definitely trying.

The crops grown for feed include wheat, oats, triticale, corn and soy. The cow rations are mixed with small amounts of purchased amendments, including nutrients, minerals and clay, to

ensure optimal nutrition and animal health. Bruce has even added to the cows' rations specifically to aid the soil health:

I ran out of it, but we were putting Humate in [the feed]; it's humic shale that promotes bacteria growth. The cow uses some and the rest goes out in the soil. So your humic acid, your clays, the conditioner, and the Geobond, which are bonding agents, also bond your nutrient particles, hold it and help build the soil more than just the regular mineral.

Bruce is concerned with the quality of the manure because it directly affects the quality of the soil. Since he has more land than manure, he uses the manure very lightly on pasture, "for the inoculant value," and saves the bulk of it for the actively tilled crop fields. Ultimately, Bruce says that the



manure, and what goes into the cow to create that manure, affects everything on this farm. He recounts a meeting with a well-known organic livestock expert who explained how conventional dairy 'best practices' turn once-valuable manure into a waste product:

I got there, you know, like maybe five minutes late, and he's explaining a cow's manure, and I've sat through that I don't know how many times, 'well this will be pretty boring.' Within a few minutes he had me lost. Says, a cow needs this, but what are we doing? We're feeding this, now we're short this, so we bring this in, we bring this over. But this affects this, now we bring this in, and now we need a buffer, so we bring this in. He says, pretty soon you have not got manure. This is not what you want going on your land. You know, and it was quite an eye opener when you get looking at that.

The Holmes' generally seek to put cover crops down—rye, wheat, oats—but sometimes a very short growing season means that soybeans come off in early November and there is no time for a cover crop to take hold before the winter freeze. However, the organic standards require a cover crop between two consecutive years of corn and because the Holmes' corn stores are low, they made it a priority to ensure that the cover crop was on the acreage that will be in corn again next year so that they are able to replenish the corn stores without depleting the soil or running afoul of their organic certifying agency.

When prepping to plant the winter grains, they put down the organic fertilizer blend made specifically for their fields in a mix that includes white Dutch clover seed. The mix helps fix nitrogen but also avoids the problems of harvesting grain with taller clovers growing up through them. They have recently bought a discbine that allows them to cut and harvest the short white clover for feed. As the clover attests to, Bruce is careful about the varieties he chooses, and he sees that there is a difference between what is being bred for the market and what might be the most beneficial for his farm or for the public in general:

Well, now when you can't use all these fertilizers, the conventional fertilizers, now you're looking at a different plant. You're looking at a plant with more root growth to actually harvest the soil, but now you also need a soil that's working,

you're not dumping chemical on it and harvesting the chemical. You want the biological action in that soil, so you also want a different plant. So there's a huge difference there... When you get into seeds, and this one really makes me mad, like [a regional seed dealer], they've got a hybrid in there that does really, really well in this area, but the parent genetics they have to buy from I think it's Monsanto. Now Monsanto will not release this one parent untreated, they treat it. Well now they've got one parent that's treated, another one that isn't, but it's not organic seed because they can't get the untreated parent. Monsanto's controlling it or Pioneer or DuPont or whoever, and the American public has no idea what's going on. God gave us all of these genetic plants. Where in the world did these companies get proprietary ownership on these? These belong to the public.

One of the most recent additions that improves soil health here is the installation of

dedicated travel lanes for the animals. These lanes confine compaction and erosion to a few designated areas. But the cows movements are not wholly under the guise of 'best management practices,' at least in terms of water quality. Some of the cows have access to the stream that runs alongside the barns. Bruce is aware that this is viewed by extension and soil conservation as a poor practice. However, his explanation of the stream situation exemplifies how his observational and systemic view is the predominant influence on his decisionmaking, coupled with his distrust of wouldbe experts. As he explains:



What we're looking at here is a stream that the cows can get at. Best management practices, we want that stream fenced off so the cows can't get it. 'We'll come in, we'll put you a well so you have water over on that side for them to drink, we'll get you down to one little crossing so they're only spoiling one area, not this whole thing.' Well, it's not going to work. Why not? You've gotta build fence down through there, and now the water comes up and we get winter, and now we've got ice, where's the fence going? It's going right downstream. Who's going to build the fence every year? Who's going to dig it out of the creek every year? Not me. And when you come back this summer, you're going to look at that stream bank, and I'm going to ask you where the erosion is, because they have access to that whole thing, they cross in different spots, your imprint is in different spots, it's spread out. You don't have a severe problem. You've got fresh vegetation growing. Nutrients come down off the hill that vegetation's in the growing stage, it'll absorb that, nutrients. If you've got old woody stuff, it'll come right on through, right like that over there, on that bank where you've got your woods. It's going to come on through because there's nothing there to grab it and hold it. So we go round and round. When we first came here, that was pasture, so you had 35-40 cows through here. What we've done is we put the dairy on that side of the road, dry cows are here so there's six to ten here [by the stream]. The traffic is over there. We've already done quite a bit, don't ask for more.... But they're the experts, and they're college educated, we're not, so we're not supposed to know anything, they're supposed to tell us.

A similar issue came up in a local farmer focus group where another organic dairy farmer has the same problem and a similar viewpoint, with the best management practice of not allowing cows into the streams. She says:

Soil conservation had always told us—and I actually believed—that you should never have your cows in the riparian areas, the streams, and it turns out that's totally wrong, and I wish I figured this out 15-20 years ago, because I have two fields where the river bends into the field so it pushes against the wall there. Every year I lose 4 or 5 feet of beautiful river bottom ground. I ignored the government and I did graze the streams that run through the farm, but I only did it twice a year. Usually in July or August when everything dried up and it was totally dry, put all the dry cows in there, lock them in with a bale of hay or something, make them really trample it down, and they did a beautiful job of turning a stream that went like this, like straight sides, and now it goes like this. And the whole entire stream, sides and bottom, are grass, really tall grass now. So in '06 and '11, when a huge mountain of water was running through that, the grass laid flat and the water went, sshhft, and I don't think a bit of soil left. It was fantastic.

Clearly for Bruce and some of his neighbors, observation of their animals' behavior and affects on the land take precedence over regulations or voluntary best management practices. His appreciation and attention to his herd is considerable, and when asked what are the most and least helpful aspects of the way he farms in terms of soil health, the cows were foremost on his mind:

The biggest key would be the animals. With the manure going back on, to help you have a good, healthy, productive soil, with that biological going back on, and the humus. Least helpful is being scattered so much, and so much of a workload that there's times that you can't take off, and then there's times that when you do take off, when you get back, you've got more to do. I would say the workload is too consistent to where you can't really shift it around.

When asked to list the five most important influences on how soil management decisions are made this farm, Bruce writes:

BELIEF THET SOIL AMMENDMENT IS CORRECT APPROACH Budget to work with How quick for results Jilled crop has preference PASTURE HAS preference

on

This list shows how the logic of observation also accounts for economic and practical considerations. It also shows how organic system observation and education has supported the emergence of a belief that active soil management is a key means to producing the best quality soil health possible.

#### **Observation and sustainability**

Sustainability on the farm encompasses, at a minimum, three interconnected realms: social, environmental and economic. The potential for social sustainability at Holmes Family Farm falls into two categories of concern; the first concerns public perceptions of farming and, relatedly, regulation and rule making, and the second concerns labor, and relatedly, gender issues, on the farm itself. Neither of these are particular to this farm, they are common themes farmers bring up throughout the Chesapeake Bay watershed.

Like many farmers, Bruce is concerned about the public disconnect with farm work. There is a sense that most people are uninformed about what farming really entails, believing either the quaint happy-cow images presented by advertisers or rallying against all farms as a megalithic group of polluters and animal abusers. As Bruce laments:

How many are in agriculture? Two percent, four percent of the population? It's pretty low... You've got 90 percent of the population telling us what to do, and they don't have a clue.

When asked what might correct this, he half-jokingly suggests a mandatory farm-work period in every young adult's life: "They'd almost have to come out and intern for a year, really." Bruce suggests this from experience, having hosted young people on his farm and seeing them come to an understanding of the complexities of the work through first hand observation. As he says:

We interact with a lot of people; just the way things are. My [distant relative] had a daughter that wanted to go in the Peace Corps, and they made her do a short apprenticeship on a farm, and she knew we were farming so she came up here and did it. No exposure to farming. Loves it, loves the agronomy part of it; changed her major to agronomy. [Another distant relative] came out. Loves it; changing over to animal husbandry. These people, their interest is there, but there's no exposure, they don't know. And then you've got these idiot schools, everything's computer, oh, 'we gotta have computer this, computer that, we've gotta have these chip factories' and that's going to disappear just as fast as they came because that's global, that's gone. Agriculture is here, but they don't want to look at it, it's not important.

Bruce's concern with the public disconnect extends to food and farm regulators without an agricultural background. While he currently finds the regulatory system a bit irksome, he says he would take much more issue with strong rules, rather than the proliferation of voluntary measures he mostly deals with now. His concern stems from the specificity of each farm and the non-specific nature of most regulations; the prime example for his farm being 'no cows allowed in streams.' But in the larger context he talks about chemical runoff and aquatic pollution loads, where Bruce feels that agriculture has been dealt an unfair level of responsibility when suburban households and developments continue to apply lawn and road chemicals with little regulatory consequence or acknowledgement.

Bruce is adamant that the desire for control is at the heart of agricultural regulations, that the government uses the measures, voluntary or not, to gain "control of the land and the scenery." Bruce's daughter, Helen, has a suggestion to remedy some of these potential policy issues that is clearly in line with her father's ideas on direct observation and experience:

This goes for any profession or any industry, specifically agriculture: if you have not experienced it yourself, and with agriculture, if you're not going to get your hands dirty and see what it is we're even talking about, how can you be helping make policy on this? I would just encourage anyone who thinks that they are a policy maker—helping agriculture or helping farmers—come play in the soil with us, come get your hands dirty, and feel like two days later, 'why can't I get that mud out from under my fingernails?' you know. Really, literally, get your hands on it. Because if you're not going to understand what it is that you're talking about or regulating, you're not helping anybody.

At the level of the farm itself, the social sustainability issues of most importance are time constraints, which relates to a labor shortage for acres in production. Bruce regrets having too much to do so that sometimes he is unable to, for instance, plant cover crops everywhere he would like too, or grow a soil-enriching crop on some set aside acreage. With the dairy, he almost never takes vacation, although he does not suggest that this is a hardship. However, this social constraint may soon be a thing of the past; now that the barn is full, the size of the herd is unlikely to expand so the workload may come more into alignment with the available labor, because Helen has only recently returned home to work full-time on the farm.

Helen adds significantly to the available labor on the farm but she also brings a new perspective, and new social sustainability challenges, both because she is a young farmer, and because she is a woman. She openly wonders how she will be able to carve out a life that includes finding a partner and being supported as a woman in a line of work that caters to, and is dominated by, men. Even though she grew up on this farm—having seen the transition to organic when she was about nine years old—it was only very recently that she realized she wanted to farm, or that it was even a realistic option for her, because of her sex:

The whole time [at university] I just kept thinking about how I could become involved in agriculture without being a farmer. Especially being a woman, I thought that was something I was incapable of. The guys on our farm are extremely mechanical, so handy, they can fix anything, they're rugged guys, they move things, and I'm just like I can't drive a tractor, this isn't going to work. Finally I got over that and I worked on a couple farms overseas and my perspective just changed. It was really like, if I'm not farming with my family, it's not very much fun... Being a woman, and especially a young single woman, it has its challenges and it gets me thinking a little bit about, not right now in the moment, but long term also, is this necessarily sustainable to my life and mental health? Those are questions that I think will come up no matter where you are and what you're doing, so it is what it is. Other than the fact that I have a few issues of being a woman on the farm with very rugged men, and I'm trying to be just like them and it's not working.

Helen suggests that some of the farm practices will shift to accommodate the new head farmers down the road; from chores, to machinery, and barn set-up, there are ways to make the farm more amenable, but, for now, these changes will have to wait. While Bruce continues to enjoy milking cows, he is supportive of the next generation taking the operation in a direction of their choosing even if that means not being a dairy farm. Bruce wants to slowly transition away from the work, to not leave them "cold-turkey." At the same time, he is keen to allow Helen and her cousin to decide how Holmes' Family Farm will operate in the future.

In terms of economic sustainability, it is the transition to organic that paved the way for this to be a multigenerational farm with a promising future. Three adults now work here as their sole employment: Bruce, Helen and her cousin. Dave continues to work on the farm while holding another full time job, and all three of the men's wives work in jobs off of the farm. The current situation would not have been possible as a conventional dairy. Bruce is clear that if they had not transitioned to organic they would have gone under:

There's a future now where there wasn't before. Because we were getting to the point, we were financially sound, but were chewing up our equity and the equipment was getting worn out enough and old enough that it was getting to be nothing left to fix. And then organic came along and then all of a sudden we could start buying some decent used equipment.

In terms of environmental sustainability, this twenty-year organic farm is moving toward a closed-loop system that is restoring soil carbon and recycling nutrients through an integrated crop and livestock system. The high organic matter content and continued productivity of the land attests to the effectiveness of Bruce and Dave's management decisions, which are often made with the goal of supporting soil biology. When asked what soil health means to him, instead of defining the term, Bruce offers the following, which attests to the implicit goal of supporting soil health with every management decision:

That's everything, right there. That's the most important thing if you haven't got good soils, you're doomed.

In addition, the environmental benefits of pasture and managed grazing are well known and provide a validation for the work Bruce is doing. He sees a systemic interlinkage between the pastures, grown on healthy soil, with livestock production and the human diet. As he says:

Getting back to grass as the most ecologically correct crop, the only way to get that into the human food chain is with animals.

Helen elaborates on this systemic environmental view that undergirds Holmes Family Farm:

I just can't imagine how putting something that I would freak out if it was on my skin, I can't imagine how putting that on a tender blade of grass or a small plant that's trying to grow, how that helps them. Then again, being back to the soil health, say you're spraying potato plants or something, it doesn't just land on the potato plants, it lands on the ground, too, of course, and I think it kills a lot of the microbes in there that are all part of the system that I'm trying to help foster, because I think it's all creation that works together.

It is likely that the logic of observation, and a deep care for the soil and the land, will continue to influence management decisions at Holmes Family Farm as long as it is in the Holmes' family. The sustainability of this small organic dairy is attested to by its ability to pass down an economically viable business supported by healthy soils, to the next generation.

## Appendix

# **Soil Health Test Reports**

#### **CORNELL SOIL HEALTH TEST REPORT** Sample ID: k31 Name of Farmer: Location: Agent: 0 Field/Treatment: Agent's Email: 0 Tillage: no till Given Soil Texture: channery silt loam Crops Grown: COG/SOY/COG Date Sampled: 3/27/2013 Constraint Value Rating Indicators Aggregate Stability (%) 19.0 20 aeration, infiltration, rooting PHYSICAL 72 Available Water Capacity (m/m) 0.19 Surface Hardness (psi) 239 22 rooting, water transmission Subsurface Hardness (psi) 309 **43** Organic Matter (%) 4.0 66 BIOLOGICAL Permanganate Oxidizable Carbon 57 644 (ppm) Potentially Mineralizable Nitrogen (µgN/ gdwsoil/week) 2.7 11 N Supply Capacity 75 Root Health Rating (1-9) 3.0 7.2 100 pH (see CNAL Report) **CHEMICA** <4.5:Plant P Availability, Extractable Phosphorus >25: Env. Loss Potential (see CNAL Report) 268.1 0 Extractable Potassium (see CNAL Report) 173.7 100 Minor Elements (see CNAL Report) 100 **Medium OVERALL QUALITY SCORE (OUT OF 100):** 55.4 Soil Textural Class:==> silt loam SAND (%): 13.5 SILT (%): 76.3 CLAY (%): 10.2

# Case No. 1 | Innovation | Art Byron Farm

CORNELL SOIL HEALTH TEST REPORT						
e of Farmer:	<u>Sample ID: k29</u>					
tion: 2	Agent: 0					
/Treatment:	Agent's Email: 0					
ge: no till	Given Soil Texture: shaley silt loam					
s Grown: GRT/GRT/GRT	Date Sampled: 3/27/2013					
Indicators	Rating	Constraint				
Aggregate Stability (%)	28.3	36				
Available Water Capacity (m/m)	0.15	42				
Surface Hardness (psi)	175	49				
Subsurface Hardness (psi)	225	76				
Organic Matter (%)	4.2	70				
Permanganate Oxidizable Carbon (ppm)	585	44				
Potentially Mineralizable Nitrogen (μgN/ gdwsoil/week)	2.3	10	N Supply Capacity			
Root Health Rating (1-9)	3.0	75				
pH (see CNAL Report)	6.8	100				
Extractable Phosphorus (see CNAL Report)	10.0	100				
Extractable Potassium (see CNAL Report)	68.7	100				
Minor Elements (see CNAL Report)		100				
OVERALL QUALITY SCORE (OU	66.8	Medium				
Soil Textural Class:==> silt loam           SAND (%): 37.6         SILT (%): 52.1         CLAY (%): 10.3						
	e of Farmer: ion: : Treatment: ge: no till s Grown: GRT/GRT/GRT Indicators Aggregate Stability (%) Available Water Capacity (m/m) Surface Hardness (psi) Subsurface Hardness (psi) Subsurface Hardness (psi) Organic Matter (%) Permanganate Oxidizable Carbon ppm) Potentially Mineralizable Nitrogen µgN/ gdwsoil/week) Root Health Rating (1-9) OH (see CNAL Report) Extractable Phosphorus see CNAL Report) Extractable Potassium see CNAL Report) Extractable Potassium see CNAL Report) OVERALL QUALITY SCORE (OU Soil Textural Class:==> SAND (%):	c CORTAELLE SOILL III         c of Farmer:         tion: :         Treatment:         ge: no till         s Grown: GRT/GRT/GRT         Indicators       Value         Aggregate Stability (%)       28.3         Available Water Capacity (m/m)       0.15         Surface Hardness (psi)       175         Subsurface Hardness (psi)       225         Organic Matter (%)       4.2         Permanganate Oxidizable Carbon       585         Potentially Mineralizable Nitrogen       2.3         Root Health Rating (1-9)       3.0         oH (see CNAL Report)       6.8         Extractable Phosphorus       10.0         Extractable Potassium       68.7         Winor Elements       68.7         See CNAL Report)       68.7         OVERALL QUALITY SCORE (OUT OF 100):       Soil Textural Class:==> silt loam         SAND (%): 37.6	e of Farmer: tion: : Treatment: ge: no till s Grown: GRT/GRT/GRT Indicators Value Rating Aggregate Stability (%) 28.3 36 Available Water Capacity (m/m) 0.15 42 Surface Hardness (psi) 175 49 Subsurface Hardness (psi) 225 76 Drganic Matter (%) 4.2 70 Permanganate Oxidizable Carbon ppm) 585 44 Potentially Mineralizable Nitrogen µgN/gdwsoil/week) 2.3 10 Root Health Rating (1-9) 3.0 75 OH (see CNAL Report) 6.8 100 Extractable Phosphorus see CNAL Report) 68.7 100 Minor Elements see CNAL Report) 68.7 100 Minor Elements see CNAL Report) 10.0 100 Extractable Potassium see CNAL Report) 68.7 100 Minor Elements see CNAL Report) 100 DVERALL QUALITY SCORE (OUT OF 100): 66.8 Soil Textural Class:==> silt loam SAND (%): 37.6 SILT (%):			

# Case No. 3 | Experimentation | Comeback Farm

CORNELL SOIL HEALTH TEST REPORT						
Nan	ne of Farmer:	Sample ID: k32				
Loc	ation:	Agent: 0				
Fiel	d/Treatment:	Agent's Email: 0				
Tilla	age: no till	Given Soil Texture: fine sandy loam				
Cro	ps Grown: COG/BND/COG	Date Sampled: 3/27/2013				
Indicators Value Rating				Constraint		
. 1	Aggregate Stability (%)	12.1	11	aeration, infiltration, rooting		
PHYSICAL	Available Water Capacity (m/m)	0.19	79			
	Surface Hardness (psi)	193	41			
	Subsurface Hardness (psi)	238	80			
د	Organic Matter (%)	2.3	30	energy storage, C sequestration, water retention		
BIOLOGICAI	Permanganate Oxidizable Carbon (ppm)	357	20	Soil Biological Activity		
	Potentially Mineralizable Nitrogen (μgN/ gdwsoil/week)	0.6	9	N Supply Capacity		
	Root Health Rating (1-9)	3.8	75			
HEMICAL	pH (see CNAL Report)	6.3	89			
	Extractable Phosphorus (see CNAL Report)	17.8	100			
	Extractable Potassium (see CNAL Report)	115.3	100			
0	Minor Elements (see CNAL Report)		100			
OVERALL QUALITY SCORE (OUT OF 100): 61.1 Medium						
Soil Textural Class:==> sandy loam           SAND (%): 48.4         SILT (%): 45.7         CLAY (%): 6.0						

# Case No. 2 | Privilege | Bay Edge Farms

# Case No. 4 | Observation | Holmes Family Farm

CORNELL SOIL HEALTH TEST REPORT						
Name of Farmer:				<u>Sample ID: k52</u>		
Loc	atior					
Fiel	d/Treatment:	Agent's Email				
Tilla	age: 1-7 inch	Given Soil Texture: gravelly silt loam				
Crops Grown: CGT/SOY/OAT				Date Sampled: 4/13/2013		
Indicators Value Rating				Constraint		
	Aggregate Stability (%)	67.6	96			
PHYSICAL	Available Water Capacity (m/m)	0.23	90			
	Surface Hardness (psi)	130	69			
	Subsurface Hardness (psi)	270	59			
د	Organic Matter (%)	7.8	100			
<b>IOLOGICAI</b>	Permanganate Oxidizable Carbon (ppm)	862	91			
	Potentially Mineralizable Nitrogen (μgN/ gdwsoil/week)	12.2	49			
B	Root Health Rating (1-9)	4.0	63			
CHEMICAL	pH (see CNAL Report)	7.1	100			
	Extractable Phosphorus (see CNAL Report)	7.7	100			
	Extractable Potassium (see CNAL Report)	120.6	100			
	Minor Elements (see CNAL Report)		100			
OVERALL QUALITY SCORE (OUT OF 100): 84.7 High						
	Soil Textural Class:==> silt loam           SAND (%): 26.0         SILT (%): 55.5         CLAY (%): 18.4					