
Biotechnology on Rural Landscapes

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In my former career as a university professor, between 1985 and 1995, I strived to help crop producers design environmentally sound cropping systems in, and adjacent to, some of the world's most pristine estuarine resources, the Albemarle and Pamlico Sounds in eastern North Carolina. Those efforts ranged from small-plot work to designing an organic research station to help growers produce more birds on their properties as they farmed. People ask me why I gave up—as my wife would say—the last secure job in America, the tenured full professorship. In any case, I gave it up and went to work at Monsanto because I felt it was an organization that had an opportunity to expand the frontiers of science and do the kinds of things that I learned about back in my graduate-school days when working with Ralph Hardy, Bill Jackson, Dick Hageman, and others. Those names may be unfamiliar to many, but they were preeminent scientists in their day—ethical, moral people who intended to do good with what they were trying to accomplish.

EIGHT TRUTHS

My third career will be retirement. Some work harder in retirement than they did when they were employed. I am going to write a book: "Things That I Know to be True." Some of the discussion at this conference has clearly been based on poor information. So, before starting my presentation proper, I want

to list eight things that I know to be true and, although ancillary, are worthy of consideration particularly in relation to biotechnology.

- Technology crosses boundaries in response to capital.
- Complexity breeds expense. The more complicated something is the more expensive it is to deal with it.
- When I taught at NC State, I used to have at least one person stand up every day and say this to remind people: a dollar today is worth more than a dollar tomorrow.
- People respond to incentives.
- The more we do something, the better we become at it, which speaks to Dr. Kirschenmann's concepts of the commodity business.
- It's far easier for a small group of people to stop something than it is for a large group of people to accomplish something.
- It costs today, about \$80+ million to commercialize a biotechnology trait in 8 years. Four years of that activity and about \$8 million dollars are dedicated to the regulatory process that establishes food, feed and ecological safety.
- Finally, I'm going to define science because that word has been used a lot. Science is a conversation that changes over time wherein the correctness of an answer is swayed by the preponderance and the quality of the evidence.

PLUS ÇA CHANGE...

Samuel D. Champlain, as he explored the northeast territories, stated in his diaries: "These savages all along the coast where we have been, said that birds, which are very large, come along when the corn is ripe. They imitated to us a cry which resembled a turkey." This shows that when the Europeans arrived, the Indians were already interacting with wildlife in their agricultural fields. The Europeans brought along tourism and economical development based on natural resources. It's the same today as yesterday—the issues are similar.

A footnote, dated 1907, at the bottom of the page in the book I used says, "The wild turkey, long since extirpated"—which means removed—"in New England, is still found occasionally in Canada and frequently in the southern States." Although clearly abundant when Champlain came along, in 1930 there were only 30,000 wild turkeys in the United States. Today there are 30,000 turkeys in the state of Vermont alone. Therefore, that species has been rejuvenated, and there are several similar examples. All kinds of issues and discussions go along with this, but the issues, again, remain the same.

FUNDAMENTALS

I am a fan of Thomas Friedman, the foreign affairs writer for the *New York Times*. I don't like his politics, but, from my perspective, he is very bright and

understands how the world's markets and financial instruments are interconnected. The title of his book, "The Lexus and the Olive Tree," is metaphorical: the lexus is global capitalism and the olive tree is the sense of local culture that everyone is trying to hold on to. Dr. Kirschenmann said it's not enough to be a good technology person, or a good reductionist scientist; to be effective in the modern world you have to understand culture, finance, environmentalism, politics, and national security. It's a multi-dimensional information albatross. Furthermore, sometimes events occur and technologies develop that nobody has foreseen, yet great things result.

While studying biology in high school, my daughter had the opportunity to dine with James Watson. She said that he was funny, but she wasn't sure if he understood how she thinks. I said, "Welcome to the real world. Sometimes you get your best ideas from the fringe, and so you should always listen and figure out how you want to operate." If you look at biotechnology today—keeping in mind that it's a very immature industry (the first transformed plant was produced in 1983) and when things are young, like my daughter, you don't always know how they work—we do know for a fact that it can increase grain and fiber yields. We know it can decrease operating costs. Remember, the more we do something the better we become at it; when you're in a global commodity business, every time you double global output, the price comes down 15 to 25%. If you put it into deflated dollars on a logarithmic scale, the decrease is linear. The real values of corn, soybean, and wheat have been declining consistently since 1962. Biotechnology offers an opportunity to go back and change the rules and add value. Accordingly, reduced soil erosion extrapolates to enhanced water conservation and anybody who travels in this country knows that water is the big issue. Decreased pesticide spraying means that growers make more money; they adopted *Bt* technology at unprecedented levels because it creates value.

CONSERVATION HISTORY

It has been said that the environmental movement started with Rachel Carson's book "Silent Spring," but I think that's incorrect. In my opinion, the new testament, if you will, of the conservation movement is "A Sand County Almanac," which Aldo Leopold published in 1949. The old testament was Herbert Stoddard's work in the red hills of Southwest Georgia in the 1930s, in which he criticized cotton producers.

Unknown to most people, the number-one person at Monsanto in the 1930s and 40s, the person who established it as a science and technology company was Edgar Queeny, who wrote "Prairie Wings" and shepherded the development of the waterfowl industry in the upper Mississippi belt.

Clearly, there is a long conservation history, but I want to speak to how agriculture, economic development, and environmental benefit may occur on the same landscape.

LANDSCAPE DEMOGRAPHICS

When I was growing up in North Carolina, there was a wonderful commercial called “North Carolina, Variety Vacation Land”: 3 hours from the beach, 3 hours from the mountains, pristine the whole way. Today, economic development, tourism, and agriculture all share the same landscape. As we look at landscapes, one of the things that I used to complain about as an academic was that when you really want to do something everybody starts arguing about definitions, so I prefer to say don’t look at how you define it, look at what I’m planning to do. This is a definition from an agency of biological integrity: body, composition and structure and functioning, a genetic organism in community levels comparable with historic conditions, including the natural biological processes, shape genomes, organisms and communities. That sounds like a good definition to me, although I have one question: what does “historic conditions” mean? Does it mean when Champlain came along? Does it mean when Leopold was writing or when Edgar Queeny was in Arkansas? Or does it mean today?

Rather than worry about that definition, I am going to try to address today’s challenge, to create working farms in which crop, forest, and wildlife resources are integrated as agronomic systems that preserve water quality, enhance wildlife habitat, and contribute to the rural economy.

I heard a wonderful presentation from a gentleman in Arkansas some time ago who talked about the 66/66 rule, for which there is no sound scientific basis, or so I thought. The 66/66 rule is that 66% of the farmland in this country is controlled by people over 66 years of age. While looking at a Web site late in the evening preparing for this presentation, I discovered documentation for this, from the Iowa Department of Natural Resources: 86% of Iowa landowners are 55 years or older—and there could be “a major shift in ownership in the next 10 years from farmers to middle-age absentee non-farmers who could have different ownership objectives for their resources.”

Also, I heard a fascinating presentation recently about the companion-animal industry. (The definition of a companion animal is one that has a name.) People spend \$2,300 a year per companion animal in addition to food costs. People are moving out of the town that I live in and are setting up farms close by, of 10 to 40 acres. Part of the evidence for this, as stated in our local newspaper, is that small-tractor sales now far exceed those of large tractors indicating a reorganization of the agricultural landscape in the next few years with great opportunities for organic farming. Companion-animal customers are highly educated and likely to be female, wanting to know the science underpinning how things work. This will constitute the largest transfer of wealth in this country in the next 10 years. I know a representative of the Nature Conservancy who is fascinated by this, seeing it as an opportunity to teach these people about conservation.

What will agriculture look like in that scenario? I would suggest that those individuals will expect certain things, bearing in mind that water is the issue. Ecological benefits are possible from biotechnology. In some Illinois watersheds, where corn herbicides have been an issue, replacement of conventional corn with Roundup Ready® corn in 1999 to 2001, has resulted in dramatic decreases in numbers of samples above 4 parts atrazine per billion—a very real environmental benefit of importance to those living on that landscape in terms of drinking-water quality.

The hottest growing business outdoors today is the wildlife plant-material industry. These plant materials attract wildlife, thus supplementing habitats. Although some scientists have issues with this, it's a fast-growing business because of the changing demographic on the landscape and demands for recreational opportunities. In the fall 2003 meeting agenda for the American Society of Farm Managers and Rural Appraisers—farm managers who represent absentee landowners, certainly an increasingly powerful group—the number-one topic was recreational use of farmland. It's a growing industry resulting from the changing dynamic on the landscape.

Therefore, what's the hot ticket in wildlife food crops? It's Roundup Ready® corn and soybeans. Why? Because they are simple to use for people who don't routinely farm, but want enhanced wildlife habitat. Public and private agencies and state wildlife agencies in North Carolina, South Dakota, Iowa, Nebraska, are utilizing *Bt* both on public and on private lands with input from scientists who understand the risk assessments that have been done. The YieldGard® root-worm technology is also attractive for those who are moving out from town, by way of ensuring pesticide reductions and improvements in water quality.

A COTTON CASE STUDY

Cotton became a dirty word in wildlife circles because of intensive tillage in the late 1800s and early 1900s. I can remember J. Fulton Luce, the pioneer of soil conservation—I took his course—telling me about the erosion that occurred when cotton covered western North Carolina. In *Cotton Today*, Roger Leonard and Ron Smith at Auburn University recently discussed impacts of Bollgard® (*Bt*) cotton. Benefits of \$168 million have accrued to Monsanto, to growers, and ultimately to consumers. Some 104 million pounds less insecticide active ingredient have been used. And, most importantly, it has saved 41,250 10-hour workdays on the farm and eliminated 2,150 10-hour aerial application days. The really interesting story is how biotech cotton contributes to growers who have ecological values.

One of the things I like to say to people is, "You travel on farm landscapes; draw me a picture of what it will look like in 10 years." Very few even try. If you don't know what it's going to look like, then you don't know how to address what you are going to do over the next few years. At Monsanto we have been

trying to convince farmers (and sometimes landowners because most farmland is rented) to get away from mowing ditches and disking fields and move towards managing ditch banks and crop residues. There are opportunities for managing farmland in the United States today for biodiversity improvement by not cultivating ditch banks, headlands, and other unprofitable areas. Wes Burger at Mississippi State University has done a great job of putting these into a GIS system so that you can tell where they are. You can put your production map from your yield monitor right over the top of your economic map and come up with a negative layer and take it out of production.

It is likely, as a result of the movement of people onto the farm landscape, that the next two Farm Bills will focus upon paying farmers to create public good through conservation. Clearly there's hope and opportunity for ecologically sound approaches. But don't underestimate how difficult it is to move into a farm culture and get them not to mow that ditch—professional stature is frequently based on how clean a farm is and, in my neighborhood, how neatly manicured your yard is and how good your roses look.

How do you package something that includes intensive agriculture and maintains an ecologically sound landscape? First, you manage the non-crop areas for biodiversity and wildlife. I am just old enough to have plowed with a mule and have a strong memory of the landscape mosaics of the 1950s. The Farm Bill will offer opportunities to manage agricultural landscapes intensively simultaneously with non-crop areas managed for biodiversity; in my opinion you can have it all.

CONSERVATION TILLAGE AND WILDLIFE

Conservation tillage increases the quality of brood habitat for quail chicks. It's a good story from John Carroll at the University of Georgia. Cotton growers today care about these things; they use biotech cotton and conservation tillage and they manage their noncrop habitats to increase bird numbers. At the NILO plantation in southwest Georgia, 8.4 coveys of wild birds per hour have been reported—very high numbers. The manager, Ernie Iler commented, "It appears that the *Bt* gene is an asset to quail because of the insects we don't have to kill." Quail have to grow feathers and fly within 2 weeks of hatching to avoid predation. Insects available on the soil surface provide a high-protein diet, and 20 inches of cover provide protection from aerial predators. The shorter the period of time spent fertilizing and raking with conservation tillage, the better is bird survival. Quail are found 200 yards or more into cotton fields, hence 8.4 coveys per hour.

Biotech has done much for conservation tillage, as was described by Jim Cook. Some 63% of soybean growers who have reduced their tillage since 1996 cite the herbicide-tolerant technology as the key factor. The benefits on rural landscapes are huge. Farmers who do not use herbicide-tolerant seeds are not likely to engage in conservation tillage. It is largely black and white.

In answer to the question, "What has Bollgard® cotton done for wildlife on your farm?", 31% said that *Bt* cotton increased wildlife and in areas where people know most about that, e.g. northeast Georgia and Tennessee, it was 59%.

Furthermore, Roundup Ready® corn is expanding the range of wild turkeys in North America and it's being used by wildlife agencies to enhance pheasant habitat.

NONPECUNIARY BENEFITS

With regard to the recently deregulated YieldGard® technology to combat rootworm, what will a farmer pay above the cost of insecticide in order not to be exposed to organophosphates? How about \$1.79/acre? What will a grower pay to know that his farming activities relative to corn rootworm and organophosphate application, have no offsite impact?: \$1.46. These data are from Julian Austin and Michelle Merrer. We know that YieldGard® protects yield potential, as do most IPM tools. We know it provides superior control in comparison with insecticides; it's more consistent. What will growers pay for the fact that corn may be standing up straight at harvest where otherwise it might be curved or crooked over due to rootworm? How about \$5.29/acre? I thought that would be the highest because, during 20 years working for *Foreign Farmers*, they talked yield but they bought standability. What would they pay for peace of mind through consistent performance?: \$4.03/acre. And what would they pay just for the pure simplicity of not having to calibrate or fill an insecticide applicator?: \$1.94 and \$1.57/acre.

FUTURE GLOBAL VILLAGE

In a hypothetical exercise at Monsanto some time ago, we asked what a village of 100 people would look like in 2020: fifty-seven Asians, twenty-one Europeans, fourteen from the western hemisphere, and eight Africans; seventy other than white and thirty white; seventy other than Christian and thirty Christian; 50% of the wealth will be in the hands of six people, all US citizens; seventy will be unable to read; fifty will suffer from malnutrition; eighty will live in substandard housing; and one will have a college education. So, when you are dealing with global economics, and you are dealing with foreign cultures, it will be a hard job to sell the benefits of any new technology even to people to whom benefits may accrue. It will be a challenge, but I believe that that there will be opportunities for biotechnology to contribute both to ecological health and to economic health on many landscapes.