Watershed Approach to Floods Discussion

In the recent historical past, Iowa was covered with forests, prairies, wetlands, thick sod, streams and rivers. Rain that fell to the earth was retained, cleansed, used and slowly passed through the state. That changed with the coming of settlers who broke the sod of the prairies for cultivation agriculture. The historic hydrology of the state was altered with the need to drain fields. To accomplish that draining, we now have some 880,000 miles of field tile in Iowa. Records show a doubling and even tripling of the flow of some rivers over the last 100 years. Also, because tile lines provide a direct conduit to surface and ground waters, we have lost the water's contact with the cleansing soil and surface flora, resulting in streams and rivers that are in many cases contaminated with silt, fecal waste and chemicals.

This discussion includes changes to the watershed and to the agricultural cropping systems which could end floods as we know them and would cost cities no money for flood control. This discussion will include pre-settlement vegetation cover before we turned the landscape upside down and put the soil on the top; the differences in rain infiltration of historic vegetation and current row crops; agricultural systems available today which mimic the rain infiltration rates of presettlement vegetation; and the goal of returning the landscape to a system with soil beneath vegetation. Also discussed is what using those perennial cropping systems would mean for cleaning up water, holding and creating soil, cleaning our air, and reducing our contribution to the Dead Zone in the Gulf of Mexico.

*From Connie Mutel's "A Watershed Year", Wayne Petersen's chapter 9, "The Hydrology of Urban Landscapes", pages 87-89:

"…Prior to the 1830's, when native prairies and savannas dominated Iowa, not more that about 10 percent of the annual precipitation became surface runoff. Most of this 10 percent would have been snowmelt or runoff from rain on frozen ground. The other 90 percent was held by vegetation or entered the soil. When rain falls on vegetation, some of it evaporates back into the atmosphere. Some drops to the ground and infiltrates the soil, where it is taken up by plant roots and 'breathed' back into the atmosphere (through the process of transpiration). About 40 percent of all rainfall would never have flowed into a stream, because it would have been evaporated or transpired directly back into the atmosphere.

The remaining 50 percent or so of annual rainfall would have infiltrated the soil and slowly percolated downward to feed deep aquifers or become part of the groundwater flow. Because runoff was minimal before the 1830s, surface waters were fed primarily through this slow, steady groundwater flow. Because groundwater generally discharges at a constant rate, fluctuations in water levels would have been minimal.

The ancient cycling of water's flow through native prairies and savannas was stable and sustainable. It was infiltration-based and groundwater-driven. The land evaporated,

transpired, and infiltrated more rainfall and shed less runoff, certainly compared to today's urban landscapes. Consequently, the land was far more flood-resistant, with water levels in surface waters remaining relatively stable (as well as clean). …"

*Briefly discussed is an end to toxic and greenhouse gasses contributed by industrial agriculture; an end to antibiotic resistant diseases; and an end to untreated confinement and feedlot waste washing into our streams and rivers. Along with bacteria from this waste, the other non-point pollution contributors to our water quality problems are nitrogen, phosphorus and sediment (soil). As long as our model of agriculture is corn and beans, and livestock confinements and feedlots, we will continue to have this non-point pollution and surface runoff contributing to flooding and water quality. Change the federal farm programs and you will affect quantity and quality of water in the state.

This discussion includes manufacturing and processing which would need to be done locally from new cropping systems and new crops being raised in Iowa, with a bio-regional and sustainable approach. And we will touch on the multitude of new products from these crops. We will discuss humans becoming healthier by not eating processed corn and soybeans, and a reduction of obesity, heart disease, and type II diabetes, which have exploded since we changed to a diet of processed foods.

We will talk about the need to modernize our transportation system because of new crops and more people living in rural areas. This includes roads and rail.

We will talk about what city dwellers can do to help make these changes; what it will cost you in political capital instead of in dollars; and how you as cities can change the watershed cropping systems to protect yourselves from flooding in the future.

Surprisingly, the floods of '08 have provided an opportunity to test Wendell Berry's axiom that "the problem of agriculture is an urban problem." By that I take it he meant the ignorance of urban people to what our agricultural system has become. This can be tested by saying to Cedar Rapids, Des Moines and other flood damaged cities that you can prevent floods by changing cropping practices in agriculture instead of spending billions (CR) and millions (DSM) on flood control infrastructure. We are corn and bean farmers, because that is what the federal programs pay for. A change in those programs will lead to changes in the hydrology of the state.

This discussion shows the means to stop flood damage to towns and cities; clean up our water, soil, and air; provide more jobs in farming and manufacturing; encourage people to have healthier diets; and save towns and cities money otherwise spent on flood control projects.

*Estimated Cost of Flood Control for Cities using Levees and Pumps:

With a watershed approach to control flooding, cities wouldn't need to spend millions of dollars on levees and pumping systems. The original Cedar Rapids estimate for levees

and pumps was $1 Billion dollars. Des Moines' ballpark figure was a $250 Million dollar project.

*Vegetation covers and their relation to infiltration and storage:

Land Management Options	Infiltration Rates (in./hr.)
Pasture and Row Crops	1 – 3
Rotational Grazing, Alfalfas	3 - 7
Un-Pastured Native Grasses	7 – 13
Mature Trees	10 – 14

*From the Jackson/Keeney chapter "Perennial Farming Systems That Resist Flooding" (pp. 216-225) in the Connie Mutel edited 2010 book, "A Watershed Year: Anatomy of the Iowa Floods of 2008" we have the following discussion:

"To prevent rains from flowing rapidly into channels and raising water levels, some of their moisture must be returned directly to the atmosphere or discharged steadily and slowly (not in flashy gushes) into drainage ways. Agriculture can help achieve these ends and thus make the land more flood-resilient if it can:

1. Minimize runoff by increasing the speed at which water soaks into the soil and the quantity of water the soil can hold.
2. Store an abundance of water in healthy soils that are high in organic matter, instead of immediately draining it into streams.
3. Increase the amount of time that growing crops are pumping water back into the atmosphere.
4. Intercept any runoff from intense rainfall, passing it into nearby wetlands or through buffer strips that protect streams.

The truth is, the corn and soybeans that now dominate Iowa's agriculture (…92% of planted acres are row crops. Only 50% in the 1950's…) It would be difficult to find two crops that do a worse job of handling Iowa's rainfall. In conjunction, these croplands pollute our waterways by their release of sediment, fertilizers, and pesticides. [The fourth non-point pollutant, non-soil bacteria, comes mainly from the untreated waste from feedlots and confinements; Watson] Scientists studying the problems of surface and groundwater contamination, the Dead Zone in the Gulf of Mexico, and flooding have arrived at the same conclusion: we need to re-perennialize the landscape. Quite literally, we have to rediscover and cultivate our deepest roots.

Before the coming of European Americans in the mid-1800s, the prairie soils of Iowa were filled with a dense and deep underground network of perennial plant roots. These roots filled the soil year round, not just in July and August. They made the soil more crumbly, porous, and spongy. They shielded it from the destructive power of raindrops. Year in and year out, perennial plant roots added humus to the soil, built pores, and supported a rich community of arthropods, fungi, and bacteria. The perennial sod could absorb tremendous quantities of rain without producing runoff. Perennials active in early

spring began using water in April, and the diversity of plant growth ensured that soil water was used through October. Excess water not used by plants steadily percolated into the shallow groundwater and onto wetlands and streams, or it recharged deeper aquifers. Many features made this landscape flood-resistant. It is no wonder that Know (2006) describes the agricultural conversion of prairie and forest in the upper Mississippi River basin as *'the most important environmental change that influenced fluvial {river and stream} activity in this region during the last 10,000 years'* [emphasis added, Stone & Watson].

Agriculture can increase perennial plant cover and contribute to Iowa's hydro-logical health in a variety of ways. Corn and soybeans could become part of four-to-five year crop rotations that include small grains, hay and pasture. Long crop rotations were in wide use up until the 1950's…Today we can improve on the farming of the 1950's by implementing conservation tillage, better options for pest control, intensively managed rotational grazing, and cover crops to protect the soil before the row crops are well established. …we need to critically examine subsurface water (tile) drainage. Farmlands are tiled to dry out the root zone as fast as possible. This has caused more water to flow into our rivers in the spring, instead of lingering in the soils (Schilling and Helmers 2008). Thus, as happened in 2008, rivers are often running full when a really big early summer storm arrives.

Researchers at Iowa State University are modifying strip-cropping practices (which now alternate row crops with European pasture grasses or legumes, such as alfalfa, in strips along the contour) by using deeper-rooted native prairie strips instead. Preliminary results indicate that prairie strips covering just 10 to 20 percent of the total field area were able to reduce sediment loss by 95 percent. Prairie strips should also be able to draw down soil moisture earlier in the spring and later in the fall. By occasionally moving these strips, better soil structure could be restored throughout a field.

Taking the use of perennials one step further, they could be incorporated directly into grain production. Farmers in Australia have pioneered a new method to grow their winter grains (oats, wheat, and barley) in the same field with perennial warm-season pasture grasses. And for over 25 years, researchers at The Land Institute in Kansas have worked to develop high-yielding mixtures of perennial grains (Cox et al. 2006). Recently they have made rapid progress by hybridizing wheat, sorghum, and sunflower with their wild perennial relatives. Perennial grains could revolutionize our whole way of doing agriculture, but a great deal more research will be required to develop crops with economic yields. [The time needed for this research and the time it will take to make political changes to the federal farm programs and implementation of this model should coincide. In other words by the time we change the programs, the perennial crops will be ready; Watson.]

Although cropland runoff can be decreased, some will remain. This should flow into a wetland or buffer strip before reaching a stream. Buffer strips of prairie grasses, shrubs, and trees along streams will trap sediments, improve soil quality, remove some nitrogen and phosphorus and increase water infiltration into the soil. By breaking selected field

tiles as they meet the buffer strip, we could further slow the movement of water into streams.

As flood damages increase, the need for hydrological resilience grows more urgent. A re-perennialized agricultural landscape will still produce food but also will restore community values and ecosystem services that have been lost. This landscape will once again regulate and purify water, sustain soil fertility, replenish the groundwater supply, support wildlife and pollinators, and carry forward the ancient heritage of our native prairies, woodlands, and wetlands. The challenge will be to incorporate these very real ecosystem services into a market that has until now neglected and nearly destroyed them. An agricultural economy modeled on natural perennial systems will shoulder its share of the responsibility for a healthy, resilient landscape."

*Wes Jackson's Perennial Polyculture/ Natural Systems Agriculture http://www.landinstitute.org : rain infiltration rates of 7 to 13 inches per hour. 12 to 15 foot deep roots restoring the life of our soils. Replanted only every 6 or 7 years. Native cover cropping system rather than row crop monoculture of corn and beans that needs millions of pounds of fertilizers, pesticides and herbicides annually.

I recently, July 2011, emailed Wes with this question: "I heard you say, or read somewhere, that you had "copyrighted" one variety of prairie grass. Did I hear that correctly? If so, what does that mean? Is that variety ready to be scaled up?" This is Wes's response: "We have one species being domesticated. We call it Kernza™ and have used the name we made up as a trademark name. We still have lots of breeding – probably another 9 years before farm ready and then with agronomists assisting."

So, by 2020, probably the same amount of time that it will take to change the farm bill, Wes's prairie crops could be in fields.

*10% of annual field planted to native prairie strips leads to a 95% reduction in erosion. This email is from Matt Liebman, H.A. Wallace Chair for Sustainable Agriculture / Professor of Agronomy Iowa State University, in response to my question about an article that described up to a 95% reduction in erosion using prairie strips as part of row crops:

"This web site shows graphs of the reduction in soil erosion in the experiment. http://www.nrem.iastate.edu/research/STRIPs/research/index.php?page=Ecohydrological

To my knowledge, Wes Jackson's concept of perennial polycultures for seed production has not been used for the soil, water, and wildlife conservation purposes in working lands for which we're using the prairie strips at Neal Smith NWR.

The farmer who operates our experimental site baled the prairie strips for bedding for his cattle after he harvested the corn and soybean crops that grew among the strips. There are several farmers in SE MN who are pelleting prairie vegetation and burning it to heat greenhouses."

If you asked if there is one aspect of our presentation that you could work on first, it would be to require native prairie strips covering 10% of all annual fields.

*Hemp: http://www.lumes.lu.se/database/alumni/04.05/theses/erin_young.pdf

This pdf is a Masters Thesis describing the world wide hemp market and discusses the inclusion of hemp in a sustainable rotation model of agriculture. The US is only one of 2 or 3 countries in the world which prohibits the growing of hemp. There are thousands of products available from hemp. Next to soybeans, hemp is the second highest plant in percent protein content, and has the correct essential fatty acids in the correct percentages for humans. It is a cover crop which needs little or no commercial help to grow, especially when used in crop rotations, and is good for rain infiltration.

The economics for rural farming communities is dependant largely on transport and proximity to processing and manufacturing facilities. The bulk nature of hemp crops requires that processing facilities are located nearby hemp fields. The decentralization of hemp production will reduce transport costs and hence product manufacturing costs. Bioregional production and processing of hemp would be beneficial to rural commerce and contribute to rural community self sufficiency.

For more on hemp see these two links:
http://www.treehugger.com/environmental-policy/perfect-plant-7-great-uses-for-industrial-hemp.html
and http://www.hort.purdue.edu/newcrop/ncnu02/v5-284.html/

Hemp can also be a reseeding annual that supplies its own nutrients through decomposition: http://www.finola.com/ : “The FINOLA oilseed hemp variety is an excellent source of sustainable food and fiber. The exceptional fatty acid profile in Finola hempseed oil offers a rich source of the essential fatty acids (EFAs); omega-3 ALA and omega-6 LA, in addition to significant amounts of GLA and SDA. The human body can't make the EFAs, so we have to get them from the daily diet. The EFAs are needed to produce many important things in our bodies, including optimal nerve functions throughout the brain and central nervous system. Finola hempseed oil is a safe and nutritious way to consume our dietary EFAs, to better our somatic health already at the neuronal level.” (from the Finola website)

*Hays and Alfalfas: cover crops which can be cropped for years and then turned under for green manure. 3 to 7 inches per hour rain infiltration.

*Pastures and Rotational Grazing: provides feed for livestock and holds water during rain events. This becomes important as all CAFOs, confinements and open feedlots are phased out. All animals would be raised on the land.

*Woodlands: provides traditional forest products, plus 10 to 14 inches per hour of rain infiltration.

*Vegetables and Fruits: provide nutrition lacking in the modern processed food diet.

*Small grains such as oats, barley, wheat, etc. Cover type crops for both human and animal consumption. Can be grown with other cover crops.

*Prairie strips, constructed wetlands and other soil saving and runoff mitigation efforts: Federal programs could include “continuously shifting through the field” prairie strips as a necessary part of any row crop system for obvious benefits. (see also above in Wes Jackson’s section)

*This is a graph and discussion showing Iowa River data over time, and changing crops and cropping systems. This data shows that if we adopt a land use model more similar to what we had earlier in our history, our flooding will more than likely decrease:

“The Raccoon River at Fleur has crested above flood stage 62 times since 1903 according to the Van Meter record.

There have been four separate crests above flood stage in 2010. That has happened only three other times: 1973 (5 times), 1983 (4), and 1984 (4).

By looking at the Van Meter gauge, it is doubted the Raccoon ever left its banks a single time at Fleur from March of 1929 until May of 1944. To look at the most recent 15-year period, the Raccoon has gone out of its banks 16 times since 1995. It can’t be said for certain that the table below is exactly accurate, but it is pretty close to what has been observed at Fleur:”

Decades	Crests above flood stage
2010-19	4
2000-09	7
1990-99	8
1980-89	11
1970-79	8
1960-69	7
1950-59	8
1940-49	6
1930-39	0
1920-29	2
1910-19	0
1900-09	1

*Some advantages of phasing out certain crops, cropping systems and industrial animal systems:

By phasing out most row crops and all confinements and feedlots, we would end most pollution of our soil, water, and air. This would result in fewer fertilizers, pesticides, herbicides, and nitrogen and phosphorus being put into our soil, running into our water, and evaporating into our air.

Toxic sewer and greenhouse gasses from confinements and feedlots would no longer be produced and vented into our air. Diseases from proximity to hydrogen-sulfide and ammonia (asthma, etc.) would no longer be a problem in rural areas.

Antibiotics, hormones, and endocrine disruptors would no longer be put into our soil, water and air from confinement and feedlot waste. Antibiotic resistant diseases would slowly be eliminated.

Infectious diseases such as MRSA, and Ebola would no longer be living in confinement herds or in the people who work with those confined animals. Integrons, which are the vehicle for antibiotic resistance being passed from one organism to another, would not be living in confinement conditions ripe for spreading that resistance to germs which infect people.

*Manufacturing and Processing:

Products from Hemp: see pdf's and links above. Because of bulk, the manufacturing and processing of this crop would need to stay local therefore encouraging bio-regional systems.

Food preserving and processing:

Unlike the highly processed foods essentially made from corn and soybeans, these grains, vegetables, and fruits would be preserved and processed locally.

Animal processing plants would be smaller and more wide spread with the capability to process a variety of species and size of animals.

*Federal Farm Programs:

Subsidy per acre only, regardless of use.

Subsidy ($) to the farmer who is actually working the land; not to the owner (takes land out of investment category and returns it to working land).

Rent limited to 100% of actual tax per acre.

Farmers today are corn and bean farmers because those are the programs. Change the programs and you will change how farmers farm.

*2nd Clean Water Act:

Regulate non-point source pollution. If we are ever to truly get a handle on water pollution in America, we need a new "Clean Water Act" to regulate non-point pollution, which primarily comes from this model of agriculture now in use.

*Repopulate and Revitalize Rural America:

By growing crops that need to be processed and made into products locally, you will need to have a greater population base in rural America. These cropping and animal raising models would need labor and management (farmers) instead of inputs (structures, chemicals and energy) and would therefore require many more farmers and laborers in rural areas.

This would enhance the prosperity of larger cities, which are regional engines of commerce.

*Rail and Road Infrastructure:

Because of the bulk of hemp, processing and manufacturing will need to be local and there will be a need to return rail transportation to the rural areas.

Farm to market roads will attain higher use and as a result will be built and maintained with higher use in mind.

Bob Watson

2736 Lannon Hill Rd
Decorah, IA 52101
563-379-4147
bobandlinda@civandinc.net