WATER QUALITY AND SOIL CONSERVATION: CONFLICTS OF RIGHTS ISSUES

Report of Seminar
College of Agriculture
and Extension Division
University of Missouri-Columbia
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WATER QUALITY AND SOIL CONSERVATION:
CONFLICT OF RIGHTS ISSUES

Few topics bearing on the quality of life in rural Missouri and rural America are getting as much attention as those relating to water and soil. At the 16th annual policy seminar held on the University of Missouri-Columbia campus November 17-18, 1988, issues bearing on water and soil policy were reviewed by speakers from universities; federal, state, and local government; agriculture; and agribusiness. The 150 persons attending joined in discussions from the floor.

Although water quality and soil conservation are linked in several ways including private-social interface, the conservation topics were those of the conservation compliance rule in the 1985 farm law.

The 1989 seminar will be held November 16-17. It will again be presented by the College of Agriculture and the Extension Division of UMC and funded from the Breimyer Seminar Fund of the UMC Development Fund. -- Harold F. Breimyer

Appreciation is due Professor Breimyer for preparing this proceedings report in such a timely fashion and for his continuing contribution to the seminar.

-- Robert J. Bevins
Chairman, Seminar Committee

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Agricultural Marketing and Policy
College of Agriculture
and
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THE INTERCONNECTION BETWEEN SURFACE AND THE SUBSURFACE: A LOOK AT MISSOURI AND WHAT WE KNOW ABOUT LIKELY WATER QUALITY AND SOIL CONSERVATION PROBLEMS

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A question may be asked as to why a geologist would be participating in an agricultural economics program. The answer is that it seems appropriate to a discussion of groundwater problems to have a hydrogeologist involved. We geologists like to say that everything has its roots in geology.

My intention is to offer a few general comments about groundwater, review what the groundwater situation is in Missouri, call attention to agricultural impacts on groundwater, and then add a few ideas I have about soil conservation policies and practices.

Unfortunately, the nature of groundwater is not understood well. I like to quote from an 1861 decision by the Ohio Supreme Court. A suit arose where someone had a spring on his property, and a neighbor put in a well. The spring dried up -- as might be expected. A justice ruled in these words:

> Because the existence, origin, movement, and course of such waters and the causes which govern and direct their movements are so secret, occult, and concealed, an attempt to administer any set of legal rules with respect to them would be involved in hopeless uncertainty and would therefore be practically impossible.
>
> The man with the spring lost.

We have a long way to go in educating the public about groundwater, and also in changing groundwater laws. Laws are changed only when they are challenged in the courts.

I certainly don't want to consider groundwater movement to be occult.

In Missouri we have a diverse group of aquifers. Aquifer is defined in economic terms. It refers to a geologic unit that can provide a sufficient quantity of water at a reasonable cost. What is an aquifer to a farmer who needs water for a small livestock herd may not be an aquifer to a municipality that needs millions of gallons a day. It is strictly an economic definition.

Missouri Geology

A geologic map of the state of Missouri shows bedrock units. In the area around the St. Francois mountains in the southeast there are

igneous rocks. It's an old pre-Cambrian zone. Dipping away from there, various units of limestone and dolomite characterize the southern half of the state. In the northwest we find primarily Pennsylvanian shales. Along the Missouri and Mississippi rivers are alluvial deposits.

Geology has a lot to do with the groundwater we are dealing with. The Department of Natural Resources has divided the state into groundwater regions. Among them are the area around the St. Francois mountains, the Ozarks, the Bootheel, the Osage salt plains, the glaciated plains, the alluvium of the Missouri, Meramec, and Mississippi river valleys. Missouri also has a transition zone. We have in our deeper groundwater systems north and west of the transition line systems that are highly saline. They are not usable as water supplies. In the St. Francois mountains, the sandstone, limestone, and dolomite provide good aquifers. But we get water out of granite only if it is fractured.

The Ozarks, which are most of the southern half of the state, are a karst region. There are major solution cavities within the rock. I comment in passing that people talk about casing wells, and about casing them down in solid bedrock. I have walked through some of that solid bedrock. In karst regions we do not find solid bedrock. There are major openings, and any contaminants can easily move into the subsurface and they can easily move through the subsurface. The area is very much in need of careful protection. It's the area in which we find sinkholes, and caves and major springs. In terms of a general flow pattern within the Ozark region, there is movement north to the Missouri river, and toward the Osage river, and to the south toward Arkansas. We also find a more local system in the area between the Osage river and the Missouri river. And the fresh water systems in the Ozarks meet up with saline water coming in a very long flow system all the way from the Rockies, under Colorado and Kansas. Where the two meet we have the fresh water-salt water interface. The fresh and saline systems mix along the transition zone. It's not mysterious, but nothing can be done about it. There's no way to clean that system up.

When we talk about the Osage and the salt plains, we are talking about areas that are primarily capped by the Pennsylvanian shale. That shale has low permeability material, and not a lot of groundwater recharge goes through it. Because of that, it's also where we are getting the saline system coming under that section. The saline system gets a chance to discharge when it gets to the point where the rivers have cut down through the Pennsylvanian into the older Mississippian limestones. That's where we have discharge into the saline system. So underneath the Pennsylvanian shale, both in the Osage salt plain and under the glaciated plain, we have saline waters in the deep section.

With regard to groundwater supply in the northwest part of the state, in what the DNR refers to as the glaciated plains, if it is preferred to drink water that isn't saline, we are dealing with smaller sources. We are dealing with the alluvial valleys of the

smaller rivers and with some buried rivers. I hesitate to use the term, because I don't want to portray these as rivers but as river deposits, buried by glacial deposits. We have sand and gravel, overlain by glacial till; and also loess deposits. Sometimes we can find the buried channels and can use them as aquifers.

Some of our more productive aquifers are the alluvium, the alluvium of the Missouri, the Mississippi, and also the Meramec river. Also, the whole Bootheel region represents alluvium on the surface; it is a very productive aquifer. It is also very susceptible to contamination. The alluvium is interesting because waters move from the rivers into the alluvium, and from the alluvium into the rivers. The direction of motion sometimes depends on the river stage -- how high the river is. So it is a highly complicated system, but also a highly productive one.

To touch on geography, most of the southern half of the state is the Ozarks and is dominated by the Ozark aquifer. In the northern half of the state we are dealing primarily with Pennsylvanian shale cover and also glacial deposit cover, and sources of groundwater are much fewer there. Our best aquifers are in the southern half of the state and the alluvium of the Missouri and Mississippi rivers including the Bootheel region.

Persons dealing with agriculture can note that some of our better farmland is not necessarily located where we have the better water supplies. Not a lot of cropping is done in the southern half of the state. There, farmland properties are limestone and dolomite, residuum soils that are not real good. It can be shown that a map of poverty regions, not just in Missouri but in the United States, reveals an amazing correlation with karst regions. This is hardly surprising to persons knowledgeable about soil properties.

Chemical Transport in a Water System

With regard to water quality issues, what must we pay attention to when we are worrying about chemical transport, either through the unsaturated zone down through the groundwater, or through the groundwater? We need to take note of how fast the water is moving by itself carrying chemicals with it. And of whatever diffusion or dispersion properties are causing a spreading of the contaminant, so that it's not just a simple case of knowing exactly where the water goes -- where the contaminant goes. Instead there tends to be a spreading. Then too we have to pay attention to whatever reactions there are.

So we are dealing with various reactions that could be sorption reactions, degradation reactions, volatilization reactions, photolysis. There are things that will cause chemicals to break down and be removed from the transport mechanism.

We are going to deal with velocity. The simplest way to do it is with Darcy's law that holds in the saturated zone, and that also holds in the unsaturated zone with a couple of modifications. And we

are simply dealing with something that depends primarily on the hydrolic conductivity or the permeability -- permeability being a generic term. And it depends on a gradient of the hydrolic head. If we are looking at a transport velocity we generally are concerned with the porosity and permeability.

Most geologists have hesitated to deal with the unsaturated zone. It's a messy system, because the hydrolic conductivity depends on the moisture content; the hydrolic head, the pressure head in that case primarily, is not in a unique relationship as it depends on whether the soil is getting wetter or getting drier. It's a difficult system to work with.

What we find in general is that the geologists and engineers have dealt with things, once we get to the water table. The soil physicists deal with everything from the ground surface down to the bottom of the root zone. Often we have a fairly long distance between the bottom of the root zone and the water table. It's an area that has not received a lot of attention. And yet most of our contaminants are probably leaking through that zone. It's a zone that needs a lot more study.

What kind of factors should we pay attention to when we are looking at transport of some contaminants? We have to pay attention to hydrolic conductivity, permeability. When we are dealing with the unsaturated zone the moisture content makes a big difference. That obviously will depend on precipitation, it will depend on irrigation, it will depend on evapotransporation.

There's a lot of talk about macropores. These are pores of large size, whether root holes or worm holes. I did some work in the Rockies last summer on an acid rain project and in that case the macropores were gopher holes. When we speak of macropores we can regard them as pipes of two-inch diameter in the system. We do have to pay attention to precipitation, and not just the amount but also the timing. When we tile fields for drainage what are we doing? We are encouraging water movement through that system. And we are encouraging transport of chemicals out of the system. As far as I am concerned, in protecting the groundwater we probably are getting some protection by putting in tile. Persons concerned about surface water contamination -- who ought to be all of us -- can note that what we probably are doing is transporting any chemicals coming out through the tiles much more quickly to the surface water system.

We certainly need to pay attention to irrigation. We are putting a lot more water on the fields by irrigation than would be falling on them by precipitation. If not all the water is being taken up by the crops, further leachings of chemicals from the root zone down toward the groundwater is probably being encouraged.

What kind of chemical factors do we need to deal with? We need to pay attention to what degradation processes take place, in terms of chemical processes. We are talking about nitrification or denitrification and so forth with fertilizers; or we are talking

about breakdown of pesticides when we are dealing with volatilization, photolysis, bacterial degradation. Whatever processes we are talking about, we need to pay attention to what is going on.

A term in use, partition coefficient, refers to the relative affinity of some chemical species for the organic matter in the sediment. When we geologists use the term sediment we include everything, even the soil. I find myself interpreting for engineers and agronomists, who have different definitions of soil. We are considering the partitioning between the organic matter and the water, and we are examining how much organic carbon is in the soil (sediment). So we need to pay attention to these factors in terms of understanding what kind of processes will tend to retard or speed up the process of chemical transport.

Point versus Non-point Sources

When we talk about groundwater contamination we can talk about point sources, or non-point sources. Point sources refer to a relatively confined area where contaminant gets into the groundwater. Non-point sources refer to a very large area that is contributing to a contamination problem. We have tended to think in terms of point sources but there has been more emphasis lately on non-point sources, especially relative to agriculture. With regard to point sources, what comes to mind first are landfills that are leaking. A landmark landfill study is being made in Ontario, Canada. The study shows a plume of chlorides migrating away from the landfill and being transported down into the groundwater flow path.

We also have contaminants coming in from spills, tanker trucks that turn over and leak out some contaminant, and train wrecks. The behavior of the contaminant through the unsaturated zone is extremely important but has not been studied as much as what goes on in the groundwater. What goes on in the groundwater, if we are dealing with an organic contaminant, has been looked at in terms of how dense that material is. If it is a liquid that is much more dense than water it is likely to sink down toward the bottom of the aquifer. On the other hand, something such as gasoline leaking out of our millions of leaking underground storage tanks is more likely to be floating on top of the water table.

Not all agricultural problems are of non-point source. If we are dealing with areas where there is a lot of loading and rinsing of equipment that is being used for agricultural chemicals, whether pesticides or fertilizers and so on, a lot of problems arise. They are more of a point than a non-point source. So we can have pesticide problems and we can have nitrate problems related to specific areas where there is a lot of loading and rinsing of the tanks.

More often, when we worry about the agricultural industry we are dealing with non-point contaminants. This is true whether we are talking about agricultural chemicals, fertilizers, pesticides, or

about problems with feedlots -- the size of the feedlot may be such that it can be called a point source, although that may depend on how far away from it a person lives. Septic tanks too can be problems. Especially in the karst regions of the state we can recognize major problems from any of these sources.

With regard to nitrates the problem is worst when fertilizer moves fast through the water system from the fertilizer truck and is altered into nitrates and transported in the groundwater. The problem with nitrates in the groundwater is not so much with adults as with children. Children sometimes have trouble as the nitrates become nitrites in the human physiology and interfere with oxygen transport by the hemoglobin, and cause the blue baby syndrome. That's why the official regulation on nitrates is 10 milligrams per liter of nitrates as nitrogen. It is related to problems of infants.

So if we look at what is going on relative to nitrogen, it's moving through the system because water is moving through the system.

We may be adding rainfall by irrigation. A question is how well the plants are taking it up. If the plants take everything up there will be no nitrate problem. If, however, the growing year is not good the odds are high that not all the nitrate will be taken up. In such a year we particularly have problems with its being leached down to the groundwater.

The whole nitrogen cycle within the soil zone is horrendously complex. Nitrification, denitrification, sorption. It's a subject area that I hesitate to address. I am working on a nitrate transport problem in Iowa, with the Agricultural Research Service, and we are starting below the root zone.

Nitrates certainly are not the only problem. Data on pesticides as found in various states how a lot to be present in groundwater but often in very small quantities. I have data on atrazine. The U.S. Geological Survey is studying atrazine in groundwater and surface water in the midcontinent. Few if any data are available yet for Missouri.

The question is, why do these chemicals show up in the groundwater? They have been tested extensively; they are not supposed to be leached out of the soil zone, the root zone; they have a short half-life -- they start breaking down; and yet they show up in the groundwater. The question is, why? I think of a couple of reasons: they may be transported very quickly out of the soil zone, and the half-life is being determined in the soil zone. These are not half-lives that represent the groundwater, but half-lives within the soil zone, where there is a chance for volatilization, a chance for photolysis, for much more microbial activities than in the groundwater. However, there is some microbial activity in the groundwater -- let me make that clear -- but it not as great as in the soil zone. The processes which are breaking down the pesticides are not as active once the water gets below the root zone. So if material is moved out of the root zone before it is broken down extensively there is a chance that the materials will be transported.

My next question is, what about the degradation products? People are looking for the pesticides. To date they have not looked a lot at degradation products. What about the chemicals that have been formed by the various processes that have degraded the pesticides? Are they more toxic, less toxic, more soluble, less soluble? Are they more likely to be absorbed on the organic matter, or less likely? I leave these as rhetorical questions.

Soil Conservation Practices

Let's tie this back into some of the soil conservation practices. A tremendous increase in conservation tillage has been reported. Obviously, farmers are practicing it because they want to save on energy costs. The fewer times they run equipment through a field, the less fuel they burn. They also hope to reduce soil erosion. What are the effects of using conservation tillage? It often involves increased use of pesticides, and as weeds are controlled less by tillage there often is an increased use of herbicides. Presumably the amount of run-off is reduced; does that mean there is increased infiltration into the subsurface? And therefore increased leaching of whatever chemicals we have put into the system? At first I thought this to be simple. If the run-off is decreased there must be increased infiltration and increased leaching of contaminants. In looking into the matter I found, first, that there are many varieties of conservation tillage. No-till. Ridge tills. Mulch till. Reduced till. I hear about minimal till, which in some cases means conventional tillage -- the least one can get away with. The data are pretty confusing. How important is the run-off decrease, and infiltration increase? Each probably varies with soil type and also with timing of the rainfall. Run-off may increase sometimes, and decrease at other times, depending on the form of conservation tillage. It is not a simple, straightforward relationship. It follows that differences in run-off will lead to differences in leaching.

The other concern in conservation tillage is that by reducing the number of times the soil is being tilled the macropores are being enlarged. The question is whether, by virtue of leaving larger sized pores in the system, the leaching of chemicals out of the system will be increased. Again, it's reasonable to suppose that if pores are larger, there is a chance of moving more material out more quickly. That is probably the case if there is movement quickly after incorporation of material or spreading of material. However, if there is movement of the chemicals into the smaller pores and then a big rain comes, the chances are that cleaner water is being moved through the macropores, and the chemical species are primarily in the smaller pores. So again the relationship is not necessarily straightforward, as to the influence of macropores in the system.

What do we have in Missouri? We have first a lack of data. Where are our problems likely to be? In the southern half of the state we have crummy soil but we are not cropping it greatly, and probably are not putting so much agricultural chemical on the land. But we need to pay careful attention to what is happening in karst

regions in the southern half of the state. Quite a lot of livestock are being raised there and problems associated with livestock could be important. In the Bootheel the soils are very sandy. There is a lot of crop growth, and heavy applications of fertilizer and pesticides. It's an area where the USGS has found various pesticides. The area needs to be watched carefully. A similar area is the alluvium elsewhere along the Missouri and Mississippi rivers. There's lots of agriculture on permeable soils, and it's highly likely that problems will develop.

In the upper northwest too, where there are loess deposits, problems are likely to arise. All my comments are guarded; I don't have firm answers but those areas should be checked.

A problem that is distinctive in Missouri, relative to most other states, is found in the transition zone between fresh water and salt water. I have referred to it previously. It passes through the west side of Boone county and goes up through Audrain county and on toward the Mississippi river. The fresh water is maintained because there is recharge in some areas of Mississippian limestone rather than Pennsylvanian shales at the surface. There's a lot of irrigation in this region, and lots of pumpage. The more that system is pumped, the more likely it is that the salt-water, fresh-water interface will be drawn closer toward us here in Columbia. That likelihood has its problems in terms of salinity and also, apparently, in terms of radioactivity. There is a belt of radioactive waters that in some cases exceed drinking water standards, and it seems to be related to the salt-water, fresh-water transition zone. It seems to be a question of an oxidation, reduction reaction of mixing the two waters. So if the interface is moved closer, the radiation problems may move closer.

A well near Harrisburg was shut down because of its high radioactivity. I note that it was shut down the first time it was tested. No one knows how long it may have had problems previously.

So we have a situation where agriculture could have an influence on a totally different contamination problem, and it is related to the amount of water that is being pumped, pulling the fresh-water, salt-water interface closer to a region where people are trying to use the water.

A few conclusions. I think it is definitely true that the agricultural industry is having an impact on water quality, in terms of both groundwater and surface water. Most of the problem lies in non-point pollution, but there is also a problem of point sources, such as where loading tanks are cleaned. We really don't know the health effects of the various pesticides on humans. In many cases no limits have been set on the pesticides, in terms of drinking water standards. We also do not know what the degradation products are. Although we don't know what the health effects are, I point out that the chemicals have been applied in order to kill something -- to wipe out vegetation, weeds, insect pests, and so forth. The whole matter deserves our attention.

Prevention is Best

This is an economics seminar. In terms of economics, when we are dealing with groundwater contamination, it is cheaper to prevent problems than to clean them up. It is very difficult to clean up a groundwater system. It is a slow-moving system, for the most part, except in karst regions with their totally different set of circumstances. And then there is the issue, how clean is clean? The question is raised often in groundwater circles. As we do not know the health effects of contaminants we do not know how clean is clean.

Obviously, prevention requires knowledge of the systems and it requires planning, and policy. I end with a quotation from George Hallberg of the Iowa Geologic Survey: "The policies for production must be integrated with policies for soil conservation and water quality." We need to pay attention to water quality. And what are the ramifications of various soil conservation practices in terms of what is getting into the groundwater, and what is getting into the surface water? We must ask the question, and answer it as we are able.

THE IDEA OF PROPERTY:
A WAY TO THINK ABOUT SOIL AND WATER ISSUES

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Rights as Reciprocal Opportunity

"Freedom for the pike is death for the minnow," says Isaiah Berlin. In a world of scarcity it is impossible to implement freedom for everyone. One person's freedoms and opportunities are a cost to another. Rights defining opportunities can be understood by looking at the reciprocal relationships of people with incompatible preferences. Externalities are everywhere if we mean by externalities the costs for person A of B's actions. Rights then control the direction of externality.

To own is to coerce, i.e., to create costs for others. It is to be able to choose without the consent of others when your acts impinge on others. The other person must persuade you to act otherwise. If trade is allowed, to own is to be a seller rather than a buyer. Government is a process by which some persons are selected to be sellers and some to be buyers with reference to a given economic action. Government may not eliminate externalities, but may choose to shift them from one party to another. The choice of the pattern of externality is a choice of great consequence for the kind of world we live in, including the physical environment of soil and water. Government can remove an externality for person A by shifting it to B. In choosing, it weighs the alternative costs and consequences.

Given the above perspective, what does it mean to describe a transaction as voluntaristic? At the most fundamental level it can mean to have participated in government and to consent to its rights distributions. If these rights include the right to trade, then subsequent to rights distribution the parties may volunteer to exchange. The fact that a person chooses to trade does not confirm consent to what one has to trade. The non-owner is always coerced by the owner, although at a more fundamental level the parties may consent to the distribution of ownership. A market is the nexus of mutual coercion of interacting owners (Samuels, 1981, pp. 12-14). The market is the arena of solved distributional conflicts. In this sense, the market is never separate from government.

Scope of the State

The subject matter and functional boundaries of the state are co-extensive with the sources of human interdependence. If there is conflict, there is either a state, or war and anarchy. Beyond anarchy, there are structural alternatives and different people may use the state, but it does not make any sense to speak of more versus less state presence. An alternative view is often referred to as the

"minimalist state" where the "sole functions of collective action are the establishment of the rules and the allocation of rights at the beginning, and, therefore, arbitration in any disputes that might arise from disagreements over contracts between individuals" (Whynes and Bowles, pp. 12-13). Anything more than that is regarded as interventionist. Let's look at some soil and water policy alternatives and see which view is accurate. What are the policy alternatives in the context of farming activities which affect downstream siltation or air or water quality (ground or surface)?

Cost Sharing in Conservation Practices. The current Agricultural Conservation Program (ACP) makes government money available to help farmers pay for conservation practices and to furnish technical assistance. This is often mislabeled as a voluntary program in contrast with regulation. In property rights terms this acknowledges that a farmer has the right to create sedimentation costs to downstream parties. Like any non-owner who wants something he does not own, they have to buy the opportunity from its owners. The downstream people through government either pay the farmer to stop, or help him install a technique that reduces the damage. It may be voluntary from the farmer's point of view, but this is only half the story. It is quite compulsory for the non-owner -- he pays or he gets no relief. To see ACP as a subsidy program is to miss the essentials.

The point can be seen if we compare it to the purchase of a conservation easement by a downstream party. This is a straightforward payment for something that party does not own, like buying bread at the grocery store. So whether the non-owner buys a conservation easement or helps the owner install some technology which reduces the downstream effect depends on which gives the non-owner the most for his money rather than anything fundamentally different in terms of rights.

There is one difference between buying bread and buying relief from pollution. One consumer can buy bread or not without involving other consumers. Not so for pollution. If relief is obtained, all parties benefit whether or not they helped pay for it. A tax used to finance conservation easements or conservation practices avoids the free rider, and all beneficiaries act together or not at all. So maybe a subsidy should be defined as a collective purchase by non-owners of something they want but do not own.

Taxation. The use of taxation implies a fundamentally different ownership of the conflicting opportunity. A tax on a farmer says the farmer doesn't own any or all of the resource, but can buy what he wants at will at a given price. The owner, for the moment anyway, cannot refuse to sell. The only difference between a tax on an activity and ordinary asking prices for goods offered for sale is that a tax can be collected by an agent for the owners and tied to the use of a product other than the one actually used and owned by others. For example, if underground water or downstream water courses are owned by non-farmers, a tax can be placed on use of fertilizers or pesticides or as some function of the number of

animals fed in a big feedlot. The owner does not have the expense of collecting his selling price or actually proving that the farmer used his resource (more on this below).

In other words, a tax is like a surrogate lease price charged by the owner of the resource. The surrogate is important because it may be very difficult to monitor the actual use of the natural resource, but easy to monitor the use of some farm input which is associated with the natural resource. So in essence, a tax implements an owner's rights to sell his resource but the price can be expressed in terms of units of the resource owned or in terms of some associated input or even farm output such as beef or corn. Like any purchase, it is voluntary in the sense that there is no choice but to pay if you want the opportunity.

The right to get your rights via taxes on an input does create problems for those who use the inputs but don't use any of the resource owned by others. The person who is careful and does not let any of his fertilizer or pesticide get away pays the same per unit of use as does the polluter. If it were easy to distinguish these people, a surrogate in place of charging for use of the resource itself would be necessary. Sometimes our concern for the inequity of the incidence of the tax is greater than our concern for the inequity of one party's being able to use another's property without his consent. Rights clash.

Prohibition/Liability. In property rights terms, a prohibition is a statement by the owner that he won't sell at any price. It is not fundamentally different from any private owner's refusal to sell, as he continues to enjoy the goods. There are, however, some subtle and important differences. Like a tax, a prohibition may be placed on a related activity rather than on the use of the owned resource. So it is possible to prohibit the use of a certain chemical when the action is a means to prevent the unauthorized taking of the natural resource.

How does a regulatory prohibition resemble private property? In private property, when someone steals it or harms it, the owner either goes to the police and asks that the thief be restrained or goes to court and asks for an injunction or damages. Violation of a prohibition against farming a steep hillside or using a certain chemical may put the violator in jail. The public prosecutor bears the cost of bringing him to court and the result is that the resource owner enjoys this property without interference. The same may also occur if there are criminal sanctions against theft or private property.

But some private property is protected only if the owner bears the cost of bringing a civil suit. The judge may or may not grant an injunction and stop the harm. Often the judge will only assess damages after the harm has been done. If your cows get out and destroy my crop, I can sue for damages because it is my property. If your silt or chemicals get out and destroy my downstream fish or underground water, the government may assess a fine or collect

damages because it is some group's property. Prohibition of the conflicting acts of others is what it means to own something.

Let's look at zoning. We are most familiar with this in the case of urban land where a certain area is designated for housing and industry is prohibited. The prohibition of industry is the instrument for the opportunities of homeowners to enjoy a quiet and clean environment. And vice versa; if homes were prohibited in an industrial (agricultural) zone, the industries (farmers) would enjoy not worrying about the effects of interspersed homes. Restricting an area to houses rather than industry, to cows rather than houses, to open space rather than row houses, to grass rather than row crops, is the instrument for the protection of some other individual or group owned rights. The advantage of zoning or other kinds of regulation over rights of civil liability is that the owner does not have to keep proving damages, but otherwise it has the same effect -- the owner prohibits others from taking his property.

But doesn't regulation destroy property values and does not the constitution prohibit the taking of property? Yes, regulation reduces the value of someone's property, but it increases the value of someone else's. Consider a 1987 U.S. Supreme Court ruling in First English Church versus County of Los Angeles. The county had passed a flood plain ordinance that prohibited building in the flood plain because it increased downstream flood damages -- the parallel with downstream siltation or pollution is obvious. The church objected that the law made its land worthless. The church probably did not point out that the ordinance made downstream land worth more (perhaps worth more or less than the change in the value of the church's land). It would be convenient for the church to argue that its freedom was curtailed and appeal for support from all freedom loving people. But the same argument could be used by the opponents -- namely, that their freedom from floods would be taken if the church developed its land.

The Court sided with the church and said the zoning law had gone too far in denying any development. It in effect split the opportunities between the upstream and downstream users. It did not say how far the county could have gone in, for example, specifying the density of allowable development. Suppose the land were worth $500/acre as a church camp ground and $200 as hunting land, so that the church was out $300 or even $500 in the extreme case. Because no building was allowed, the Court said it went too far. Yet it would be easy to find land worth $10,000 per acre for single family homes or $25,000 for apartments where the loss in value of $15,000 had been upheld by the Courts as constitutional. The point here is not to try to predict how the Court might rule on a statute prohibiting row crops on steep land, but to note that the distribution of opportunities and income can't be settled by crying loss of freedom or income since freedom has two sides.

Link Farm Income Support to Conservation Practices. The 1985 Food Security Act says that farmers are not eligible for price supports if they break up former wetlands or erodible lands, and a

conservation plan must be implemented by 1995. In property rights terms this is like the ACP in that it acknowledges that farmers have the right to pollute and that people who don't like it have to pay one way or another. But it also means that farmers are not unconditionally entitled to price/income supports. They can have strings attached. It is rather like a parent with an adult child living at home -- the latter has to play by the parents' rules. Perhaps the instrumental role of the new approach would have been clearer if the price support program cost had been reduced by some dollar amount and the saving allocated to a new program to buy conservation easements on wetlands. The only difference is that if price supports are ever terminated or get so low that they do not exceed the value of the opportunity to farm the wetlands, the public will not have bought any continuing rights to keep the wetlands. The public will only have leased the wetlands and the lease can be cancelled.

Stewardship. An important dimension of soil conservation is transferring an intact capital stock of land to future generations. In rights terms, the issue is whether the present generation has the right to mine the soil or if some of its capacity must be given to the future. In the case of a person who is a trustee for a child, our law insists that the capital be reasonably preserved. But the court listens only to the child who exists, not the unborn. Our concept of the fiduciary responsibility does not yet acknowledge the interests of the unborn. Partly this is because we do not agree on who shall speak for them. In reality, those so appointed enjoy the results now. Only the native Americans on this continent had a concept that they were only the temporary users of the land and must preserve it fundamentally intact for the unbroken link to future people. These Indians said, "We did not inherit this land from our ancestors. We are borrowing it from our children." Religion and culture can be more powerful than police or tax collectors.

Monetary Policy. What has monetary policy to do with land and water use? Quite a lot actually, as interest rates affect conservation decisions. But the point I want to make here is that peoples' rights to enjoy opportunities are affected by many more actions of government than conservation cost shares, sodbusting rules, or pesticide regulation. If our government were to issue a rule tomorrow that certain farmers (maybe those on hills) had to go out of business, there would be a revolution coming in part from a feeling that this would be too heavy handed in restricting freedom. Yet it has already done something very similar. In response to other pressures, it has raised interest rates so that many farmers could not meet their obligations, and they have gone out of business. Just because the farmers affected were not named by the government does not lessen the effect. Government inevitably affects our relative opportunities in everything it does. In fact, the courts have become involved when, in the context of farm bankruptcies, states have passed laws for debt relief which contravene mortgage contracts. When governments and events alter business relationships in unpredictable ways, the courts must decide on the distribution of the pain. Being for freedom and property doesn't help much.

Recapitulation: Ownership and Regulation

We have seen that private ownership and regulation are instrumentally equivalent. So are regulation and liability. Both are means of opportunity. A person who wants to avoid pollution (or any disagreeable activity) by his neighbors can alternatively assert that the neighbor is liable for damages or seek a regulation prohibiting the activity. The suit would petition to have the offending activity declared a nuisance. This would commonly be referred to as a means of defining a person's private property. The offending activity is effectively defined as theft although we usually reserve the word for those offenses that initiate criminal action rather than civil action. The main difference between tort law and misdemeanors or criminal offenses is that the transaction costs for redress in the first case are paid by the individual bringing the suit rather than by collective taxpayers. But in terms of obtaining one person's opportunity to be free of some neighbor's incompatible action, the result is the same.

The same result can also be obtained by a zoning law prohibiting a specified land use. Can this regulation be described as an attenuation of private property? It is an attenuation of neighbor B's opportunities, but it is an expansion of person A's opportunities. One important difference is that A cannot sell the right to B. Put more precisely, the right to be free of an offending use is jointly owned by A and still other neighbors. To own is to be able to participate in decisions regarding the use of a resource (either a veto power or some rule for collective choice). Since the environment is non-divisible, it is not possible for A to sell independently of owner C's utilization. The particular C with a high reservation price would reject all offers even if the right were tradable. This conflicts with the interests of other joint owners with lower reservation prices. But the same is true for any corporate ownership. A corporate stockholder can sell his claim on profits, but not his claim to any specific physical asset of the firm, for to do so would destroy the functioning of the whole enterprise. Such a decision is controlled by agents, and collective choice rules.

The state is the inevitable agent that determines who is liable, who is a lone or joint owner, who has opportunities because of prohibitions, and who bears the costs of redress. All can be designed to produce similar results. The private versus public dichotomy loses easy meaning. The non-owner who avoids a certain activity because of anticipation of having to pay damages in a liability suit is as effectively prohibited (coerced) by the owner's options as would be the case if there were a prohibition via any regulation such as zoning or licensing.

Interdependence is never left to work itself out naturally by government silence or absence. The term "natural" is a matter of selective perception. Where there is capacity for interdependence, there is government. If A has the capacity to grab something (say dump silt in a stream or smells into the air), then it is effectively his if B is limited by capacity or right to prevent the grab. If B

can't use the capacities he had (such as interfering with A's farming) then A has the right to the resource (i.e., the ability to act without interference from B) as surely as any right specifically referred to by statute or court decision. In effect, A's opportunity is defined by B's liability for interfering. Government appears nominally to be silent by specifying no rights in land, water, or air. But this is instrumentally false. Government by limiting B's options (mutual coercions) has defined A's rights. In this sense, no option or right is ever defined. Opportunities are what they are as worked out by the whole system of rights interacting with capacities.

Is Cost a Physical or Social Phenomenon? Cost is in part a social phenomenon and institutionally dependent, and not an independent empirical fact of physics. It is not possible to contrast marginal social cost and marginal private cost because cost is dependent on rights. When a farmer utilizes an owned opportunity, he considers the cost of this opportunity in terms of what other things he could do with the opportunity, including selling it to B. If a farmer rejects B's offer, in what sense is there an independent social value which A is not considering? What B can offer is a function of B's preferences and rights, not wishes and druthers. B might wish he were an owner listening to bids rather than making bids, but this ability is obviously a matter of rights, not physics. But what about the silt damages which B suffers as a result of the farmer's actions? It is factually correct to say that B would be richer if not for the farmer and vice versa. But to say that the farmer acts without considering social costs is only to say that you prefer B to be richer than farmers or vice versa.

In conclusion, the implication is that resource use and property rights distribution are inextricably connected. The farm economy is not something prior to and independent of the process of government. It does not resolve any issues to appeal to freedom and rail against big government. This positive description should give no comfort to any particular party who wants the process of government to support his interests. It should, however, make the debate clearer and less presumptive.

WATER ISSUES: HOW WE GOT HERE AND WHAT OTHERS ARE DOING

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When traces of agricultural chemicals show up in well water, chances are that the news media and the public health authorities will show up too. In general, the reasons for concern are simple enough: groundwater is a source of drinking water for about 50 percent of the United States population, and certain agricultural chemicals are potentially harmful to human health (14, p. 7)[1].

There is much uncertainty, even among experts, as to what level of concentration of agricultural chemicals in drinking water will produce adverse health effects. Some persons argue that any chemical that poses a potential health threat, no matter how small, should be banned. Others say that such an approach would do more harm than good, given the importance of some chemicals to agriculture, and given the low probability that those chemicals will find their way into drinking water supplies in sufficient concentrations to cause harm.

Yet some agricultural chemicals have been found in groundwater. Their presence there has resulted in large public expenditures for remedial measures. In one such case, the offending pesticide had its registration cancelled, effectively banning its further use (1). such instances, though isolated, have called public attention to agricultural uses of pesticides and created concerns over the safety of drinking water supplies. A result has been increased governmental activity aimed at protecting groundwater quality.

The Role of Federal Government

Over the past few decades the federal government has been a central force in water pollution control, protection of drinking water quality, and the registration and regulation of pesticides. The three major regulatory programs stem from three separate pieces of legislation: the Federal Water Pollution Control Act Amendments of 1972 (now called the Clean Water Act), the Federal Insecticide, Fungicide, Rodenticide Act Amendments of 1972 (FIFRA), and the Safe Drinking Water Act of 1974.

The Clean Water Act. The Clean Water Act was designed to give the federal government firm regulatory control over water pollutants, but the act was primarily focused on surface water and "end-of-the-pipe" sources of pollution, called point sources. However, 1987

[1]See numbered references at end of paper.

amendments to the Act provide for $200 million worth of planning grants to the states, inviting them to develop strategies for the control of "non-point" sources of water pollution, specifically including groundwater (11). Runoff and infiltration to groundwater from agricultural operations are specifically included in the definition of non-point sources. The states were given a target date of August 1988 for submitting to the U.S. Environmental Protection Agency an assessment of priority areas for focusing state water quality management efforts. The 1987 amendments did not provide strict guidelines for the states to follow in the design of water quality control measures. Considerable latitude is allowed for tailoring state programs to fit unique needs and circumstances on a state-by-state basis.

FIFRA. The Federal Insecticide, Fungicide, and Rodenticide Act gives the Environmental Protection Agency broad authority to register pesticide products in the United States. The statute mandates a balancing of the risks and benefits associated with any pesticide use. Uses that pose "unreasonable adverse effects" may be denied registration or may be removed from the market after their initial registration. EPA may place restrictions on the use of registered pesticides to reduce the risk they present. Because of recent public concern over pesticide residues in groundwater, in its decisions whether to register and label pesticides, EPA now considers the risks to public health that could result from pesticide contamination of groundwater. Many states have their own specialized pesticide registration programs.

Safe Drinking Water Act. The federal Safe Drinking Water Act is designed to assure that the water of public water systems meets minimum standards for the protection of health. As required by the Act, EPA publishes drinking water regulations for contaminants that could have adverse effects on the health of humans. These regulations specify either "maximum contaminant levels" (MCLs) which set the maximum contamination level of chemicals in water served to the public, or treatment techniques that must be used to remove contaminants which are either technically or economically infeasible to detect. MCLs are enforceable, and EPA requires public systems to monitor and report findings to assure that the water they provide complies with the MCLs. States are permitted to set standards that are more stringent than federal standards and to set standards for substances not addressed by federal regulation.

The Role of State Government

Although groundwater quality issues have received increasing attention at the federal level, state governments have historically exercised primary authority over the use, management and protection of groundwater (8, p. 27). The states are likely to retain that primary role, for several reasons. First, a well developed system of laws and programs already exists in most states, with evidence that state governments have accepted responsibility. Second, the nature of groundwater and potential sources of contamination differ from state to state, making it impractical to establish a uniform or

comprehensive nationwide program. Third, many of the proposals for groundwater protection involve land use controls, a role historically reserved for state and local units of government pursuant to the "police power" for the protection of health and welfare. Finally, for these and other reasons, states have typically assumed responsibility for administering federally enacted pollution control laws.

Although states have retained a prominent role in protection of groundwater quality, it is difficult to generalize about the nature of groundwater protection methods from one state to another. Some states have extensive statutory programs. Others have very little statutory basis for groundwater quality protection. In a 1986 report, the National Research Council listed 10 states as having identifiable programs for groundwater quality protection (7). These were Arizona, California, Massachusetts, Colorado, Connecticut, Florida, Kansas, New York, New Jersey, and Wisconsin. The Council developed a set of recommendations for state and local programs, based on a composite of the state programs included in its study.

First, the Council urged all states and localities to develop detailed information about the geohydrology of the jurisdictions within which ground water quality is a concern. Geohydrology is the study of water as it moves through underground geologic formations. This information would help determine the water yield characteristics of a given aquifer; the suitability of the water, based on its quality, for different beneficial uses; and the geographic location and extent of recharge areas (where geologic conditions are such that water at the surface can percolate down to replenish the ground water supplies), thus indicating locations where the aquifer is vulnerable to contamination.

Second, the Council recommended a permanent inventory system for potential contaminants of groundwater. Such an inventory would establish the quantity, location, and timing of the use of chemicals that could have an effect on water quality. Pesticides and fertilizers would be among the substances to be inventoried.

Third, a comprehensive aquifer classification system was recommended. Aquifers would be classified according to the nature of water use. For example, the EPA's ground water strategy would define aquifers used in drinking water supplies to be Class I. Waters for uses that are less sensitive to quality, such as irrigation (which can tolerate nutrients, but not salts) would have a II or perhaps a III designation. Classifying known aquifer systems according to their designated use is intended to help focus measures designed to prevent their contamination. Fourth, standards of quality were to be defined and established for each aquifer class. These "ambient ground water quality standards" would be used to define nondegradation of high-quality waters, for example. This process would be highly complex, given that decisions would have to be made concerning acceptable levels of hundreds of compounds that could conceivably find their way in trace amounts into the groundwater.

Fifth, the Council recommended that the states devise and implement programs to control known sources of contamination. Specifically mentioned were hazardous and solid wastes, underground storage tanks, and non-point sources (as from agriculture). The Council recommended that states develop a pesticide use data base, monitoring the location and timing of pesticide applications, and requiring accounting by pesticide applicators. A registration procedure for certain chemicals would be established as a routine procedure for flagging pesticides that have a potential for leaching into and contaminating ground water. A pesticide tax to fund monitoring programs was suggested. It would require users or distributors of pesticides to foot the bill and provide an economic incentive for pesticide manufacturers to develop pesticides having less tendency to leach into groundwater.

Finally, the Council recommended that states assist local units of government in developing land use controls in designated sensitive areas. The idea is to keep potentially polluting activities out of aquifer recharge areas, or, at least, to keep them away from public water supply wells.

The list of recommendations is significant because it represents an inventory of measures already implemented in one or more of the 10 states mentioned. The recommendations are consistent with a Groundwater Protection Strategy issued by the EPA in 1984 (6).

Issues

Proposals for public sector involvement in protecting ground water from agricultural sources of contamination raise a number of important issues.

Who Pays? In June 1987, Iowa's Groundwater Protection Act (House File 63) was signed into law. The act imposed a 75-cents-per-ton tax on nitrogen fertilizer, annual pesticide manufacturers' registration fees ranging from $250 to $3,000, and an annual gross sales fee of one-tenth of one percent to be paid by pesticide dealers. These and other funding provisions were adopted as a way to pay for programs to assess the extent of groundwater contamination, gauge the risk to public health, and determine methods to correct or limit future contamination (9). The bill also established the Leopold Center for sustainable agriculture at Iowa State University to research the negative and socio-economic impacts of agricultural practices.

The new law is controversial. The executive vice president of the Iowa Fertilizer and Chemical Association declared, "This misdirected law puts Iowa agriculture at a competitive disadvantage with neighboring states and the world market" (9). Some people fault the law because they think it taxes agricultural inputs to finance research on sustainable agriculture, and they perceive sustainable agriculture as an effort to eliminate commercial production inputs such as fertilizer and agricultural chemicals. Supporters of the law argue that the emphasis on sustainable agriculture will simply lead

to better management of the agricultural chemicals and nitrogen fertilizers. They also point out that farmers and pesticide manufacturers do not bear the entire cost of the five-year, $64.5 million program. Of the 75 percent to be raised from fees and higher taxes, some will come from a state oil overcharge fund created by a court settlement, some will come from an increase in garbage-dumping fees, and some will come from an annual fee charged to grocers and other retailers, based on household products that could pollute groundwater (10). Clearly, the issue of "who should pay" for programs to protect groundwater quality will be controversial.

A similar controversy arises in conjunction with proposals to restrict land-use activities in the vicinity of well-heads or aquifer recharge areas for purposes of protecting groundwater quality. For example, the Department of Environmental Regulation in Florida conducted a lengthy rule-making process in 1986 and 1987 to refine the definition of "G-I" aquifers (those used as sole source of drinking water for public water suppliers) and to adopt protective restrictions within 200 feet of the well head and within a five-year "zone of protection" (based on estimates of rates of water movement within the aquifers). The proposals were bitterly opposed by landowner and development interests because of many technical difficulties relating to identifying and measuring zones of protection and because of property rights issues.

Liability. Historically, when groundwater pollution has been at issue, state courts have typically applied common law tort doctrines, such as nuisance, negligence, and strict liability (for abnormally dangerous activities) (8, p. 32). A private nuisance is defined as a "substantial and unreasonable interference with the use and enjoyment of his own land" (8, p. 33). A public nuisance is defined as an "unreasonable interference with a right common to the general public." Negligence, often described as the absence of "due care," similarly involves a defendant's creation of an "unreasonable risk of harm" to others. Where the courts consider a defendant's groundwater-polluting activity to be "abnormally dangerous," they may impose strict liability on the defendant (8, p. 34). This means that the defendant is liable for the resulting harm, regardless of whether he acted "reasonably" or with "due care." In some states, statutes specify the circumstances warranting a finding of strict liability. The state common law groundwater pollution remedies (nuisance, negligence, and strict liability) may provide for injunctive relief, instructing the defendant to stop the pollution. Or they may allow for the payment of money damages, including the costs of obtaining alternative water supplies or compensation for reduced property values (8, p. 32).

Legal scholars criticize the common law approach to groundwater quality protection because it is reactive and not forward-looking (3, p. 432). It operates only after a perceived harm has been inflicted but does not actively prevent harmful acts. Neither does it provide for such actions as research, monitoring, and testing. It is largely because of these limitations of the common law approach that states have enacted various statutory approaches to water quality protection.

But the liability issue transcends the choice of policy measures to prevent water pollution. The subject of groundwater contamination is surrounded by uncertainty and potential risk. Who would be held liable in the event of economic loss or human injury from pesticide-contaminated groundwater? In some states, statutes may specify the circumstances warranting a finding of strict liability. California's Proposition 65, for example, reverses the burden of proof from the plaintiff to the defendant -- that is, a chemical must be proved safe by the disposer or user rather than a plaintiff having to prove that the chemical is harmful (California Safe Drinking Water and Toxic Enforcement Act of 1986). Under the California law, no one may "knowingly discharge or release a chemical known to cause cancer or reproductive toxicity into water or onto land" where the chemical can pass into any drinking water source. Exceptions can be made if the person either proves the discharge to be safe or gives "clear and reasonable warning" to anyone exposed -- including consumers of farm products (13). The California law also authorizes any citizen to bring legal action to enforce water quality regulations if enforcement agencies decline to take action, and provides that the citizens bringing suit under such circumstances will receive 25 percent of any fines levied as a result of the suit.

Iowa, on the other hand, specifically exempts farmers and growers from liability for the costs of active cleanup or for any damage to groundwater resulting from the application of nitrates or pesticides, provided that the product has been applied in compliance with soil test results and according to label directions.

"How Much Risk Is Acceptable?" Laws covering many aspects of our daily lives are attempts by society to limit risks to acceptable levels (15, p. 127). An example is the establishment of Maximum Contaminant Levels for drinking water by the EPA pursuant to the Safe Drinking Water Act. In our personal decisions, a subjective impression of the magnitude of the risks we take may be sufficient. But where laws are concerned, an attempt is made to base decisions on quantitative assessments of the risks concerned, and to determine acceptable levels for them. Risk assessment is the stuff of toxicology and epidemiology, and the issues are technical. Decisions about the level of acceptable risk are controversial because they are subjective in nature and because people disagree, often with intense emotions, over the definition of "acceptable risk." Some argue that chemicals known to cause cancer in laboratory animals should be assigned a zero tolerance level in drinking water (and in foods, for that matter). Others argue that concentrations of known carcinogens at, say, four parts per trillion in drinking water pose no meaningful threat to health, and, further, that achieving zero tolerances for such substances is not economically feasible -- the cost of achieving zero tolerances for a few substances would be better incurred in other areas where hazards to human health are far greater.

A former administrator for Policy and Planning and Evaluation at the Environmental Protection Agency has been quoted as follows:

> Real people are suffering and dying because they don't know when to worry, and when to calm down. They don't know when to demand action to reduce risk and when to relax, because health risks are trivial or simply not there. I see a nation on worry overload. One reaction is free floating anxiety. Another is defensive indifference. If everything causes cancer, why stop smoking, wear seat belts or do something about radon in the home? Anxiety and stress are public health hazards in themselves. When the worry is focused on phantom or insignificant risks it diverts personal attention from risks that can be reduced (18, p. 6).

These issues are difficult, and feelings run high among contending factions.

"Low-Input" and "Sustainable" Farming.

> Advocates, scientists, bureaucrats, and farmers gathered at USDA (September 7 and 8, 1988) not only to sing the praises of a system which would free farmers from overdependence on chemicals but also to emphasize its practicality as well. The system, whose success can be measured by the fact that it now has its own acronym, LISA, had speaker after speaker urge the participants -- about 130 -- to seek increased funding and political support for low-input/sustainable agriculture (LISA) (17).

Low-input farming, organic farming, and sustainable agriculture are terms often used in reference to farming methods that show great promise for reducing the use of commercial fertilizers and pesticides, and thus reducing the risk of groundwater contamination from agricultural chemicals (2). Gordon K. Douglass has identified three distinct schools of thought on the meaning of agricultural sustainability (4). One school attributed to the proponents of "highly specialized, mechanized, chemical-intensive, science-based methods applied to increasingly large farm and distribution units" is referred to by Douglass as the "Food Sufficiency" group. Adherents to this school of thought point to the need to provide sufficient food and fiber for a growing world population. Exhaustible resources and renewable resources are to be dedicated to meeting the food sufficiency goal as a first priority, and resource preservation is regarded as a needlessly high standard of performance as long as technological advances can be counted on to more than compensate for the effects of resource depletion on output. Sustainability is not a steady state condition, but rather a succession of adaptations to resource depletion, new technology, and competing demands for agricultural resources. A second school of thought is the "Sustainability of Stewardship" group. This is an ecological view of agricultural sustainability that arises from the belief that nature in the long run imposes definite limits on humankind's collective capacity to provide food for the people of the world. When modern production processes, such as "petroleum-intensive agriculture," begin to cause environmental damage, stewards of nature are

disinclined to regard the temporary benefits that modern technology may yield as constituting a meaningful compensation for the depletion of resources or other damage to the environment.

A third school of thought is called the "Sustainability as Community" group. This group draws heavily on the notion of stewardship, but also places major emphasis on the meaning of "community" in the rural agricultural setting, and the importance of making certain that all members of the community have a voice in their own destiny. Thus, the tendency of modern technological agriculture to displace labor and management units (i.e., family farmers) on the way to larger, more efficient farm sizes is viewed as inherently destructive of fundamentally important community values.

The issues involved in these competing views are basic and important. The intuitive and emotional appeal of the stewardship and the community view of sustainability, however, do not account for the compelling nature of the economic issues. It is one thing to demonstrate that a few farms have done quite well, financially, using organic farming practices. It is quite another matter to contemplate such a move for every farm in the United States. Several questions remain unanswered. Is it possible to maintain aggregate levels of production while reducing or eliminating commercial fertilizers and pesticides? There is evidence that many farmers waste fertilizer by applying too much. The same may be true for pesticides. So some reduction in these inputs is no doubt possible without adversely affecting yields. But what happens to yields if fertilizer and pesticide use is reduced over and above those levels that currently constitute waste? Would not such changes in farming practices require increases in the amount and type of management effort brought to bear on the farming operation? Would there not be an increase in the need for, say, mechanical cultivation? Would there not be a need for more labor -- either more people in farming or longer hours for those currently in farming? How would we attract the management and labor needed? Would unit costs of production rise, at least initially? How could farmers survive in the short run in a world agricultural economy where the sales go to the low-cost (in the short run) producers? If U.S. farmers cannot survive in the short run, what is the meaning of sustainability in the long run? Would we erect barriers to food and fiber imports in order to protect a high-cost, sustainable, farming sector in our country? What effect would that have on our ability to maintain export markets for non-agricultural products from other sectors of the U.S. economy?

To extrapolate recommendations for sustainable farming practices to the entire U.S. farm sector raises fundamental, and unavoidable, questions about aggregate yield effects, input demand effects, cost effects, price effects, and effects on the U.S. balance of trade. Best Management Practices and Integrated Pest Management seem to be headed in the right direction. But it is important that everyone involved in the debates about appropriate farming methods own up to <u>all</u> the tough trade-offs implicit in wide adoption of practices sharply different from those currently in vogue.

FIFRA and Groundwater Protection. In October 1988, Congress passed a bill reauthorizing and amending the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The bill was a stripped down version of a pesticide reform package that nearly passed during the closing days of the 99th Congress in 1986. The earlier version was a compromise bill which included a provision to set limits on pesticide contamination of groundwater and to require a clampdown on pesticide use if contamination at a specific site exceeded the maximum level (16). However, the final version, commonly referred to as "FIFRA Lite," did not significantly increase the role of EPA in groundwater protection through pesticide regulation.

Environmentalists are generally committed to a goal of amending FIFRA in ways that make environmental and public health objectives the paramount concern of the EPA pesticide regulatory program. Chemical manufacturers are keenly interested in those aspects of regulatory reform that pertain to liability, costs of evaluating pesticide ingredients for registration purposes, and the amount of time consumed in the registration process. Farmers have reasons of their own for wanting to avoid contamination of their water wells, but most of them also find pesticides to be an important part of their farming practices, and are unwilling to jeopardize the availability of pesticides with what they consider to be overly stringent environmental safeguards. These issues are likely to be revisited periodically. The environmental organizations will force the issue of environmental protection and health safety, especially if instances of pesticide contamination of groundwater increase in frequency with the passage of time.

The 1985 Farm Law and Groundwater Protection. The 1985 Farm Law includes "sodbuster" and "swampbuster" measures to deny commodity program and other benefits to farming operations on newly tilled, erodible lands and on wetlands. It also has a Conservation Reserve Program designed to encourage the removal of erosion-prone lands from farming. There is now serious talk of extending these approaches to acreages with groundwater contamination problems. Early in 1988, Senator Bob Dole (R-Kansas) introduced legislation that would introduce ECARP (Environmental Conservation Acreage Reserve Program) which, in turn, would extend long-term land retirement to base acres with groundwater contamination problems or those on which pesticide use is restricted because of endangered species (5). Under terms of this proposal, ECARP land would count toward the Acreage Reduction Program set-aside requirements. Senator Sam Nunn (D-Georgia) introduced a bill in July 1987 that would reform the Farm Law by, among other things, expanding the Conservation Reserve Program to include more lands contributing to water quality problems (12). Such programs offer the potential for achieving environmental objectives in ways that soften the burden on farmers. The costs would be shared by the general taxpaying public.

Comments

The relationship of farming practices to environmental quality and health safety has become increasingly complex over the years. It

has also captured the attention of the news media, environmental groups, and public health advocates. The effect of farming practices on groundwater quality is an issue that will almost certainly be on the policy agenda during years ahead. The Farm Law, FIFRA, the Clean Water Act, and the Safe Drinking Water Act are statutory programs initiated by the federal government in which these issues have been debated.

It is likely that the most direct and stringent measures dealing with farming and groundwater quality will be enacted and administered at the state and local levels. This is because of the location-specific nature of the problem. The use of chemicals by agriculture, for example, differs widely from one part of the nation to another, and also from one county to another within states. Moreover, the nature of aquifer systems varies significantly from one location to another. The type of comprehensive groundwater protection program recommended by the National Research Council could be highly effective in areas where problems exist, but would probably be viewed as unnecessary and expensive to maintain where problems are minimal. State and local programs, therefore, are likely to be introduced in targeted areas and tailored to the conditions existing there.

The need to set standards defining acceptable levels of concentration for controlled substances in water supplies will continue to be important. The analytical work, however, including toxicological and epidemiological studies, is costly and time-consuming. It would be wasteful if states individually duplicated their efforts. Many persons argue that it is a legitimate and necessary role of federal government to underwrite the cost of such work.

For people engaged in farming, the best advice is probably, "Be careful!" regarding the handling and use of chemicals and other substances that could damage the environment or create health hazards. Stringent regulatory programs are much more likely to gain popular support if the news reports are full of stories about water contaminated by agriculture. There is evidence that many farmers use more fertilizer than they need to. The same may be true of pesticides. Additional effort by management to avoid unnecessary fertilizer and pesticide applications could pay dividends in reduced operating costs and a better public image.

Education is important for all of us. We might have less controversy if we all understood the complex technical and political issues better. It is an article of faith for educators that we are better equipped to prevent problems and resolve issues if our knowledge and understanding are well developed. Education itself is expensive but it is an investment we cannot afford to pass up.

Communication is also critically important. Most of our serious problems are compounded by the fact that we disagree among ourselves on what our priorities ought to be. We disagree in our perceptions of what constitutes "acceptable risk." We disagree on who should pay for solutions to problems. There are no scientifically "correct"

answers to these arguments. Our best bet is to foster communication among groups and individuals who disagree, and to encourage good-faith efforts to understand differences in values, perspectives, and vested interests. We may never achieve consensus, but at least we can improve the chances for finding common ground and identifying workable compromises.

References

1. Carriker, Roy R., "Agriculture and Groundwater Quality: the Florida Experience." Increasing Understanding of Public Problems and Policies--1987. Oak Brook, Illinois: Farm Foundation, Jan. 1988. pp. 149-156.

2. "Comprehensive Low-Chemical-Farming Legislation Introduced." Pesticide & Toxic Chemical News, Oct. 19, 1988, p. 51.

3. Davis, Peter N., "Eastern Water Diversion Permit Statutes: Precedents for Missouri?" Missouri Law Review, vol. 47, 1982, pp. 429-470.

4. Douglass, Gordon K., "The Meanings of Agricultural Sustainability." Agricultural Sustainability In a Changing World Order, Boulder, Colorado: Westview Press, 1984, pp. 3-29.

5. "ECARP--a Bigger CRP." Doane's Agricultural Report, Feb. 12, 1988, p. 4.

6. Ground-water Protection Strategy. United States Environmental Protection Agency, Office of Ground-Water Protection, Washington, DC 20460, Aug. 1984.

7. Ground Water Quality Protection: State and Local Strategies. Washington, DC: National Academy Press, 1986.

8. Henderson, Timothy R., Jeffrey Trauberman, and Tara Gallagher, Groundwater: Strategies for State Action, Washington, DC: Environmental Law Institute, 1984.

9. "Iowa's Groundwater Law: Where's It Headed?" Progress, May/June 1988, p. 14.

10. Mosher, Lawrence, "How to Deal With Groundwater Contamination." Journal of Soil and Water Conservation, vol. 42, no. 5, Sept.-Oct. 1987, p. 333.

11. Myers, Carl F., "Viewpoint: a New Nonpoint-Source Water Pollution Control Challenge." Journal of Soil and Water Conservation, vol. 42, no. 4, July-Aug. 1987. p. 222.

12. Nunn, Sam, "Agricultural Policy: Ripe For Reform." Issues In Science and Technology, Winter 1988, pp. 56-59.

13. Pelzer, David, "Catching Proposition 65 Fever." Agri Finance, Nov. 1987, pp. 28-29.

14. Protecting the Nation's Groundwater From Contamination, Volume I. Congress of the United States, Office of Technology Assessment, Washington, DC, 20510.

15. Shankland, D. L., "Risk Assessment and Risk Management." Proceedings of the 1987 Water Quality Conference, Metropolitan Dade County Department of Environmental Resources Management, Miami, Florida, May 7-8, 1987, pp. 127-138.

16. Stanfield, Rochelle L., "Legalized Poisons." National Journal, vol. 19, no. 18, May 2, 1987, pp. 1062-1066.

17. "Sustainable Agriculture Hailed As the Farming of the Future." Pesticide & Toxic Chemical News, Sept. 4, 1988, p. 22.

18. Wiggins, Mason E., Jr., "California's Proposition 65--Implications for Agriculture." Agricultural Law Update, May 1988, p. 6.

WATER QUALITY PROBLEMS DEVELOPING IN MISSOURI: WHY SHOULD WE BE CONCERNED AND WHAT ARE THE OPTIONS?

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Let me explain first the organizational structure of the Department of Natural Resources. The Division of Energy handles the state's energy conservation programs and also looks for indigenous resources in the state. We are trying to handle our own balance of payments problems here in Missouri, trying to avoid sending billions of dollars every year out of the state to other states and foreign countries. We have a Division of Environmental Quality that gets in the news all the time. Controversial issues never go away. Everyone is familiar with Times Beach. Controversial permit and enforcement decisions must be dealt with on a daily basis, inasmuch as the Division has responsibility for all of the state's environmental programs from clean air to clean water to waste management and land reclamation.

We have another division that normally doesn't get us into trouble or controversy. That's our Division of Parks, Recreation and Historic Preservation. But the Katy Trail issue somehow was not quite as easy as we thought it was going to be.

With regard to water quality problems, I will give most attention to the problems we have and what I think needs to happen. There aren't many options.

First of all, we legitimately have water quality problems in the state of Missouri. Anyone who tells you differently is simply wrong, naive, and uninformed. We have naturally occurring water problems. The groundwater resources of our state are actually quite restricted as far as their utility is concerned, because in northern and western Missouri a large quantity of dissolved solids, including various types of salts, is in the water. So our usable groundwater is primarily in the Ozarks area and in the Bootheel and along the alluvium of our major rivers, the Missouri and the Mississippi. There are pockets of good water in northern Missouri, those buried pre-glacial river channels; and then -- something we'll have to come back to later -- there's also a small amount of usable water in northern Missouri in near-surface, shallow aquifers that is not affected by the salt water that is in the bedrock below. So when it comes to an issue of whether we need to be worried about insecticides and herbicides, there's no escape from the aquifer issue in northern Missouri because of the bedrock-total dissolve problem. Thousands of people in northern Missouri draw enough water for their own use and for livestock watering from these shallow aquifers near the surface and not from the bedrock.

That total-dissolve solids problem in northern Missouri gives rise to various strategies that our Department has to employ and encourage as we deal with water supply issues and drought. In northern Missouri, most cities, big industrial operations, and large farms have to rely on surface water supplies. That is, water that's flowing in the streams or water from impoundments. If a drought is prolonged, the water supply from streams grows unreliable. The only water left is in reservoirs. We made it through this last year fairly well. A lot of our folks were surprised that we had done that well because we did not know the capacity of some northern Missouri reservoirs. We could measure how high the dams were, but we did not know how much siltation had occurred and how much storage remained. We face the great limitation of lack of good groundwater in the bedrock in northern Missouri. And so other approaches have to be followed -- surface storage, and interconnection with other water supplies that are reliable. We have been trying to get public water suppliers to cooperate with each other and actually hook up together so that they can help out each other in times of crisis.

In selected spots in the Ozarks we have contamination from fluoride and cadmium. These are limited in scope but they present a serious problem that we have had to deal with. We have had to encourage certain small water suppliers to try to find other sources.

A matter that seems to be a surprise to groups to whom I talk is the naturally occurring radio nuclide problem in the state. In Missouri an interface between the salt waters to the north and west and the fresh water of the Ozark area runs from St. Louis and St. Charles county westward through northern Boone County and over toward Kansas City and then south toward Springfield. Along that interface are found many public water supplies that far exceed the maximum contaminant level specified for radio nuclides. The principal radio nuclide that we are concerned about is radium because it is what is called a bone-seeker. If it is ingested, by drinking water or using the water for cooking, the radium will reside -- it acts as calcium does -- in the skeleton and can continue to cause problems. It's not eliminated from the body in a short period of time. The source of these radio nuclides is probably just a natural one, through the natural process of decay of uranium and thorium. Uranium and thorium occur naturally throughout the United States, but in varying concentrations. We have a bedrock unit in southwest Missouri, called the Chattanooga shale, that is high in uranium. In the 1950s when everybody was running around with geiger counters hoping to find uranium and strike it rich, the Chattanooga shale was being considered for actual mining. As these areas that have concentrations of uranium are eroded and as water solubilizes the materials that can move it, there has been a migration to this interface. We can do little about the radio nuclide problem except to find alternate water supplies for the folks who are confronted with it, as we did with Harrisburg in northern Boone county.

Now, man-caused problems. Dozens of abandoned and uncontrolled hazardous waste sites in Missouri have commanded our Department's attention. The sites are on a state registry. We have set up

monitoring around them. In many cases groundwater supplies are contaminated from these waste sites, a number of which have been in place for decades. Some examples of areas where we have groundwater problems are Liberty, Valley Park, and Republic (which had trichlor ethylene, an industrial solvent, in its water supply). We have since shut down certain wells and encouraged the cities to put wells in new locations. People are no longer being exposed to TCE exceeding the maximum contaminant level.

Another example is New Franklin. Also Fairfax, Missouri, where petroleum product additives were found -- benzine and dichloro-benzine. These are just a small number of examples. We have a significant problem with petroleum products coming into both public and private water supplies in the state.

Our Department gets a weekly report from our environmental emergency response program. By state law, if there's a spill of more than 50 gallons of a material that may cause damage to public health or environment, the responsible party is required to call that program office. Or, if other people feel there's been a significant spill, they also will call. Of the 29 reports from a recent week many have to do with petroleum products getting into water supplies. It's a serious problem and we need to deal with it responsibly. A leaking underground storage tank is often involved, an issue that will have to be addressed in the upcoming General Assembly in January of 1989. A bill was introduced this last year but we could not reach any kind of accommodation satisfactory to all parties, so we are making another run at it.

We believe that there are roughly 20,000-35,000 underground storage tanks that contain mainly petroleum products but also other materials. If we are to believe the findings of studies done at the federal level and by other states, we can predict that at least 2,000 of those tanks are leaking and are contaminating the groundwater supplies. These situations do not necessarily make the news. If someone calls us and reports a gasoline smell in water in his private residence, and we find the residence is near a tank location -- though perhaps distant by more than 1,000 feet -- we conclude that there's been a significant amount of groundwater contamination over a period of time. In a more bizarre case, a house blew up and severely injured the resident, when gasoline fumes had migrated at the top of the water table and got into the house and reached the explosive limit. The house was fairly distant from the tank that was causing the problem, yet it was entirely destroyed and the residents were lucky to survive. Leaky storage tanks are an extremely serious problem. We're going to have to deal with it. I don't know exactly how a state program is going to be structured or paid for.

Other issues that confront us are the more routine ones that are well known. One is sewage effluent -- ordinary domestic sewage from cities and towns across the state. We have not met the schedule that was originally laid out by Congress. Very few states are able to claim that they have met the schedule. Secondary treatment is not a fact all across Missouri. We have streams that are receiving sewage

effluent that is only partially treated. Or, in some cases, the systems are not adequate to handle the loading, especially when there are periods when storm waters flush through the system and raw sewage is discharged into streams.

A similar problem is of interest to people involved in agriculture. Animal wastes from various types of feedlot operations or poultry operations have caused significant problems around the state. At this point we are trying to give technical advice to those people who are in that kind of business; but there is a very large loading of certain streams with nutrients and high biochemical oxygen coming from operations having large amounts of animal wastes. It's not a problem that can be ignored. It has resulted in fish kills. Numerous complaints come from the public to our agency. Also, other chemicals are showing up in fish. Fish are contaminated in various places in the state. The level of contamination by various chemicals in fish filets actually is above the FDA limits and miles of streams have had to be closed off to fishing for that reason. The four principal ones that have caused problems in Missouri are chlordane, the PCBs, dioxin, the most potent isomer, the 2378 TCDD isomer. Then too, lead is a problem in the big river.

On a U.S. map showing the presence of nitrates and possibly other ag chemicals, reported detections are shown in Iowa and Illinois but none in Missouri. Testing has now begun in Missouri and I can give you some preliminary findings.

Testing has been done in the Bootheel and in northwest Missouri. It's very limited and the testing was not set up to try to find the contamination, so we don't believe there's any particular bias toward showing it. I think the tests will prove to be fairly representative of what we will see later in larger scale testing.

As far as nitrates are concerned, the presence of nitrates in private water supplies that have a shallow source was over 50 percent. The key question is whether the level was above the maximum set by EPA, which is 10 parts per million. In 25 percent of the cases, it was above 10 parts per million. My guess is that because the Bootheel area is so flat and there's little hydrostatic head to move water out -- therefore less flushing of the water there -- the problem as reported may be representative of the Bootheel but not representative of all Missouri. As we look at northwest Missouri, we may get lower numbers; we hope we do.

With regard to insecticides and herbicides, again a large number of the wells that were sampled, over half, showed the presence of a considerable number of different herbicides and insecticides. I cannot report whether the data were over or under an MCL (maximum contaminant level), because we do not have those numbers yet for many of the chemicals. The safe drinking water act of 1986 has established a time table that EPA is supposed to meet, to set MCLs for the various chemicals -- for treflan, Aldecar, 2-4D -- ones that may be banned but are still in the environment. MCLs are supposed to be set. The way the law was set up, by approximately 1993 a massive

testing is called for, applying to all public water supplies for a very long list of the pesticides and herbicides that are commonly used now and in the past. EPA, though, is typically late. The agency does not have the resources to set the MCLs. Information is deficient on the health impact of ingesting the various materials at a certain small level in parts per billion. We don't know what that is. I don't believe EPA knows what it is, yet it has a mandate from Congress to come up with numbers.

This is what is in the future for the agricultural community and yet right now I cannot say what is going to happen. But slowly the MCL numbers are going to come out unless Congress changes its mind -- which is unlikely. When that happens the water supplies of the state will be monitored. The places where contamination will show up as a problem are not in the Ozarks region with its deep wells where there are slowly circulating groundwaters. It would take a great deal of time for surface contaminants to reach those waters, except in the very active karst areas, which Dr. Blanchard mentions, where water can move more quickly. Wherever a well is very deep, contamination is not likely to show up. Where it will be found is the areas of the largest amount of application of contaminating materials and especially in northern Missouri where surface water from a stream or reservoir is relied on so heavily.

Very briefly I mention a concern I have with quantity. I wasn't asked to speak about quantity, but quantity is a quality issue. The two are inseparable, and quantity has to be brought into the equation in any discussion of the future of agriculture and how it relates to water quality issues.

An example of quantity-quality intertwining was seen during the drought this last year. We had to re-evaluate all of our discharge permits for northern Missouri -- the water pollution emission control permits because they're set for a certain level of flow in the stream. It's not desirable to allow a permit holder to overload the stream with a certain contaminant or with a certain nutrient, or have a biochemical oxygen demand that would be too high. And so, the level is set according to a certain minimum flow that could be expected in 10 years -- the lowest 7-day low flow. During the drought this last year, we were getting very close to that and we were concerned that we might have to go back to permit holders and tell them that the drought situation is a special case and it will be necessary to restrict operations because the stream is no longer capable of receiving the emissions from the permit holders' operation. As it turned out, we didn't have to do that in any case; but we came close. That is to say, we didn't have to do that as far as any industrial or agricultural operations were concerned. With regard to some sewage treatment facilities connected to communities we had no choice. We couldn't just tell the communities to put a cork in the end of the pipe. Some of the streams of northern Missouri were running primarily on sewage -- the effluent from sewage treatment facilities -- this last summer.

The reason quantity is an issue is that if pumping is increased in certain areas, other wells will be dried up. People will switch

to a different source, or the salt water/fresh water interface may be moved. Even though it is true that Missouri is at the margin and we do not pump a great deal of water for irrigation, when there is a severe drought a lot more water will be pumped. It is necessary to look at the severe situations. We have cones of depression, as in Mexico and Columbia. A fairly severe one under the city of Springfield right now is fully 250 feet below the normal level of the water table. Many private well owners who live above that cone have had no end of problems because their wells have dried up. They've had to deepen them further. They lowered the pumps, but their wells dried up again. Finally they have had to give up and hook into some other source.

The Missouri River presents a quantity issue that we worry about. If affects agriculture. Agricultural produce is shipped on the Missouri River. The navigation season was shortened in 1988. The mainstream reservoirs, the six mainstream reservoirs, were way below that the Corps of Engineers would like to see. Another year comparable to 1988 would put us in fairly severe trouble. Innovative approaches would be sought in order to keep the barges floating not only along the Missouri River to St. Louis but from St. Louis down to New Orleans. This past summer the releases from the mainstem reservoirs along the Missouri River were providing 60 percent of the flow in the Mississippi below St. Louis. The barges would not have been moving anywhere south of St. Louis and to the confluence of the Ohio if it had not been for the flows in the Missouri River. That's why we are concerned.

Finally, trends. Where is all this going? I asked our geologist, Dr. Blanchard, how he felt about this. He said he has some optimism, some pessimism. I feel, frankly, that the trends bode ill for us. The environmental problems we face are increasingly complex, even though we have done many good things in the last 15-20 years. We have made great progress in sewage treatment facilities, closing of open dumps, and getting more stringent controls on hazardous waste and radioactive wastes. But larger, more chronic issues now confront us. If anyone thinks that he can forget about the global warming issue, believing it is something that will go away, he is dead wrong. I taught about that in 1972, when I was a teaching fellow. It was accepted by everybody in the scientific community at that time that CO_2 in the environment was going to cause a global climate change. No one could know when that would happen. Now the conventional wisdom and a growing consensus in the scientific community are that we are at the point of onset of global climate change. As it takes place it will affect water quantity and water quality and will make a deep impact on agriculture.

Another reason why I am concerned about these various issues that are so chronic and pernicious and insidious is that they become ones that we have to deal with, yet our society is not prepared to do so. Ours is a society where 25 percent of the students do not even graduate from high school, 50 percent of the people cannot read a newspaper article, and 50 percent don't even bother to vote. It's appalling that there is such a limited understanding of even the

simplest mathematical or scientific concepts. It's going to be hard for people to talk about what is an acceptable risk or what strategy should be employed to solve environmental problems when our society is not capable of understanding those problems. That's why I think that in addressing the issues that are the topic of this seminar, an important part of it is educational. The research and education community has got to take much stronger initiatives in getting the public educated to the problems that we face and to potential solutions.

I cannot say what all the solutions are. I don't know what they are. I only know that severe problems are in our future. They are so severe that many of our elected officials don't want to talk about them; they are bad news. But everyone in the research and education community is going to have to take a leadership role. Otherwise, we all will be left behind as the problems get worse and worse.

TREATMENT FACILITIES

John T. O'Connor
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University of Missouri-Columbia

Before addressing my topic I want to go on record to express my pleasure in being invited to have a part in this program. This may be the only time in my career when I will have an opportunity to take part in a session on agricultural policy. In a sense I am perhaps the least likely person to do so. I grew up in New York City, more particularly Hell's Kitchen. It would be hard to conjure up a group of people who knew less about agriculture, or a place more remote from agriculture, than Hell's Kitchen in New York City. Yet I want to say a word about the concept of this seminar on agricultural policy. I regard it as a wonderful idea. I am glad to add my thoughts to the discussion here even though I have not shared the experiences that one needs to have in order to speak about agricultural policy.

Even though I am a city engineer, I think that those of us who live in the city recognize that we all are dependent on a productive agriculture. We may be more sensitive to this than farmers are. We don't know much about the particulars of obtaining the food supply, and in many respects we have romanticized agriculture. We are respectful toward issues in soil conservation and support for agriculture, and there may be more support for those concerns in urban than in rural areas. I think people in urban areas feel there is something almost mystical and magic about the production of all the wealth and richness that agriculture gives us. They know that, basically, much of our wealth stems from that. Much of our well-being stems from that. And they know it needs to be protected, even if they don't know quite what it is.

So I think that city people are not unsympathetic to the needs of agriculture. I think that they know more and more, through television, than they knew even before -- that agriculture is important not only to our standard of living and to maintaining the level of affluence that we have come to expect in this country, but that it is important in terms of our international relationships, our international affairs. It is important in terms of stemming what is becoming a monstrous imbalance in payments.

City people are concerned about agriculture. They are concerned about the quality of life in farming communities.

For my part, since coming to Missouri I have gained a clearer understanding than I had previously about the nature of agriculture today. I know farming is a complicated undertaking. It is increasingly capital-intensive and energy-dependent. It involves complex scientific and technical decisions regarding fertilizers, pesticides, and the ecology of interactions between crops and soils

and soil organisms, insects, weeds, and weather. I have even learned something about the socio-economic-political influences that are brought to bear on the agricultural economy.

In view of the prevailing urban appreciation of agriculture and the rural economy, it is perhaps not unreasonable that this seminar include a commentary on agriculture and agricultural policy that comes from someone who was reared in the city.

When I arrived on campus I found that the extension policy letter I received, often written by Professor Breimyer, told me a lot about agriculture. A picture was filled in -- about how complex agriculture is, and the technological and scientific issues to be addressed, and the social and political issues too. I circulated the letter to the Civil Engineering faculty. If the faculty members don't know what is going in agricultural policy it is their own fault.

Quantity of Water

Now, about water. There are two aspects, it seems to me. Ron Kucera touches on both. Number one, the first issue, is the quantity of water. Until I began to live in the midwest I didn't really appreciate the impact of periodic droughts. Drought means to a person in New York City only that the streets get washed even less frequently than usual, and the garbage smells riper than before. But drought in the midwest, as we had it in 1988, brings to all the people in the state the realization that we are in many respects disarmed statewide by the impact of lack of water and high temperatures. As I recall, it was reported in the newspaper that in 1988 we had only 40 percent of our normal agricultural yield. I don't know exactly what that means, but I know it translates into shortages of funding for state government; into higher unemployment; into many dislocations in budgets for various agencies. If the state of Missouri loses 60 percent of agricultural productivity, the shortfall means something to everyone. It means something to the university. Less money is available to the university because the legislature has less available for appropriation.

I have thought about a water shortage from the standpoint of water use in rural areas. Urban areas, let's admit, are often supplied from very large water sources -- large lakes, the Missouri River, sources that have a high degree of reliability. Rural areas are usually riding on the thin edge of disaster. I did not know how close they were to disaster. According to a list compiled by the DNR, 30 to 40 communities were within months of putting radical restrictions on their water use because they did not have the mechanism to establish conservation programs. People were allowed to wash cars and water lawns until the water supply was almost exhausted. Then at the last moment the authorities were going to shut the gates. I asked some water managers, "How are you going to curb the use of water?" He said, "For one thing, we will stop selling bulk water." I wasn't quite sure what bulk water was -- that is, what it was used for. It's used for farm animals, isn't it? Were we going to stop selling water for farm animals? In Missouri?

In 1988 we found that most Missouri farmers did not have alternate groundwater sources or irrigation equipment. They were vulnerable to drought -- even in a water-rich state with groundwater and impounded surface supplies. The means for delivering water were limited.

I wonder what we have learned from that drought. I don't know the answer. But we have not learned to reinforce these systems, and to provide back-up; if we have not started to enact laws which will enable us to anticipate drought and stretch our water supplies when things look as though they are starting to get bad -- if we have not done that we have made a grievous mistake.

What could be expected if Missouri should have similar droughts in 1990 and 1991? What would be left of Missouri farms and rural water supplies? I'm almost afraid to ask, fearing that we might learn that, despite this powerful reminder, farm communities feel that they cannot afford to reinforce their basic water systems for animals or for supplemental irrigation.

Water Quality

If we have water -- we usually do -- is it of satisfactory quality for farm families, for farm animals, for irrigation?

If it's rainwater, it is just about perfect.

Unfortunately, as the plumber said, most water "ain't all water."

It is an axiom in the water works profession that all waters are different. Actually, that is not true. All water is the same. It's only the stuff that's in it that's different.

On the farm, what is the stuff that gets into water and where does it come from? There are many things that come from various sources.

In the city, the situation is known pretty well. We camouflage domestic wastes by flushing toilets and draining the laundry water. Cities accommodate the waste water from breweries, pharmaceutical industries, and so on.

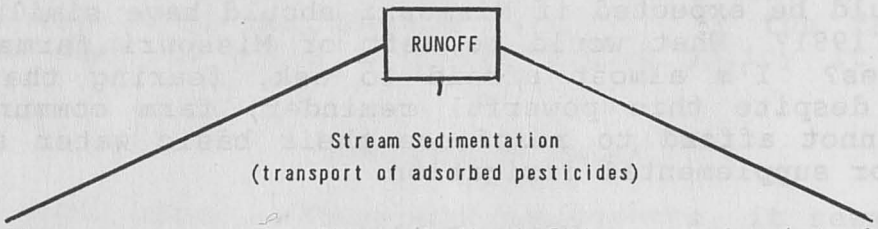
In agriculture, the substances that go into the water and, you might say, give it its uniqueness range from soil loss from erosion, to salts coming from the handling, storage, and field management of pesticides and herbicides, to animal wastes.

In some cases again as a city boy I have been thunderstruck to find out about big confined feedlots and the quantity and the strength of the wastes that are produced from them. There is hardly anything parallel to this in any urban area, that I am aware of. Silage, fertilizers. Fertilizer is a good thing; I use it all the time on my house plants. However, water containing nitrogen and

phosphorus from fertilizer creates a unique set of problems for reservoirs and lakes. And, finally, we have the petroleum problem.

Because of all these operations, which are complex on farms because they are dispersed, we have wastes issuing from farmlands. They contain constituents derived from all these activities and go into farmers' and others' wells or into lagoons, or run off into the creeks and into lakes, percolating into the ground.

In reviewing water quality issues I find it useful to refer to the following outline. I present it as a sort of appendix in the text.



Lake Eutrophication

Limitation of nutrient loss

Nutrient removal:
(Phosphate, nitrate removal)

from irrigation return waters
or agricultural drainage

Bioconcentration in Fish

Soil Conservation

Sediment reduction,
silt storage

Fish contamination:
chlordane
PCB
dioxin
lead (Big River)

Groundwater Contamination

Salts - desalting solution

Nitrates - denitrification

Pathogenic organisms -
disinfection

Organic wastes (fecal origin)
- biological degradation
- septic/irrigation systems

Petro-chemical (organic pesticides) toxins:
- granular activated carbon
- abandoned water source

Water Quality Testing and Treatments

One major key to management of water quality and protection of public health among farm families is water quality testing. At present, the farm communities are virtually defenseless in this respect.

I have to be very careful in talking to farmers about water quality lest they feel that I am a city-bred engineer who does not understand their situation and problems. In some respects engineers, and particularly city ones, are not the farmer's best friend. They think in terms of treatment technology, which by and large is expensive. It requires fairly large numbers of people and fairly long periods of time to amortize the cost. And along with the treatment technology that is available for mitigating some of these problems, it's really, in many cases, some of our more advanced technology. That means that it is also some of our most expensive technology.

I don't know much about farm economics but I know that most people on farms are not high rollers. If we are talking about organic carbon removal -- using granular activated carbon for treating that water, let me tell you three things. First, the process is expensive. Second, you don't know when it is exhausted. Third, at best you may remove maybe 50 percent of the organic material that you are applying to it -- if you are smart enough to load it at low enough loading rates, which most people aren't. So it's not really a good technology for use in home water conditioning, or for farm application to clean up our contaminated well waters. It is expensive, as I have said. And it requires control.

If I find a well contaminated with organic substances, my instinct would be to abandon it. I think that would be the best judgment. And so that's why I say the engineer is not the friend of the agriculturalist and should not be the major factor in establishment of agricultural policy. It's because the technology that engineers would bring is costly and in many individual cases I would view it almost as a matter of last resort.

What I really feel is that it is wiser in agricultural policy to pursue programs of waste minimization and of ecological solutions to problems of waste generation. I think that these, in terms of economics, in terms of a long run sustainable agriculture, offer the most promise. It's not that I would not want to be involved in developing treatment technology for agriculture; it's just that in many cases the processes of advanced treatment technology are not that competitive. Oh, some are: lagoon treatment, biological stabilization of the organic waste; we are good at that and can do it economically. We have had a lot of experience. Disinfection of water that has been contaminated with viruses and bacteria and other pathogenic organisms from septic tanks -- we can handle that also, in economic fashion, on an individual farm family basis. But if we go much beyond that we have to be careful about the cost. The alternative is not to generate most of those wastes in the first place.

AGRICULTURE

Lloyd Dilbeck
Presiding Commissioner, Barry County

My presentation at this seminar is different from that of other speakers. In our area a person on the farm has to do something else to make a living. I have done several things. I grew up in Barry county and I get my information from what I see happening that gives me concern. We have a growing area. Serving on the water district board has helped me a lot in seeing the needs of our community. We have recognized its growth over the last 30 years. The development of Table Rock Lake was the beginning of the change in our area. I don't want to load anyone down with statistics but a few will make clearer where we are now in our county.

It's possible that other persons are in an area similar to ours. It may help to know what we find ourselves faced with. We have a population of about 26,300 (as of 1986) and the projection is that we will have 30,000 by 1990. It is a fast growing areas. Several factors are built into the projected further growth. Without doubt, we are going through change. Years ago, we were a county of family farms and nearly everyone lived on a farm. Agriculture was our main source of income 30 years ago. We have changed into an area that is diversified. We have a lot of employment at wage rates between $4.00 and $8.00 an hour. Our county had 9236 households in 1986. Of the total population 63½ percent was rural nonfarm. Most lived in the rural area and worked in town. Only 18.6 percent were farmers who made the major part of their money off the farm.

In 1982, of the county's population 20,000 persons were considered rural. Many of the farms were dairy farms. Now, we have 160 dairy farms, considerably fewer than in the past. That is where part of our problem lies. Before we had the dairy farms there were 10 or 15 cows on nearly every farm. There was no problem of animal waste. Now we find about 50 to 125 head of cattle on a farm, and a unit of that size creates a considerable amount of animal waste.

Another change in our agriculture is in poultry. We have a large poultry area. It is concerning us now. The projection is that in the next three years we will have over 200 more poultry houses, doubling the number of today. That is a matter about which our community is concerned.

We now have many retired people who have come in for the lake. Table Rock lake went in about 30 years ago. All this is background for our emerging problem.

For the lake area we welcome retired people and tourism. Tourism provides a big part of our income. Around Table Rock lake, subdivisions were drawn up, laid out in small lots that bordered the Corps of Engineers boundary line. Now, we have septic tank problems.

Effluent is going into our lake. About 7400 or 7500 households have septic tanks, and a lot of the tanks need repair. We first got electric power in 1944, and many of the septic tanks date from that time.

Our water comes mainly from springs and wells, and most of the wells are from 200 to 500 feet deep. In 1987, 178 homes were tested. Of them, 46 percent did not pass the standards of bacteria count. These are the problems that are facing us today.

In addition, we have a large poultry plant. It is being constructed and will employ 650 people. Another processing plant is already in operation. It hooked into the city sewer system, and the city has had problems. So much water is used that it's almost impossible to avoid problems. A plant moved out of Springdale, Arkansas, into a place about 7 or 8 miles from our county seat. The company bought 400 acres of land. The processing plant is a $15 million plant. It is generating the expansion of our poultry operations -- building turkey houses, chicken houses.

Back to the processing plant, the firm bought the 400 acres of land. It is doing a good job, I think. It is trying to do right, building the plant according to specifications. I have an extra concern because my farm is only a mile and a half distant. I feel secure, but I don't think the poultry plant has helped the salability of my land. The report from Arkansas two years ago, you may know, was that a Tyson Foods plant was polluting the streams. That report has got our people really concerned about the processing plant that is coming in. I do think the managers are doing a good job. I have sat in on many interviews with them. They explained what they would do, and I have seen their plans. They will have two holding tanks that they will pump out of, and the effluent will be irrigated on the 400 acres. I am sure that will work in a drought year such as this year. But I don't know what will happen in a wet year when the ground is full of water. The managers tell us that no bloods or fat will be pumped out of the tanks. All will work well except in case of a breakdown. That gives them some leeway -- charging a situation to a malfunction of the plant.

For the plant there are two wells that are 1600 feet deep. The supply of water is good. The firm drilled a well before it bought the land, and the availability of water is a reason it located there. To give an idea of how much water will be pumped on to the land, the plant in full production will process 260,000 birds a day. It takes five gallons of water to process a bird. These numbers tell us how much water will go back on to the land.

The land can be used only for cutting hay or seed. It cannot be pastured. It is a good location. The coming of the plant is a great asset to the community. The town near it was hit by a tornado the other night and was practically wiped out and will be rebuilt.

A few more comments. We are indeed concerned with the septic tanks in our area, the lake area. The worst part of it is that we

have the subdivisions on the lake. They cannot organize in a way to get federal funding for help in dealing with the problems. One reason for my greater concern is that I attended meetings in Arkansas, in the Soils and Water district of Benton county. We heard experts tell about the problems there. They have reached the point where they cannot put back on the land all the animal waste they have. Their wells run 200 to 300 feet in depth and about 65 percent are already contaminated. Some are no longer in use. That experience makes us concerned. We have made an application for our county to put in a public water system. We understand some funds are available. I don't know how well that will work. I know such systems have been used in Arkansas. I don't know how well our people will accept the idea. A petition is being circulated, as a result of the finding that 40 percent of our tested wells did not fall within safe levels. That information got some of our people interested in putting in a water system.

RECREATION

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I am an outdoors sportsman but cannot say that I am water-oriented in my activities. As one reason, I grew up in Kenya and in fact managed a forest preserve there; and in that area malaria and other health risks were associated with water. When I came to the United States my friends invited me to enjoy the streams and rivers. We have no malaria or wild animals in our rivers, they told me, but we do have DDT and chlordane. They were making light of what is in fact a serious subject.

Before commenting further on water, I want to say something about recreation. First of all, what is it? It is anything we do in our leisure time. Outdoor recreation is only one category of it. Most outdoor recreation is resource-based -- water, land, vegetation, etc. Recreation is a necessity in our lives. Everyone seems to understand that. It is not just something done to kill time. It is not just fun and games. One third of our time is spent in some form of leisure. That is a significant figure. This one-third keeps us healthy and happy so that we can perform acceptably the other two-thirds, which is existence and subsistence.

Recreation is big business. A conservative estimate is that the leisure industry has more than a $300 billion impact on our economy. Of that, travel and tourism contribute over $200 billion. Recreation is the second largest employer in the United States, with 5.45 million employees. It is the second largest industry in Missouri.

It brings a lot of "outside" dollars into Missouri (that is, from other states). And its dollars have a multiplier effect.

Recreation can compete economically with other land uses. I give some examples. The state of Georgia has projected that over the next 50 years the Chattahoochee National Forest will produce approximately $108 million dollars from timber and $635 million from recreation. According to the 1985 annual report of the U.S. Forest Service, benefits from recreation on its lands equal the Service's total management budget, or approximately $1.8 billion. In 1982, government at all levels invested over $8 billion in recreational programs, which works out to $103 for each American household, for a total benefit of $26 billion, a benefit-cost ratio of three to one. Admittedly, these calculations are not refined. Recreation is not like potatoes: it is a non-tangible product. Dollar values for it are hard to quantify. But the estimates give a sense of magnitude.

I mentioned outdoor recreation. The biggest attraction for the outdoors is water. The fastest growing outdoor recreation activities in America today are canoeing, swimming in lakes and rivers, boating, walking, bicycling, and snow skiing.

Fishing also is a fast growing activity. Mr. Kucera of DNR tells us in his paper about the impact some of the pollutants can have on fishing in the state of Missouri. We feel that if these recreation experiences are to be quality experiences, they must be provided in a quality environment. I cannot add to what has already been said at this seminar. I just feel that everything that has been said about water and agriculture applies to recreation as well. There are many acres of public and private land that are utilized for recreation and those must be improved and protected to maintain the quality and respond to some of the concerns that we have expressed, and also to deal with erosion and erosion control measures on recreation land and in the watershed areas and the hydrological aspects -- all these, I think, have to be addressed.

I add a note about how the 1986 Presidential Commission on America's outdoors expressed it. Water is more precious than gold. It is a magnet for recreation, a liquid gold for an ever expanding commercial tourism and service market. So I add only that we need to give it renewed attention to protect it.

A REPORT ON A UNIVERSITY WATER QUALITY PLANNING REPORT

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I should perhaps explain that I was given wide latitude as to what water quality policy issues I would discuss. In some respects my remarks repeat or summarize what other speakers have said. I will especially note the policy issues that I believe to be important to Missouri, or will be important in the near future.

Many surveys taken in the United States indicate that yes, the American people are concerned about water. A Harris poll with that message did not deal with agricultural matters per se but I content that most water issues touch agriculture in one way or another. I concur with Professor Bullock in his judgment that more non-agricultural entities are going to be involved in setting policy for agriculture. This is a change from the past. Agricultural people have long said, "We work with soil, we work with water, we are by nature ecologists. Leave us alone." The public and the government have accepted that. They are not accepting that today. So we will see increasing pressure from outside interests to set policy in agriculture. I would hope that we in agriculture would be wise enough to be involved in those policy-making activities. We need to be.

Wherever talk goes on about water quality issues, agriculture does come up. Usually it's in the pesticide area. But there are other issues of importance to agriculture.

If we talk to people in Missouri we find the consensus is that Missouri's policy is not to have policy. But that <u>is</u> a policy. And probably some of the problems we have today result from our policy of no-policy. That does not mean that we do not have policy, but we have little in comparison with other states. I think this situation will change. I think the outside entities are going to force us to make some policy decisions, whether we like to or not. That's another big change.

What are some of the specific policy issues that I see coming? In 1986, Dean Roger Mitchell of our College of Agriculture created a water quality task force and asked it to look at water quality issues in agriculture. The task force issued its report last May. Some of the issues I list below come from that report.

The key, or hottest, water quality issue in agriculture today is pesticides. But again, discussion of the issue is not being driven so much by ecological concerns as by health concerns. That is a change in policy. And that is a reason why agriculture is going to be dictated to more in the future than in the past. Missourians are

concerned about cancer, Missourians are concerned about health of our children, and their concerns are driving the policy issues. It's not so much whether we are damaging the environment as it is, "What is it going to do to me?" That is the issue.

The EPA, which is a non-agricultural entity, is highly interested in pesticides and has started its national pesticide survey in which four counties in Missouri are involved (in well testing). The agency is trying to get a broad view of where the pesticides are located and what are the statistics and so forth. The EPA is putting a lot of dollars and a lot of time into the survey. Last October Mahlon Fairchild put together a good conference on pesticides on this campus. He invited Ken Amdesen, a lawyer for EPA in Kansas City. Amdesen made a statement that I heard him reiterate more recently. He said the EPA will no longer focus on pollution but on resources. The EPA is looking at groundwater areas that are vulnerable. If the agency determines that practices being followed contaminate the water supply, it will dictate the practices, through laws. That is a change -- a policy will come down from a non-agricultural entity.

There is some positive news. Amdesen told me further that for the first time since he joined EPA he has had to sit down with people in the USDA, SCS, and USGS. So we are getting a cross-pollination and I think that is good. We need to get that agricultural input into policy-making.

We too are interested in the pesticide issue and we are beginning to ask the question many people are asking, "Do we have pesticides in our groundwater in Missouri?" It's getting almost embarrassing to admit that we in Missouri do not have as many data as surrounding states do. One reason we have not made surveys and developed data lies in our policy-of-no-policy. But now the situation is changing and data are being collected. For example, the Department of Natural Resources funded our making a two-year survey of rural water wells. We have completed the first year. We have sampled the Missouri River and north in four different areas. In each of the areas 25 wells were being sampled. These are rural wells, wells associated with agricultural production. Of course the farmer must be willing to participate in the program. The water samples are tested for pesticides and other inorganic chemicals. Next year we will go south of the river and look at some other agricultural areas. The areas were chosen for their soil types, different aquifers that may be found there, and different agricultural practices, including both animals and crops.

Do we have pesticides in our ground water? Yes, we do. We are finding them. We are sampling each well four times a year. The data I have are from last December. We do have some insecticides, and we detect them more than once. We have more herbicides than insecticides. That is not surprising because we use more herbicides. Two of them, linuron and cyanizine, show up pretty often. The next question is, how much? For the most part, the concentrations we find are within tolerance limits -- although no check was made against

limits for cancer. However, the EPA has all sorts of combinations of risk-level data and it's interesting to try to figure them out. Also, for some chemicals there are no health advisories yet. In general, herbicides are considered to be less toxic than the insecticides and the numbers we are finding represent quite safe levels, according to health people. We have found, however, three wells with atrazine above what are regarded as safe levels. Overall, though, the health people tell us that the levels we are finding do not cause them any great concern.

The nitrate issue comes up for discussion often. As a summary of all 100 wells that we sampled, Missouri does have nitrate problems. Thirty-nine percent of the wells that we tested exceed the EPA drinking water standards of 45 parts per million. In one area in the northwest, 50 percent of the wells exceed the standard. So we have areas of shallow aquifers that are highly polluted. One of the questions that follows is where the contamination is coming from. From animal feedlots, or from the use of commercial fertilizers? From the scientist's point of view it does not make any difference; nitrates in the water contaminate it. But it does make a difference in the setting of policy. Policy-makers need to know the origin of contamination. If it is animals, one kind of policy is chosen. If from fertilizers, it's another. The question is important but I cannot provide an answer. We will keep working to try to come up with an answer.

Some of our sister states, such as Wisconsin, are more aggressive than we are in addressing policy. Wisconsin has an excellent water quality program. The College of Agriculture of the University of Wisconsin has put together a lot of materials with which to help the state. I would hope that we could provide a similar service in Missouri -- to help the state to generate recommendations to help our people. And to help the officials who are setting policy to choose policies that are reasonable.

Risk assessment, as mentioned by Professor Carriker, is an important area of study. The whole situation is wild. There are so many ways to assess risk. Policies will have risk as a component and we in agriculture need to be aware of that. We need to understand risk assessment.

Another area of policy in water quality that I see changing in Missouri has to do with individual disposal of sewage in homes. Mr. Dilbeck from Barry county touches on the problems his county is having. Historically, Missouri has no policy. It's possible to put a septic tank almost anywhere, with the exception of a few counties that now have some rules. There is no state policy. I think this will have to change. Some pressure will come from the federal people because of groundwater. Groundwater is driving us with its health issues. It's interesting that 60 percent of the state of Missouri is Karst topography. That is topography where the distance between the surface -- or just below the surface -- and the groundwater is sometimes very short. It's in these areas where our population is growing. In Barry county, around the Lake of the Ozarks, Springfield

-- all these are Karst areas and it's there that population is growing. People are going in, putting in septic tanks, and they don't understand that there is a real problem. Also, there is an area in Licking county, and Warren county outside of St. Louis; and I am told that those counties are growing at the rate of 90 persons per month. Newcomers build houses in subdivisions and put a septic tank down. And we don't have policy. Yet we must have policy to deal with these issues, as they are going to become very important.

Now another policy issue that I believe will affect Missouri, though I may be something of a soothsayer, is water allocation. Historically, Missouri has been a water-rich state. We have not had to worry about allocation. I believe we should start worrying about allocation. Western states have had to deal with the issue for a long time. We will be forced to also. To sit back in a rocking chair and ignore the issue would be disastrous. In the West, the tension between the traditional agricultural uses of water for irrigation, and municipal and industrial uses, is becoming great. In some cases, irrigation agriculture is losing out. If that trend continues, you can guess where water-short states will look for water. They will look east. Toward Missouri.

We have already had one contest. Sister states to our northwest wanted to allocate water from the Missouri River to an energy use, and build a pipeline. We won that one, but there is no guarantee we will win the next one. It's interesting to read that the states of North and South Dakota, Wyoming, and Montana have entered a pact to write water policy on the major river tributaries in their states. One of these rivers is the Missouri. They say they will not interfere with the water rights of downstream states, but they already have done so and the pact will not stop them from trying again.

Missouri needs to think about allocation policies and what they will mean to us in the future.

We have developed our surface water supplies to a great extent. We have a lot of them. They are cheapest to develop as compared with groundwater. But what is going to happen when surface water allocations take water away from the state? We will turn to our groundwater resources more. Do we have policy to guide us in these areas? I don't believe we do. We need to think hard about this.

Another issue that I find interesting, although I am not an agricultural economist, is the idea of privatizing water supplies. I can think of some interesting scenarios. Again, the question is cropping up mainly in the West. But traditionally our water supplies have been viewed as a public resource to be developed for the good of the majority. When we start to bring in privatization of water and put water on the open market, everything is changed. Talk about new policies! I don't even know how to address this matter but I am sure it would affect allocation very much. What would the effects be on agriculture? I have no idea.

Drought is a topic of the day or year. It is human nature that when we have a problem, we get concerned. When the problem

diminishes, we forget that we had a problem. That seems to be our cycle in Missouri. Again, we have very little drought policy. As Mr. Kucera reminds us, we need to have a policy simply to protect our drinking water supplies in a drought year.

My last issue may seem far removed from agriculture, but I don't believe it is. It is landfills as they bear on water quality. They are a rural environmental problem. We are told that we will have fewer and bigger landfills, and the new ones will be in rural areas. That means tremendous water quality problems will be involved. It's interesting too that at a conference on the subject, a third of the time was devoted to how to handle hostile crowds. If a landfill is to be built in our county, beware! Agricultural Extension people sometimes get upset, because the liability issue keeps coming up. Here again, I think we need policies.

If you think Missouri will not be involved, let me point out that New Jersey sends half its trash to Ohio. When Ohio gets filled up, where do you think New Jersey will look? I see northern Missouri with all its nice rural area and see that from an engineering standpoint it is a perfect place to put a landfill. I don't want to promote using northern Missouri for the purpose, but it could come. I don't care much for some of the things that go into landfills, and don't want them on top of my groundwater. Just because we have saline groundwater up there is not a reason for putting a landfill there.

All these are policy issues that I believe to be important and that I believe to be coming.

Now a couple of comments about policy-setting. It seems that when we get into environmental issues we often find a clash between economics and ecology and sides are taken -- it's one way, or the other way. I am not sure that is good. I teach a course on environmental ethics. I had my students make a study of these words. Where did they come from and what do they mean? Both words, agriculture and ecology, come to us from the Greeks. Both come from the same Greek word. Ecology means studying the household. Study your surroundings. Study that in which you live. Economics is managing the household. It has a stewardship connotation. A modern dictionary shows a meaning for economics that has lost the stewardship concept. The definition relates more to production, distribution, and consumption of goods and services. Stewardship may be there but it is hidden. When we tend to promote one concept -- study and stewardship -- more than another we tend to lose that positive tension and we get into a negative tension. It's like a door spring. As long as a spring has a positive tension it functions. But if it is stretched too much it no longer has any spring to it. Sometimes I think that in clashes between economics and ecology we often go too far one way or the other. I would like to see us come back into a positive tension, so that we can consider both, as the Greeks apparently had in mind.

In setting policy, I would hope that we retain our concern on two principal issues. One is that we remember who the owner is.

When we think that we -- any one of us -- is the owner of natural resources in an absolute sense I think that what we lose is a sense of accountability. When we lose accountability we are apt to do anything we want. I don't regard that as good policy. Let's remember that we are stewards and are only on the earth for a short term. Someone will follow us in stewardship. We are not the absolute owners. Secondly, when we generate policy let's remind ourselves that policy is for people. It's impossible to please everybody. We need, in making policy, to consider the welfare of the general public, and not some selfish interest group.

On that basis I remind that educational needs are challenges to us at the university because education is our business. Our water quality task force pointed out that we have information and expertise on management issues that we can share widely. We can provide environmental data to persons working in toxicology and epidemiology and risk management. The wide interest in data and information presents a challenge for the Colleges of Agriculture and Engineering.

Sometimes we get wrapped up in the hard science data and analysis and research. We need all that. But there are also an economic, a social, and an ethical issue. We need to tie all these together.

Lastly, no one will be helped if we do not get the information out. We need to publish the materials we develop. We should help citizens to understand what groundwater is and what adding a pesticide to water does. We also need to help the agencies who are establishing policies. All this presents a major role for colleges of agriculture and I hope ours can fulfill it well.

WATER AND LAND RIGHTS: TRANSITION IN SUB-SAHARA AFRICA

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I always hesitate to talk about Africa, because although I spent a number of years traveling in Africa I feel uneasy talking about the place. It is so difficult to understand Africa, and to convey to people whatever little understanding that one has. I look on myself not as a person knowledgeable about Africa or as an expert but as someone who is always trying to learn a little more about the continent.

Africa is such a large continent and so diversified that it's difficult to describe how complex it is. However, I will try.

The continent of Africa is larger than all of western Europe, India, and China put together. One country such as the Sudan, the largest country in Africa, is larger than the United States east of the Mississippi River. Zaire, the second largest, plus Sudan, are together almost as big as two-thirds of the United States.

When we think of Africa we usually think of north (Mediterranean) Africa and of sub-Sahara Africa. North Africa of course includes Libya, Tunisia, Algeria, Egypt; and to the South is the Sahara desert. Everything south of the desert, down to the Limpopo river where South Africa begins, is the area we call sub-Sahara Africa. It is about nine million square miles in size. It is divided into some 41 independent countries.

Physically, think of Africa in terms of a piece of paper folded in the middle. There is a spinal cord running north and south, which is called the Highlands of Africa. Incidentally, Africa is one of the oldest continents in the world. It seems as though it was formed by the plates pushing against each other. We have the high mountains that are cut by a long, long fault. Some of the highlands are up to 14,000 feet in height; in Ethiopia, for example. In Kenya and Tanzania are majestic mountains, with their feet in the solid equatorial rock and their heads capped with snow the year round -- right at the equator. In the valley are the great lakes, lakes with interesting names such as Victoria and Albert. Lake Kivu, which has the bluest of blue water, is totally lifeless, without a fish, because it is full of methane that is bubbling all the time. Then down in Lake Tanganyika -- all who have seen "African Queen" remember it -- there are spots in the lake where the depth runs to 5,000 feet. And next to the lake are the walls that can be 5,000 feet above the water level. These numbers give an idea of the depth of the depression, in the geology of Eastern Africa. Africa is slowly moving away from the rest of the continent. Like California, it is slowly breaking up along the fault.

In the Rift Valley, which can be 30 to 50 miles wide in some places, there are some spectacular sights: many extinct volcanoes, and a few active ones too.

Slopes toward the Indian Ocean are very dry -- arid to semi-arid. These are the deserts of Egypt and the Sudan; and the undulating plateau of the Sahel.

In the central basin we find the wettest spot in Africa. From it the terrain slopes to the Atlantic. Africa has little flat land.

Because the terrain is so cut up, it is extremely difficult to travel in Africa by land. Very few highways have been built, because it is so difficult and costly to build them. Most travelers travel by plane.

Africa has huge rivers. The Nile, the Congo, the Zambezi, the Niger, many others. Only two rivers are used extensively for irrigation. But Africa's rivers are used for hydro-electric power. Africa could, potentially, generate enough electric power -- if it could be transmitted economically -- to satisfy the needs of the whole continent. In Zaire, the Congo River drops almost 1000 feet within a distance of 200 kilometers. Turbines in the rapids generate enough power for the industrial needs of the country, plus more for sale.

These features boggle the mind when one deals with Africa.

There is a variety of climates. We think of the jungle -- Tarzan, the dark continent, and such. Some of Africa is like that, as in the Congo basin and the rain forest of west Africa. In some places, a wash cloth following a shower can be left on the rack, and it will be just as wet the next day. Molds will cover anything overnight -- leather, clothing. I have wondered if the human soul can get moldy in that environment.

But that is only a small part of Africa. Most of it is dry. The average temperature in parts of Somalia is 110 degrees. The deserts are hot but the Highlands are cold -- you need a jacket at 2:00 in the afternoon. In Nairobi the homes do not need an air conditioner, but a fireplace.

Alongside the variety of topography and climate, Africa presents a variety of human population. Some are negroes, some are Bantus, some are Hamitic people; and there are Arabs. There are the Pygmies, and the Watusi who are the tallest people on earth, so you have the tallest and the shortest, living side by side. And let's not forget the Bushmen who were the original Africans. Some survive in South Africa, in Namibia, today.

At least 600 major languages are to be distinguished in Africa.

In Africa are some of the oldest Christians -- the Coptic Christians of Ethiopia. Moslems, animists, and of course latter-day

Christians who have been converted to Christianity by an incredible number of Christian missionaries.

Every conceivable Christian denomination can be found there.

In 1972 Mobutu of Zaire decided he wanted to abolish Christmas. The missionaries objected, so he expelled them. I went from Africa to Haiti, and found there 10 of the missionaries I formerly found in Zaire.

Because of internal diversity, it is difficult to generalize about Africa.

Let's go back in history for a few moments. When the Western world began to explore Africa one of the explorers was David Livingstone. He sent a lot of dispatches throughout the world and especially to the United States and England. In those days, people in the United States were not very much interested in Africa. Americans were too busy discovering their own country to be worrying about a faraway land. Many of those who went to Africa with Livingstone did not come back. Malaria and the tsetse fly got them along the way. Those who came back had such dreadful reports that no one was interested in hearing about Africa. Some of the things they reported are true. They reported that it was a white man's grave; and it was. Conditions for the Africans were not good either. There was slave-raiding throughout the continent. There was tribal warfare. There was a climate of fear throughout the continent. And of course there were the hunger seasons, which are still with us today.

The world paid no attention. Today, the situation has changed quite a bit. Africa is one of the richest reservoirs of natural resources in the world. Our first atom bomb was made partly with uranium that was mined in Zaire. An interesting story relates to agriculture. When I went to Zaire there was in my city a university that was run by the Catholic church out of Belgium. It was Louvanium university. The rector was a nuclear physicist who was a bishop of the Catholic church. He was the young physicist working in Zaire on the uranium project before World War II. The Belgians had already mined a considerable amount of uranium, which was in the warehouses of the project.

As Europe was falling under the control of the Germans, the rector was sent to the United States to negotiate the transfer of that uranium to New York. He did so, and the uranium ended up in the Manhattan project. But the good bishop, having done us a favor, would not let us forget. Periodically he would visit the U.S. embassy and he would walk out with enough money to build his university. He did build that university. When I went to Zaire in 1971 he wanted to build a college of agriculture. He visited with us, and he built a college of agriculture. I told him one time that I had never seen a priest blackmail people as thoroughly and efficiently as he did. As he was working he said, "Oh, by the way, I need a new ag building" and he got a new agricultural building.

Maybe the moral is to beware of Catholic priests who are nuclear physicists.

Zaire is very rich in minerals. Not only uranium but cobalt, magnesium; and Zaire is producing about 80 percent of the industrial diamonds of the world. Contrary to popular belief, the best diamond gems come not from South Africa but from Zaire.

In addition, Africa today not only has more than 41 countries but over 300 million people. Some countries are growing at the fastest rate in the world. Kenya, for example, is growing at the rate of 3.2 percent per year. That means the population is doubling every 20 years.

We cannot ignore Africa. For strategic reasons, for economic reasons, we have got to deal with Africa. We must learn more about it. We can no longer ignore it as we did 150 years ago when Livingstone was traveling in Africa. Beyond that, there is our need as human beings to see what is happening there.

One of the common elements in sub-Sahara Africa is the land situation. Throughout its history Africa has been plagued by famine. When Vasco de Gama turned around the Cape he ran into a civilization that no one in the West had heard about, the Swahili civilization. The word Swahili, by the way, the name of the language common to east Africa, means the coastal language -- in Arabic. Swahili evolved as Arabic mixed with the local languages. These people had been trading with the East for years, including China and Persia. When Vasco de Gama went up the coast he heard about the famine that had been devastating the population inside the continent. It had been recurring for years, and it is still happening today, because of the dry conditions, the aridity, of the area. In the United States we have been treated, unfortunately, to the gruesome pictures of children on TV. It's been 15 years, since 1973 as I recall, since the big famine hit Ethiopia that caused the downfall of Haile Selassie. Since then we have had famines almost every year, reported by TV -- in Somalia, Ethiopia, Sudan. It's a recurring problem.

The development officers of AID, the World Bank, everybody explain the problem in terms of bad policies followed by the various governments of Africa. We spend millions of dollars every year to provide food for relief. Then we complain that the food is not getting to the people. Politics is involved, we say. We once were friendly with Ethiopia but we are not now. We used to be the enemy of Somalia but now we are the friend. Politics gets into the picture, and we blame each other; and we set up all these development projects to try to feed the African people.

But we start with the wrong explanation, in my judgment. There's no doubt that many of the countries have adopted the wrong policies. There is no doubt that the technology of agriculture is inadequate. But there is a more fundamental problem that we have chosen to ignore. That is the problem of land tenure.

You see, in African tradition, land is not property. You can go back a few years when the continent was underpopulated, not simply because of the slave trade that removed thousands of people, but as a prevailing condition. As a natural enemy of man, a large part of the continent is covered with tsetse fly, which transmits trypanosomiasis that kills men and cattle alike. Every conceivable malaria, every conceivable tropical disease, is there. Until Western science went in and introduced means of controlling the diseases, the population would not multiply too fast. So there was a huge continent with plenty of land. And on top of that Africa has the oldest soil of the world. In the rain forest is found abundant vegetation. We could suppose the soil to be rich, but in fact the soil is some of the poorest to be found anywhere. The soils are shallow, they are thin, they are extremely acid. If you cut the forest, it is just sand. As you travel to west Africa and fly over the Congo river as it goes out to sea, you can see for 20 miles out that the ocean is brown with soils coming from the Congo basin. Everywhere in the rain forest the soil is poor.

The soils in Liberia are so acid that it is hard to grow anything in them. Even rice, in the swamps, becomes victim to iron toxicity and aluminum toxicity. Except in a very few places, Africa does not have a rich agricultural potential.

Years ago there was plenty of land, and a limited population, and it was easy; and the fertility of the soil decreased very fast. The Africans learned that they could not till a piece of land for long. After a year or two, the fertility had decreased to the point where the yields were not justifying the labor. The farmers moved, cleared the forest, and planted another crop for two years before moving again. This practice is call bush fallow or a shifting agriculture. The system is still the dominant system of agriculture in Africa. When the Europeans took over Africa in the 19th century, they thought they could settle Africa. They quickly discovered why it could not be done, except in the Highlands of Kenya and Ethiopia. The most spectacular failure can be seen in Zaire. There the Belgians, who are methodical people, cleared the forest, planted, and after two years had to clear some more. If you fly over the area you can see 40 miles of neatly settled plots. The Belgians kept extending the fallow time. By the time of independence in 1960 they were using a system of cropping the land three years and leaving it fallow 15 years, before they could come back and again raise maize and cotton on the fields. To me that is a convincing argument that Africa is not a continent of rich agricultural potential.

In that kind of setting it is not surprising that the Africans tend to look at land not as property but as something that belongs to the tribe, the village, the kingdom -- not to any one individual. If it is property it is common property. The concept of property as personal ownership of land is totally foreign in Africa. One hates to generalize, and I can cite 15 examples where this is not true, but in most places the situation is as I have described it.

Another factor is involved. It is that the Africans look at land as the repository of the spirits of their ancestors. I will

read a quotation that I found somewhere. It conveys the sentiment better than I can phrase it. A Nigerian chief said he could not dispose of the land because it did not belong to him. He said, "I conceive that land belongs to a vast family of which many are dead, few are living, and countless numbers are still unborn." It is in that context that the African looks at land.

Before the European got to Africa, a man could use as much land as he needed to take care of his family's food requirement. In view of the bush fallow system, whatever land he was using was scattered in a number of small plots. He could work it from one plot to another. He could exchange plots with somebody. He could even do a little trading on the side. If he were not using a plot he could let someone else use it, but it was not his. It belonged to the tribe. If he did not crop it properly, the chief could reassign that piece of land to someone else. But he could not sell it.

By the time the Europeans arrived, however, they entered, with the blessings of the chief, into all sorts of deals with the Africans. And the Europeans thought that if they gave a gift to the Africans, the Africans would let them use the land -- that they were buying the land. In the mind of the Africans, however, it was a temporary transfer because the land did not belong to any one person -- the land belonged to the tribe. That created all sorts of problems. It is still creating a lot of problems in Africa.

THE CONSERVATION MANDATE

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The 1985 Food Security Act (FSA), commonly referred to as the 1985 farm law, was a landmark piece of legislation with respect to soil conservation. It signals a major change in how the people of this country believe our natural resources should be managed. The knowledge of offsite impacts caused by excessive erosion and the concern about water quality, signalled in that law, have served as a focal point for addressing some of the concerns of urban and environmental groups. Voluntary programs for soil conservation are perceived by those groups as not having been successful.

The 1985 FSA conservation provisions are a deliberate attempt to move towards regulatory conservation programs. Although the FSA conservation provisions are not mandatory, one might expect even stronger legislation to be forthcoming, especially if penalties are not enforced.

Conservation Provisions of the 1985 Farm Law

The 1985 FSA contains three provisions targeted to soil conservation and one to retain wetlands. The provisions are known as the Conservation Reserve, Conservation Compliance, Sodbuster, and Swampbuster. Some of the key points of the provisions are presented below. USDA has developed fact sheets on the provisions that may be obtained at USDA agency offices.

Conservation Reserve. The Conservation Reserve Program was implemented in the spring of 1986. If offers landowners an opportunity to retire highly erodible land from crop production. To participate a landowner must submit a bid on a per-acre, per-year basis to the Agricultural Stabilization and Conservation Service (ASCS). If his bid is accepted he is obligated to convert the cropland to permanent vegetation for a period of 10 years. Rental payments are made on an annual basis. In addition, cost sharing is available on establishment of the permanent vegetation.

When the program was initiated, eligibility was limited to fields with two-thirds or more highly-erodible cropland.

The rules have been amended in recent signups to encourage tree plantings. Also, buffer strips along streams and ponds are now eligible.

Swampbuster. The swampbuster provision of the FSA is aimed at stopping the conversion of wetland for agricultural purposes. If a landowner converts wetlands to cropland use, he will lose his eligibility for certain USDA program benefits.

Wetlands consist of soils that are covered with standing water or are saturated most of the year, and that support mostly water-loving plants. The Soil Conservation Service (SCS) maintains lists of the kinds of combinations of soils and plants that define wetland areas.

When applying for USDA farm programs, landowners must certify that they are not producing crops on land that has been converted from wetlands since December 23, 1985.

Sodbuster. The sodbuster provision of the FSA is aimed at discouraging the conversion of highly erodible land for agricultural production. The provision applies to highly erodible land that was not planted to annually tilled crops during the period 1981-1985.

If a landowner intends to break out highly erodible grassland or woodland to plant crops, he needs to develop and apply a conservation plan for highly erodible fields in order to maintain eligibility for USDA programs. The plan must be approved by the local District Conservationist and Soil and Water Conservation District (SWCD) board. In addition, the plan is to be fully implemented prior to

annual crop production. The conservation plan soil erosion goal for sodbusted land is "T". It ranges from 2 to 5 tons per acre per year for most Missouri soils.

To be considered "highly erodible" cropland must have a soil erosion potential more than eight times the rate at which the soil can maintain continued productivity. To be considered a highly erodible field, one-third or more of the field must be highly erodible, or the highly erodible area must be 50 acres or more.

The alternative to developing a locally approved conservation plan is to forfeit eligibility for USDA program benefits.

Conservation Compliance. The conservation compliance provision is aimed at discouraging the production of crops on highly erodible cropland that is not carefully protected from erosion. Conservation compliance applies to land where annually tilled crops were grown at least once during the period 1981-85, and will apply to all highly erodible land in annual crop production by 1990.

A landowner has until January 1, 1990 to develop and begin actively applying a locally approved conservation plan on highly erodible cropland. He has until January 1, 1995 to complete full implementation of the conservation plan. If soil maps are not available the enforcement date will be delayed until two years after mapping. The two years can be used to develop and begin actively applying an approved conservation plan.

One alternative is to farm highly erodible fields without a conservation plan and lose eligibility for certain USDA program benefits. Another alternative is to enroll in the Conservation Reserve and plant highly erodible fields in permanent cover.

USDA Programs Affected. As mentioned above, violations of the swampbuster, sodbuster, and conservation compliance provisions may lead to loss of eligibility for certain USDA programs. These programs include:

- Price and income supports
- Crop insurance
- Farmers Home Administration loans
- Commodity Credit Corporation storage payments
- Farm storage facility loans
- Conservation Reserve Program annual payments
- Other programs under which USDA makes commodity-related payments.

Where is the Conservation Legislation Leading Us?

To understand the present and potential future impact of the 1985 FSA conservation legislation, it helps to know how we have

arrived at the present situation. The following discussion draws on a perspective presented in a recent paper by Peter Nowak.[1]

During the 1940s and 1950s many land users accepted soil conservation practices as a part of the improving of productivity and profitability. Soil conservation was a key part of sustainable agriculture. Soil conservation benefits were an integral part of the Missouri Balanced Farming Program, which took full advantage of all resources available to the farm family including land, family labor, livestock and equipment, or in other words the family business. The integrated approach resulted in an improved standard of living and conservation of the land resource.

With the arrival of low cost commercial fertilizers and new technologies, the productivity theme became less effective and the stewardship theme came to the forefront. The conservationists' arguments became, "We may not have the facts to prove the profitability of conservation, but it is ethically correct."

The traditional productivity and ethics themes gave way beginning in the 1970s to a series of four factors:

* Soil and Water Resources Act of 1971.

  (a) The extent and distribution of soil erosion was documented.
  (b) Soil erosion could no longer be considered just in national terms. Erosion as a menace was seen to be concentrated in specific areas of the country.

* Research on erosion's impacts on productivity.

  (a) Studies showed that soil erosion does not always translate as a threat to soil productivity.
  (b) The magnitude of the problem was found to be highly soil-site specific.

* Structural changes in agriculture. Farm and ranch populations were seen as continuing to decline, and the notion of a family farm as a lifestyle to be giving way to treating farming as a business.

  (a) Urban and nonfarm groups were growing in size and power.
  (b) Urban and environmental groups became capable of demanding changes in agricultural policy.

* Growing knowledge of offsite impacts caused by excessive soil erosion, and of associated water quality issues.

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[1]Peter J. Nowak, "The Cost of Excessive Soil Erosion." Journal of Soil and Water Conservation 43: 307-310, 1988.

(a) Conservation has become the theme on which a variety of groups including urban, environmental, health, and wildlife can work together to meet the wishes of their supporters.

These four factors have contributed to the logical political outcome, namely, the conservation provisions of the 1985 farm law. As Peter Nowak states, "Conservation is now being funded and promoted to protect the interests of nonfarmers. No longer do we hear about maintaining the nation's agricultural productivity or protecting the interests of land users. Instead, justifications for conservation are based on phrases containing water quality, wildlife, and human health."

This new policy direction is leading to a regulatory approach to soil conservation, and to orienting conservation toward enhancing the welfare of nonfarmers.

The new conservation players are implying that if educational efforts and payments are not effective, then they will regulate practices so as to achieve conservation.

The FSA legislation has some flaws. The program's effectiveness is highly dependent on current agricultural conditions. High commodity prices would result in low USDA program participation. Yet the attractiveness of participating in programs is one of the key incentives to entice farmers into developing and implementing conservation plans.

Another key weakness is that we continue to assume that conservation is a cost to the land user. So long as we promote this thinking, the land user will continue to expect incentives to adopt conservation practices. This is especially evident in our present cost-sharing policies where in some counties we award the most money to those landowners who have the highest rates of erosion. In those cases, if you want maximum cost-share assistance, the name of the game is to allow excessive erosion to occur for a few years.

What are the Alternatives?

Certainly, water quality and offsite damages have caught the attention of the conservation community. But are those the only issues? If we remove our conservation blinders we can see that there are many important issues to be addressed if we are to maintain or sustain the quality of the environment. We should not presume we can continue to move forward with soil conservation without considering the implication of our efforts on other environmental issues such as water quality. Just now, outside forces are pressuring us to shift from one issue to another without solving the first one. As conservationists, shouldn't our number-one objective continue to be to solve the soil erosion problem?

If we do not take care of the soil conservation issue with research, education, and financial and technical assistance, the

outcome will be that environmental and urban groups will feel justified in pushing for mandatory regulations. When these regulations are passed they will result in reducing erosion, but at a large expense to the taxpayer and with considerable loss of land use choices to the land user. Regulations also destroy the incentive to do a better or more efficient job of resource management.

The U.S. midwest contains a number of areas where sound soil conservation has been practiced and the results are highly visible. These areas often occur within county or township boundaries. In the balanced farming areas of Missouri, the success can be attributed to individuals who were competent in crop and livestock production , in farm management, and in carrying out conservation practices. They proved to be effective educators, and had the trust and support of other farmers in their community.

The business of farming and resource management, however, has grown too complicated for any one agency or group to succeed on its own. The alternative to regulation is for all the conservation players to work to enhance each other's role, so that together we can show farmers/landowners that soil conservation is not a cost but a benefit to the land user as well as to urban and environmental groups.

ALTERNATIVE CONSERVATION SYSTEMS IN CONSERVATION COMPLIANCE

Russell C. Mills
State Conservationist
Soil Conservation Service

As background, the Food Security Act of 1985 (FSA) is highly significant in that it represents a change in the traditional philosophy of agricultural policy. The basic change is that entitlement to certain agricultural programs becomes a privilege rather than a right -- a privilege in that there are now conditions that a producer must meet in order to be eligible to participate in certain USDA programs. While this concept is most stringent with regard to the preservation of wetlands and the requirements of converting native rangeland or woodland to cropland (sodbusting), it calls for even more substantial reductions in soil erosion on land already producing a commodity.

The FSA requires that a conservation plan be developed on all highly erodible cropland (HEL) by January 1, 1990 or two years after completion of the soil survey. The Soil Conservation Service (SCS) in Missouri has mounted a major effort to assist producers with the development of conservation plans on those fields identified as HEL.

This is the largest concentrated effort that we have ever undertaken and it calls for a maximum commitment of resources.

The legislative history of the FSA states,

> The Conferees note that historically, the SCS technical guides in some states have included the provision that for land to be considered adequately treated, soil losses had to be reduced to an arbitrary standard called the soil loss tolerance or "T" value. This value ranges from two (2) to five (5) tons per acre per year. In many cases soil losses on highly erodible lands can be reduced from levels ranging from as much as 20-30 tons per acre per year or more to less than 10 tons per acre per year with very cost effective measures such as conservation tillage, contour farming, or strip cropping. These measures can usually be installed with a minimum of capital investment and can reduce erosion as much as 80-90 percent. If a rigid standard of "T" value is mandated for an acceptable conservation plan, even if erosion had been reduced from say 30 tons per acre per year to 7-8 tons per acre through the application of cost effective conservation measures, the producer could be required to either install a very expensive additional practice such as terraces or convert the land to grass or trees from cropland in order to continue to be eligible for program benefits.
>
> It is not the intent of the Conferees to cause undue hardship on producers to comply with these provisions. Therefore, the Secretary should apply standards of reasonable judgment of local professional soil conservationists and consider economic consequences in establishing requirements for measures to be included in conservation plans prepared under this provision.[1]

The soil loss tolerance or "T" value referenced in the legislative history is the maximum level of soil erosion for any particular soil mapping unit that will permit a high level of crop productivity to be sustained economically and indefinitely. To meet the requirements of the Act, each state was given the latitude to establish systems that may or may not reduce erosion to "T" levels but would significantly reduce erosion without creating an undue economic burden to producers.

At this point two terms need to be defined -- "benchmark system" and "alternative conservation system." The benchmark system establishes an acceptable level of erosion for a soil which can be greater than the "T" value for that soil but still allows producers to be in compliance. An alternative conservation system or ACS is any combination of crop rotations, tillage practices, and structural

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[1]House of Representatives Conference Report #99-447, pages 459, 460.

practices that will reduce soil erosion to the acceptable level established by the benchmark system.

Before discussing ACS in more detail I give a brief background on how Missouri developed its final benchmark system. Considerable time and effort were spent by a number of people in arriving at a final decision. Much of the initial work was carried out by an SCS interdisciplinary team comprised of the State Resource Conservationist, an agronomist, a soils specialist, and an agricultural economist. Also assisting this team were an agronomist and agricultural economist from the University of Missouri Extension Service.

The major steps for determining the final benchmark system were (1) to group all upland soils and determine erosion rates for each group based on a worst case situation; (2) to develop optional benchmark systems for each soil group; and (3) to determine the physical and cost effectiveness of each system.

The grouping of Missouri's upland soils resulted in 21 groups ranging from 2 to 20 percent slopes. Rates for sheet and rill erosion were calculated for each soil group based on growing continuous soybeans and fall plowing, with no conservation practices being used. Erosion rates ranged from 7 tons per acre annually on 2 percent slopes to 160 tons per acre on 20 percent slopes.

Several different conservation systems were considered as a possible benchmark system. Four were chosen for a more detailed evaluation. All four significantly reduced erosion and were applicable to all of the soil groups. The four systems evaluated included combinations of crop rotations, and tillage and/or structural practices.

The physical and economic effects of these four systems were examined for all 21 soil groups. The universal soil loss equation (USLE) was used to determine the erosion level obtained with each of the systems and an average cost per ton of soil loss reduction was computed as a measure of cost effectiveness for each of the systems. The USLE is used to estimate sheet and rill erosion from water. The equation is a predictive model backed by years of research.

By comparing the physical and economic effects for the different systems on a particular soil, trade-offs between effectiveness and efficiency could be examined.

The last step before selecting the final benchmark system was to meet with agricultural groups and agencies to present the four systems and their effects. Those attending included representatives from commodity groups, farm organizations, and state and federal agricultural and wildlife agencies. Based on the discussions and feedback from these meetings, it was determined that significant reductions in soil erosion could be obtained without creating an undue economic hardship to most producers.

The benchmark system selected for Missouri was continuous corn no-tilled with 70 percent ground cover after planting. This means that on any HEL cropland, for a producer to be in compliance, sheet and rill erosion cannot exceed the level of erosion that would occur producing continuous no-till corn.

For example, on a 3 percent sloping soil in the worst case scenario (soybean-no conservation) the erosion rate could be as high as 16 tons per acre annually. The benchmark system (continuous no-till corn) would reduce erosion to 5 tons per acre annually. Therefore, to be in compliance a producer could not exceed this level of erosion regardless of the crop being grown.

Now, let's turn our attention to the use of ACS in conservation planning for compliance under FSA. Remember, ACS embraces alternatives that get erosion down to "T" levels. An ACS reduces erosion to the benchmark value and meets the criteria for compliance, but may or may not reach the "T" level on a particular soil. Keep in mind also that the producer is in control of all decisions and that SCS's efforts are concerned with providing him with a viable ACS.

Looking again at our example of 3 percent sloping HEL cropland with a worst-case-situation erosion rate of 16 tons per acre annually, we ask, what are some of the possible systems that would get a producer to the benchmark level of 5 tons assuming he was in a corn-soybean rotation?

Sample alternative conservation systems. (For further information see appendix.)

1. Continuous drilled, spring plowed soybeans.
2. Continuous no-till soybeans with 20 percent ground cover.
3. Corn, soybeans, wheat with 40 percent, 30 percent, and 20 percent ground cover respectively.
4. Continuous fall plowed soybeans with contouring and terraces at 120-foot spacings.

These are some of the possible ACSystems for this situation. Choosing one of them is the prerogative of the producer. It is important to note that in Missouri, 80 percent of the HEL cropland falls in the 2-5 percent range and in most cases a change in tillage practices or rotation should bring a producer into compliance on these soils. More will be mentioned later.

What then should go into a conservation plan for compliance which incorporates ACS? In general, a plan for that purpose should incorporate the same criteria as does any type of good plan. A plan should be complete, effective, efficient, and acceptable. It must be complete in that it ensures the realization of the producer's objectives and is technically feasible. A plan must be effective in that it reduces erosion to the benchmark level; and efficient in that it reduces soil erosion in a cost effective manner and does not affect the economic viability of the farming unit. Above all, a conservation plan for compliance must be acceptable. It must satisfy

the user. To do this it must be workable and must have the flexibility to be updated in order for a producer to respond to such things as markets, government programs, climatic factors, and new technologies. Agricultural producers must be able to adjust production decisions based on highly volatile markets. In many cases this may involve frequent changes in crop rotations and land use. Farming practices are diverse and represent a constantly changing technology. As new and different practices become more acceptable to producers, a conservation plan must have the flexibility to incorporate these types of changes.

SCS will make every effort to develop conservation plans that fit these criteria!

How many acres in Missouri will be treated by ACS and what is the magnitude of the impacts?

There are approximately 6.3 million acres of "highly erodible cropland" in Missouri. Currently 1.4 million of these acres have been enrolled in the Conservation Reserve Program (CRP). Total CRP acreage in Missouri is expected to increase to around 2.3 million acres, leaving 4 million acres of highly erodible cropland as potential for treatment with ACS.

The chart shows the 4 million acres by slope group and the allowable upper limit erosion level for meeting compliance. The important thing to note about the potential acres to be treated with ACS is that nearly 80 percent or 3.2 million acres fall in the 2-5 percent slope group which has erosion levels of 5 tons or less per acre to meet compliance. On the other hand, some of the acres in the 14 percent-plus slope group have up to a 20 ton allowable erosion level, but the total acres in this slope group (approximately 40,000) comprise less than 1 percent of the total potential acres to be treated with ACS.

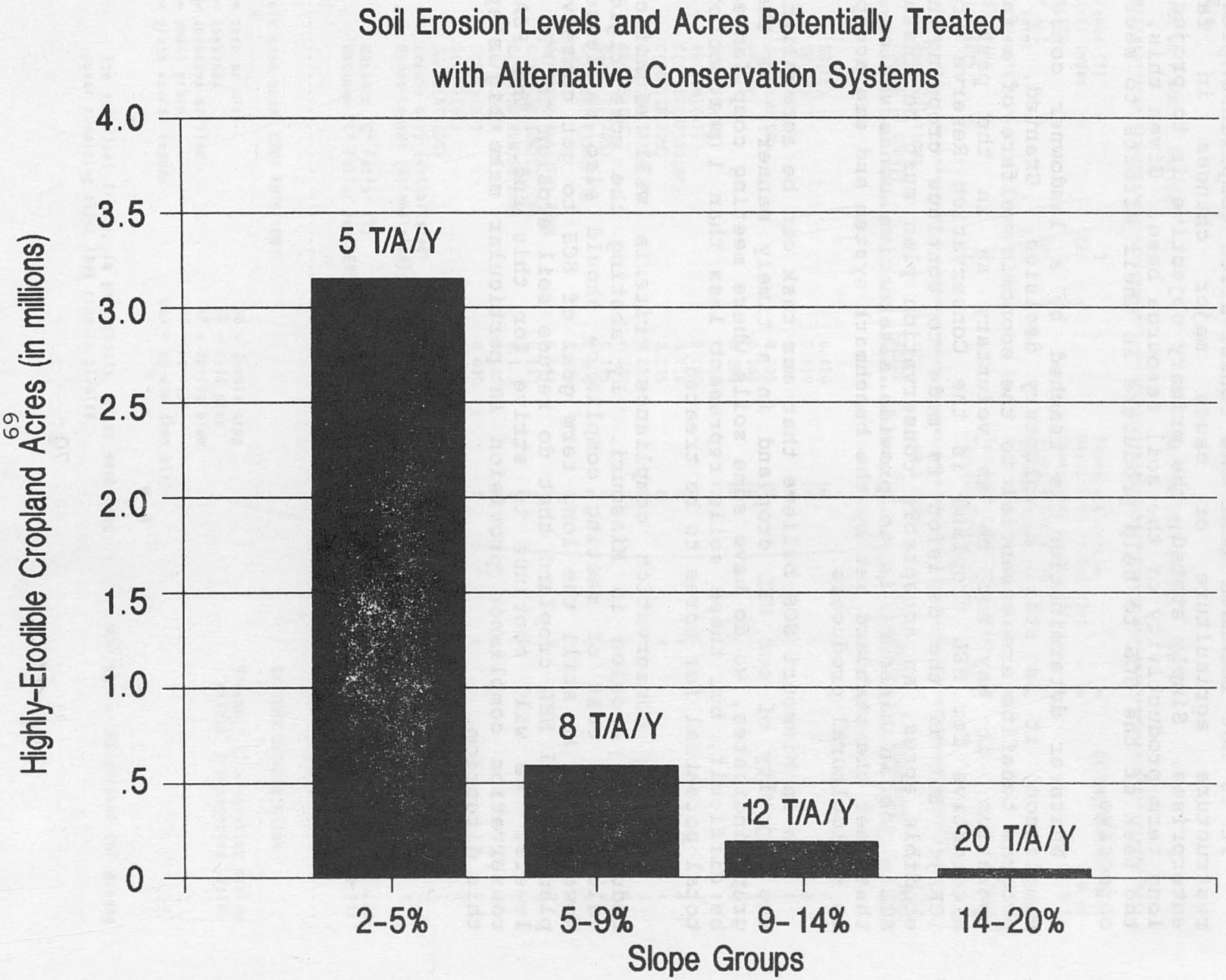
We know that not all highly erodible cropland in Missouri will be treated with ACS. Some landowners will choose not to be in compliance, thus forfeiting their right to participate in some USDA programs. At this time we do not have an accurate estimate of how many acres will be treated.

However, if all highly erodible cropland acres were treated, we could expect that on those acres:

* Sheet and rill erosion would be reduced from 74 million tons annually to 23 million tons or by nearly 70 percent

* Average erosion rates per acre would drop significantly on all soils -- for example, from 24 tons to 6 tons on 7 percent soils and from 66 tons to 17 tons on 17 percent soils

* Sediment leaving fields would be reduced from 33 million tons to 10 million tons annually, thus reducing off-site


Soil Erosion Levels and Acres Potentially Treated
with Alternative Conservation Systems
Highly-Erodible Cropland Acres (in millions)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
5 T/A/Y
8 T/A/Y
12 T/A/Y
20 T/A/Y
2-5%
5-9%
9-14%
14-20%
Slope Groups

sediment damages relating to water quality, road ditch filling, and land damage.

Summary

It is not intended that the conservation compliance provision restructure agriculture or cause major changes in farming enterprises. Simply stated, the primary objective is to project the long term productivity of the soil resource base. Given this, it is the task of the SCS to help producers in their efforts to meet this objective.

Whatever determination is reached by a landowner concerning compliance, it is still a voluntary decision. Granted, if USDA program benefits are essential to the economic welfare of a farming operation, it may not be as voluntary as in the past. One alternative for HEL cropland is the Conservation Reserve Program (CRP). But if the decision is made to continue cropping highly erodible acres, an acceptable conservation plan must be installed. SCS's job in Missouri is to provide alternative conservation plans that meet the standard set by the benchmark system and are acceptable to agricultural producers.

We in Missouri SCS believe that our task can be accomplished on the majority of our HEL cropland in a timely manner. As the bar graph indicates, we do have some soils where meeting compliance will be difficult, but these soils represent less than 1 percent of the total potential for acres to be treated.

Meeting conservation compliance criteria will significantly reduce soil erosion in Missouri. By abating the more rigid "T" values, the cost of meeting compliance should also be lessened. However, it is still the long term goal of SCS to get conservation plans on all HEL cropland that do reduce soil erosion to "T" value levels. We will continue to strive for this end. The FSA and conservation compliance provision in particular make big steps in this direction.

APPENDIX

LAND USE & TREATMENT WORK-SHEET (average annual sheet & rill erosion)

COUNTY: Boone
FARM NO: 123
FIELD(S): 1

DATE: 09-Nov-88
COOPERATOR NAME: Joe Farmer

FORM: LU&T-3R

MAPPING UNIT NAME: Mexico

MAPPING UNIT SYMBOL: 27B

Tolerance (T)	=	3	Benchmark System	=	C(70%)(NT)-U&D HILL
Rainfall Index	=	225	Strip Crop Factor (Ps)	=	0.45
Slope (%)	=	3	Contouring Factor (P)	=	0.5
Slope (L)	=	200	Terrace Slope (%)	=	3
"LS" Value	=	0.35	Terrace Slope (L)	=	120
Soil Index "K"	=	0.43	"LS" Value for Terraces	=	0.30
RK(LS) Value	=	34	Terraces (open or closed)	=	closed
Erosion (EI)	=	11	Terrace Factor (Pt)	=	0.6

NO	CROP ROTATIONS COMMON TO COUNTY	"C" FACTOR	UP & DOWN HILL	CONTOURING +	TERRACING	STRIP CROP
			Tons/Ac/Yr			
1	SB(FP)	0.480	16	8	4	7
2	SB(SP)	0.410	14	7	4	6
3	C(SP)SB(SP)	0.340	12	6	3	5
4	C(SP)SBD(SP)	0.305	10	5	3	5
5	SBD(SP)	0.300	10	5	3	5
6	C(SP)	0.290	10	5	3	4
7	W/SB(FP)(DC)	0.280	10	5	2	4
8	SB(20%)(NT)	0.260	9	4	2	4
9	C(SP)SB(SP)SG(SP)	0.250	9	4	2	4
10	C(30%)SB(30%)	0.235	8	4	2	4
11	C(SP)SBD(SP)SG(SP)	0.223	8	4	2	3
12	SB(30%)(NT)	0.200	7	3	2	3
13	C(40%)SB(40%)	0.195	7	3	2	3
14	C(FP)SB(FP)SG(FP)M	0.180	6	3	2	3
15	SG(FP)	0.170	6	3	1	3
16	C(FP)SB(FP)SG(FP)-2YrM	0.148	5	3	1	2
17	C(40%)SB(30%)SG(20%)	0.143	5	2	1	2
18	C(50%)SB(40%)SG(20%)	0.123	4	2	1	2
19	SG/SB DISK (DC)	0.100	3	2	1	2
20	C(60%)(NT)	0.090	3	2	1	1
21	C(70%)(NT)	0.060	2	1	1	1
22	SG/SB(NT)(DC)	0.040	1	1	0	1
23	Legume only (established)	0.020	1	0	0	0
24	Grass-Legume (established)	0.004	0	0	0	0
	Maximum "C" Factor (T)		0.102	0.205	0.398	0.228
	Maximum "C" Factor for BENCHMARK SYSTEM		0.060	0.120	0.233	0.133

Symbols used under CROP ROTATIONS:

C = corn or milo
SB = soybeans
SBD = soybeans drilled
SG = small grain
M = grass and/or legume
DC = double crop
FP = fall plow
SP = spring plow
NT = no-till
U&D = up and down hill

SYSTEMS DOCUMENTATION:

"Bracket" [] = existing system
"Circle" 0 = selected system

NOTE: The numerical figure, in parenthesis, after each crop in the rotation is the percent (%) ground cover remaining after that crop is planted.

THE ECONOMIC IMPACT OF CONSERVATION COMPLIANCE

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University of Missouri-Columbia

In considering the economic impact of conservation compliance I believe we need to "go back to basics." The approach taken here is built on the idea that crop budgets are essential in considering the impacts of conservation compliance. They are the building blocks for determining the likely economic consequences of different combinations of rotations and mechanical practices that a farmer can use in order to stay within soil loss limits. Hence, a micro-oriented approach is taken to identify the rotation that will generate the most net revenue for each of the mechanical practices designated to hold soil loss under T for erosive land capability classes.

Assumptions

It is important to specify the assumptions made for this analysis, so that the implications can be understood more clearly. The most important ones are:

* Conservation compliance will not go away.
* Compliance can be met by some combination of rotations and mechanical practices. And further, that the soil loss must be at T in order for terms of compliance to be met.[1]
* Some farmers will not participate in government programs and will not be impacted directly by conservation compliance. However, it is assumed that most farmers will in fact participate and, hence, will comply with compliance requirements.
* Some homogeneity of soils can be assumed within land capability classes.
* Three conservation practices will illustrate the impacts of mechanical practices. These are: (a) contouring, (b) contouring with conservation tillage, and (c) terraces with conservation tillage.
* A 10 year planning horizon has been used, with grain yields increasing one percent per year due to technology change.
* The cost directly attributable to the conservation practices will not be included in the analysis. The most important of these is the cost of building and maintaining terraces.

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[1]A benchmark soil loss greater than T has been developed for some soils by SCS in Missouri. Such a compliance requirement will not be as restrictive as T, which has been assumed here.

* The three price scenarios used (table 1) will implicitly be related to government price support programs, but the latter will not be specified as such.
* The labor wage rate has been assumed at $5.00 per hour.

Method of Analysis

As stated above, the objective of the analysis is to estimate the returns to land and management for a matrix of three conservation practices utilizing the most intensive rotations allowable by T for land capability classes, using three price scenarios. Obviously, still other combinations of prices, conservation practices, and rotations could be used. However, the assumption made here is that with the data points generated we can begin to get some insight into the likely impact of conservation compliance.

Several steps were followed in carrying out the analysis. First, the most intensive rotations allowed by T were determined for each land capability class for each of the three mechanical practices. Partial budgets were constructed to project future income. The Universal Soil Loss Equation (USLE) was used to estimate soil erosion for various crops and conservation practices. Clay and Ray counties were chosen as representative areas for data sources. The two counties represent a variety of soils and landscapes common to Missouri. Also, a soil survey was completed there recently.

Second, crop yields, soil erosion factors, and mapping unit acres were recorded (table 2). Forage yields were estimated by UMC extension personnel. Since the soil mapping units do not occupy land areas of equal size, the yields and soil erosion factors were weighted by the percent of the land area encompassed by each mapping unit. By comparing similar mapping units in an adjacent soil survey (Lafayette county), which was ten years older than the Clay-Ray soil survey, it was found that yields had increased by about 10 percent over a 10 year period. This is also consistent with yield trends reported by the Missouri office of the National Agricultural Statistics Service.

Third, budgets were calculated for corn, soybeans, wheat, alfalfa/grass hay, red clover/grass hay, as well as both improved and unimproved pasture. Fifty-seven budgets were generated.

Fourth, the budget data were used to calculate returns to land and management by price scenario, conservation practice, and land capability class. Obviously, many of the combinations of these variables could have been used in the analysis. The point to be made is that these are illustrative of the impacts that various alternative combinations can have.

Analysis and Conclusions

Given the large number of budgets generated, discussion will focus only on one illustration. Attention is called to the corn budget using the low price projection (table 3). Budgets were

Table 1. Price Scenarios Used in Analysis of Economic Impact of Conservation Compliance

Commodity	Low Price Scenario	Medium Price Scenario	High Price Scenario
	----------dollars----------		
Corn (per bu.)	1.90	2.35	3.00
Soybeans (per bu.)	4.50	5.00	7.50
Wheat (per bu.)	2.40	2.80	3.75
Alfalfa/grass hay (per ton)	60.00	65.00	70.00
Red clover/grass hay (per ton)	50.00	55.00	60.00
Pasture (per animal unit month)	6.00	7.00	8.00

calculated for land classes II, III, and IV. On a price assumption of $1.90 per bushel, the gross income was calculated for each budget. Subtracted from that were the total variable costs estimated for the average yields assumed by land class. In turn, the machinery depreciation and labor costs per acre were subtracted. In the case of $1.90-per-bushel corn, attention is called to the fact that negative returns to land can be expected, regardless of which of the three land classes is involved.

The budget data are aggregated in table 9 for the three price scenarios. Data for each scenario will be considered because a great deal of information is summarized.

Note that the low price projection scenario generates negative returns for all crops on all classes of land considered except soybeans on class II land. Clearly, this suggests that soybeans are especially important in the low price scenario. Unfortunately, however, one of the consequences of conservation compliance will be to reduce the amount of soybeans in many rotations, given the soil conservation practice utilized.

Attention is called to the profit and loss projections for individual crops assuming the medium price projection. Note that the "window of profitability" expands as price levels increase, such that especially on class II and III land several cropping alternatives become viable. However, assuming these prices, classes IV, VI, and VII land can most profitability be used as low input pasture.

Table 2. Yield and Soil Loss Data from Clay and Ray County Soil Surveys

Soil Mapping Unit	Adjusted Yield (bu.)[1]			Soil Loss Factor			Number of acres, Clay and Ray Counties	
	Corn	Soybeans	Wheat	Erosion Tolerance (T)	Soil Erodibility (K)	Slope Length and Steepness[2] (LS)	Acres	Percent
Land Capability Class II_e								
Sibley 1B	127	50	53	5	.28	.51	4,700	6.7
Sharpsburg 6B	112	47	50	5	.32	.83	35,100	50.2
Sampsel 13B	95	36	39	3	.37	.53	2,760	4.0
Lagonda 24B	99	37	42	3	.37	.53	7,950	11.4
Ladoga 26B	101	39	43	5	.32	.47	7,250	10.4
Grundy 56B	108	42	44	3	.37	.54	12,090	17.3
Weighted average[3]	109	44	47	4.35	.33	.52	69,850	100.0
Land Capability Class III_e								
Sibley 1C	119	43	44	5	.28	.81	4,575	2.1
Higginsville 2C	119	45	50	5	.37	1.30	3,440	1.6
Macksburg 5C	113	43	47	5	.32	1.10	21,650	9.8
Sharpsburg 6C2	99	44	46	5	.32	1.17	38,950	17.7
Sharpsburg 6D2	90	33	37	5	.32	2.30	9,100	4.1
Greentown 11C2	85	31	34	3	.37	1.17	11,800	5.4
Sampsel 13C	87	33	33	3	.37	.88	4,330	2.0
Lagonda 25C2	84	31	37	3	.37	.99	61,050	27.8
Ladoga 26C2	88	33	36	5	.32	.92	13,600	6.2
Ladoga 26D2	77	29	31	5	.32	1.90	7,500	3.4
Armster 41C2	64	28	31	5	.37	.93	28,450	12.9
Knox 54C2	98	36	37	5	.32	1.01	8,850	4.0
Grundy 57C2	88	33	37	3	.37	1.01	6,700	3.0
Weighted average[3]	89	35	39	4.23	.35	1.11	220,045	100.0
Land Capability Class IV_e								
Snead 9D	61	23	28	3	.37	2.10	10,650	17.6
Greentown $11C_e$	--	--	29	2	.37	1.20	2.340	3.9
Ladoga 27D3	68	25	28	5	.32	1.95	4,650	7.7
Armster 41D2	55	24	28	5	.37	2.20	16,400	27.1
Armster 42C3	57	20	24	4	.37	.96	3,350	5.5
Knox 54E2	--	--	--	5	.32	3.75	8,200	13.6
Knox 55D3	72	26	29	6	.32	1.90	14,900	24.6
Weighted average	63	24	27	4.48	.35	2.19	60,490	100.0
Land Capability Class VI_e								
Snead 9E	--	--	--	3	.37	4.20	1,223	5.6
Greentown 11D3	--	--	--	2	.37	2.30	8,090	37.3
Lagonda 25D2	--	--	--	3	.37	2.30	2,510	11.6
Armster 42E3	--	--	--	4	.37	2.00	3.610	16.7
Knox 54F	--	--	--	5	.32	7.00	6,250	28.8
Weighted average[3]	--	--	--	3.37	.36	3.71	21,683	100.0

[1]Published soil survey yields were increased 10% to account for yield increases due to improved varieties and new technology.

[2]Estimates from Soil Conservation Service tables developed for completion of CRP worksheets.

[3]Weighted by the mapping unit acres within each land capability class. Numbers in last two columns are totals.

Table 3. Corn, Soybean, and Wheat Budgets by Land Capability Class, Low Price Scenario

Item	Corn			Soybeans			Wheat		
	Land Capability Class			Land Capability Class			Land Capability Class		
	II_e	III_e	IV_e	II_e	III_e	IV_e	II_e	III_e	IV_e
Yield (bu./acre)	109	89	63	44	35	24	47	39	27
Price (dollars/bu.)	1.90	1.90	1.90	4.50	4.50	4.50	2.40	2.40	2.40
Gross income (dollars)	207.00	169.10	119.70	198.00	157.50	108.00	112.80	93.60	64.80
Variable costs (dollars)									
Seed	17.75	16.00	14.00	12.00	12.00	12.00	12.00	12.00	12.00
Fertilizer	43.99	36.66	28.36	18.07	13.41	12.01	23.28	21.03	15.86
Chemicals	25.00	25.00	25.00	40.00	40.00	40.00	--	--	--
Machine hire	5.00	5.00	5.00	--	--	--	4.00	4.00	4.00
Machine maintenance	32.00	30.00	27.25	30.50	32.00	28.00	21.50	20.00	18.00
Haul/Dry	16.50	13.35	9.45	4.40	3.50	2.40	4.70	3.90	2.70
Miscellaneous	7.01	6.30	5.45	5.25	4.90	4.72	3.27	3.05	2.63
Interest	8.10	7.28	6.30	6.06	5.66	5.45	3.78	3.52	3.04
Total	155.35	139.59	120.81	116.28	108.47	104.58	72.53	67.50	58.23
Income over variable costs (dollars)	57.75	29.51	-1.11	81.72	49.03	3.42	40.27	26.10	6.57
Labor (hours)	3.4	3.1	3.0	3.2	3.1	3.0	1.6	1.5	1.4
Machinery depreciation plus labor (dollars)	57.00	55.75	55.00	56.00	55.50	55.00	48.00	47.50	47.00
Return to land (dollars)	-5.25	-26.25	-56.11	25.72	-6.47	-51.58	-7.73	-21.40	-40.43

Table 4. Legume and Grass Hay, and Pasture, Budgets by Land Capability Class, Low Price Scenario

Item	Legume and Grass Hay				Pasture					All Soil Types, Minimum Input Fescue
	Land Capability Class				Land Capability Class					
	II_e[1]	III_e[1]	IV_e[1]	VI_e[2]	II_e	III_e	IV_e	VI_e	$VIII_e$	
Yield (tons or AUM per acre)	3.6	2.9	2.2	1.9	7.3	6.4	5.4	5.0	3.8	3.0
Price (dollars/ton, AUM)	60.00	60.00	50.00	50.00	6.00	6.00	6.00	6.00	6.00	6.00
Gross income (dollars)	216.80	174.60	110.80	95.00	43.80	38.40	32.40	30.00	22.80	18.00
Variable costs (dollars)										
Establishment	29.00	27.00	11.00	11.00	5.00	5.00	5.00	4.00	4.00	4.00
Fertilizer, lime	34.75	29.76	19.92	17.69	38.83	34.70	29.82	26.68	22.12	6.00
Crop chemicals and supplies	10.00	10.00	7.00	7.00	2.00	2.00	2.00	2.00	2.00	1.00
Machine maintenance	47.00	42.00	32.00	31.25	2.00	2.00	2.00	2.00	2.00	2.00
Miscellaneous	3.00	3.00	3.00	3.00	--	--	--	--	--	--
Interest	6.81	6.15	4.01	3.85	2.63	2.40	2.14	1.91	1.66	.72
Total	130.56	117.91	76.93	73.79	50.46	46.10	40.96	36.59	31.78	13.72
Income over variable cost	85.44	56.09	33.07	21.21	-6.66	-7.70	-8.56	-6.59	-8.98	4.28
Labor (hours)	10	9.0	6.0	6.0	1.5	1.5	1.5	1.5	1.5	1.0
Machinery depreciation plus labor (dollars)	90.00	85.00	70.00	70.00	7.50[3]	7.50[3]	7.50[3]	7.50[3]	7.50[3]	5.00[3]
Return to land (dollars)	-4.56	-28.91	-36.93	-48.79	-14.16	-15.20	-16.06	-14.09	-16.48	-0.72

[1]Legume is alfalfa
[2]Legume is red clover
[3]Labor only

Table 5. Corn, Soybean, and Wheat Budgets by Land Capability Class, Medium Price Scenario

Item	Corn			Soybeans			Wheat		
	Land Capability Class			Land Capability Class			Land Capability Class		
	II_e	III_e	IV_e	II_e	III_e	IV_e	II_e	III_e	IV_e
Yield (bu./acre)	109	89	63	44	35	24	47	39	27
Price (dollars/bu.)	2.35	2.35	2.35	5.00	5.00	5.00	2.80	2.80	2.80
Gross income (dollars)	256.15	209.15	148.05	220.00	175.00	120.00	131.60	109.20	75.60
Variable costs (dollars)									
Seed	17.75	16.00	14.00	12.00	12.00	12.00	12.00	12.00	12.00
Fertilizer	43.99	36.66	28.36	18.07	13.41	12.01	23.28	21.03	15.86
Chemicals	25.00	25.00	25.00	40.00	40.00	40.00	--	--	--
Machine hire	5.00	5.00	5.00	--	--	--	4.00	4.00	4.00
Machine maintenance	32.00	30.00	27.25	30.50	29.00	28.00	21.50	20.00	18.00
Haul/Dry	16.50	13.35	9.45	4.40	3.50	2.40	4.70	3.90	2.70
Miscellaneous	7.01	6.30	5.45	5.25	4.90	4.72	3.27	3.52	2.63
Interest	8.10	7.28	6.30	6.06	5.66	5.45	3.78	3.52	3.04
Total	155.35	139.59	120.81	116.28	108.47	104.58	72.53	67.50	58.23
Income over variable costs (dollars)	100.80	69.56	27.24	103.72	66.53	15.42	59.07	41.70	17.37
Labor (hours)	3.4	3.15	3.0	3.2	3.1	3.0	1.6	1.5	1.4
Machinery depreciation plus labor (dollars)	57.00	55.75	55.00	56.00	55.50	55.00	48.00	47.50	47.00
Return to land (dollars)	43.80	13.81	-27.76	47.72	11.03	-39.58	11.07	-5.80	-29.63

Table 6. Legume and Grass Hay, and Pasture, Budgets by Land Capability Class, Medium Price Scenario

Item	Legume and Grass Hay				Pasture					All Soil Types, Minimum Input
	Land Capability Class				Land Capability Class					
	II_e[1]	III_e[1]	IV_e[1]	VI_e[2]	II_e	III_e	IV_e	VI_e	$VIII_e$	Fescue
Yield (tons or AUM per acre)	3.6	2.9	2.2	1.9	7.3	6.4	5.4	5.0	3.8	3.0
Price (dollars/ton, AUM)	65.00	65.00	55.00	55.00	7.00	7.00	7.00	7.00	7.00	7.00
Gross income (dollars)	234.00	188.50	121.00	104.50	51.10	44.80	37.80	35.00	26.60	21.00
Variable costs (dollars)										
Establishment	29.00	27.00	11.00	11.00	5.00	5.00	5.00	4.00	4.00	4.00
Fertilizer, lime	34.75	29.76	19.92	17.69	38.83	34.70	29.82	26.68	22.12	6.00
Crop chemicals and supplies	10.00	10.00	7.00	7.00	2.00	2.00	2.00	2.00	2.00	1.00
Machine maintenance	47.00	42.00	32.00	31.25	2.00	2.00	2.00	2.00	2.00	2.00
Miscellaneous	3.00	3.00	3.00	3.00	--	--	--	--	--	--
Interest	6.81	6.15	4.01	3.85	2.63	2.40	2.14	1.91	1.66	.72
Total	130.56	117.91	76.93	73.79	50.46	46.10	40.96	36.59	31.78	13.72
Income over variable costs	103.44	70.59	44.07	30.71	.64	-1.30	-3.16	-1.59	-5.18	7.28
Labor (hours)	10	9.0	6.0	6.0	1.5	1.5	1.5	1.5	1.5	1.0
Machinery depreciation plus labor (dollars)	90.00	85.00	70.00	70.00	7.50[3]	7.50[3]	7.50[3]	7.50[3]	7.50[3]	5.00[3]
Return to land (dollars)	13.44	-14.41	-25.93	-39.29	-6.86	-8.80	-10.66	-9.09	-12.68	2.28

[1]Legume is alfalfa
[2]Legume is red clover
[3]Labor only

Table 7. Corn, Soybean, and Wheat Budgets by Land Capability Class, High Price Scenario

Item	Corn			Soybeans			Wheat		
	Land Capability Class			Land Capability Class			Land Capability Class		
	II_e	III_e	IV_e	II_e	III_e	IV_e	II_e	III_e	IV_e
Yield (bu./acre)	109	89	63	44	35	24	47	39	27
Price (dollars/bu.)	3.00	3.00	3.00	7.50	7.50	7.50	3.75	3.75	3.75
Gross income (dollars)	327.00	267.00	189.00	330.00	262.00	180.00	176.25	146.25	101.25
Variable costs (dollars)									
Seed	17.75	16.00	14.00	12.00	12.00	12.00	12.00	12.00	12.00
Fertilizer	43.99	36.66	28.36	18.07	13.41	12.01	23.28	21.03	15.86
Chemicals	25.00	25.00	25.00	40.00	40.00	40.00	--	--	--
Machine hire	5.00	5.00	5.00	--	--	--	4.00	4.00	4.00
Machine maintenance	32.00	30.00	27.25	30.50	29.00	28.00	21.50	20.00	18.00
Haul/Dry	16.50	13.35	9.45	4.40	3.50	2.40	4.70	3.90	2.70
Miscellaneous	7.01	6.30	5.45	5.25	4.90	4.72	3.27	3.52	2.63
Interest	8.10	7.28	6.30	6.06	5.66	5.45	3.78	3.52	3.04
Total	155.35	139.59	120.81	116.28	108.47	104.58	72.53	67.50	58.23
Income over variable costs (dollars)	171.65	127.41	68.19	213.72	154.03	75.42	103.72	78.75	43.02
Labor (hours)	3.4	3.15	3.0	3.2	3.1	3.0	1.6	1.5	1.4
Machinery depreciation plus labor (dollars)	57.00	55.75	55.00	56.00	55.50	55.00	48.00	47.50	47.00
Return to land (dollars)	114.65	71.66	13.19	157.72	98.53	20.42	55.72	31.25	-3.98

Table 8. Legume and Grass Hay, and Pasture, Budgets by Land Capability Class, High Price Scenario

Item	Legume and Grass Hay				Pasture					All Soil Types, Minimum Input Fescue
	Land Capability Class				Land Capability Class					
	II_e[1]	III_e[1]	IV_e[1]	VI_e[2]	II_e	III_e	IV_e	VI_e	$VIII_e$	
Yield (tons or AUM per acre)	3.6	2.9	2.2	1.9	7.3	6.4	5.4	5.0	3.8	3.0
Price (dollars/ton, AUM)	70.00	70.00	60.00	60.00	8.00	8.00	8.00	8.00	8.00	8.00
Gross income (dollars)	252.00	203.50	132.00	114.00	58.40	51.20	43.20	40.00	30.40	24.00
Variable costs (dollars)										
Establishment	29.00	27.00	11.00	11.00	5.00	5.00	5.00	4.00	4.00	4.00
Fertilizer, lime	34.75	29.76	19.92	17.69	38.83	34.70	29.82	26.68	22.12	6.00
Crop chemicals and supplies	10.00	10.00	7.00	7.00	2.00	2.00	2.00	2.00	2.00	1.00
Machine maintenance	47.00	42.00	32.00	31.25	2.00	2.00	2.00	2.00	2.00	2.00
Miscellaneous	3.00	3.00	3.00	3.00	--	--	--	--	--	--
Interest	6.81	6.15	4.01	3.85	2.63	2.40	2.14	1.91	1.66	.72
Total	130.56	117.91	76.93	73.79	50.46	46.10	40.96	36.59	31.78	13.72
Income over variable costs	121.44	85.09	55.07	40.21	7.94	5.10	2.24	3.41	-1.38	10.28
Labor (hours)	10	9.0	6.0	6.0	1.5	1.5	1.5	1.5	1.5	1.0
Machinery depreciation plus labor (dollars)	90.00	85.00	70.00	70.00	7.50[3]	7.50[3]	7.50[3]	7.50[3]	7.50[3]	5.00[3]
Return to land (dollars)	31.44	.09	-14.93	-29.79	.44	-2.40	-5.26	-4.09	-8.88	5.28

[1]Legume is alfalfa
[2]Legume is red clover
[3]Labor only

Table 9. Summary of Profit or Loss Data by Land Capability Class, for Three Price Scenarios

Crop	Assumed Price	Land Capability Class II_e	III_e	IV_e	VI_e	VII_e
	dollars					
Low Price Scenario						
Corn	1.90	-5.25	-26.24	-56.11		
Soybeans	4.50	25.72	-6.47	-51.58		
Wheat	2.40	-7.73	-21.40	-40.43		
Legume/grass	60/50[1]	-4.56[2]	-28.91[2]	-36.93[3]	-48.79[3]	
Improved pasture	6.00	-14.16	-15.20	-16.06	-14.09	-16.48
Low input pasture	6.00	-0.72	-0.72	-0.72	-0.72	-0.72
Medium Price Scenario						
Corn	2.35	43.80	13.81	-27.76		
Soybeans	5.00	47.72	11.03	-39.58		
Wheat	2.80	11.07	-5.80	-29.63		
Legume/grass	65/55[1]	13.44[2]	-14.41[2]	-25.93[3]	-39.29[3]	
Improved pasture	7.00	-6.86	-8.80	-10.66	-9.09	-12.68
Low input pasture	7.00	2.28	2.28	2.28	2.28	2.28
High Price Scenario						
Corn	3.00	114.65	71.66	13.19		
Soybeans	7.50	157.72	98.53	20.42		
Wheat	3.75	55.72	31.25	-3.98		
Legume/grass	70/60[1]	31.44[2]	.09[2]	-14.93[3]	-29.79[3]	
Improved pasture	8.00	0.44	-2.40	-5.26	-4.09	-8.88
Low input pasture	5.28	5.28	5.28	5.28	5.28	5.28

[1]Higher figure is alfalfa/grass hay; lower, red clover/grass hay
[2]Legume is alfalfa
[3]Legume is red clover

Table 10. Return to Land and Management from the Most Profitable Rotation Permitting Tolerable Soil Loss (T) By Land Capability Class and Price Scenario for Each of Three Mechanical Conservation Practices

Item	Land Capability Class				
	II_e	III_e	IV_e	VI_e	VII_e
	dollars				
Farming on contour					
Rotation	corn, soybeans, wheat	corn, soybeans, wheat, 2 yrs. meadow	corn/soybeans, wheat, 3 yrs. meadow	continuous meadow	continuous meadow
Price Scenario					
Low	4.25	-0.72[1]	-0.72[1]	-0.72[1]	-0.72[1]
Medium	34.20	4.72	2.28[1]	2.28[1]	2.28[1]
High	109.36	42.40	8.31	5.28[1]	5.28[1]
Contour plus Conservation Tillage					
Rotation	corn, soybeans	corn, corn, soybeans, wheat, meadow	corn/soybeans, wheat, 2 yrs. meadow	continuous meadow	continuous meadow
Price Scenario					
Low	10.24	-0.72[1]	-0.72[1]	-0.72[1]	-0.72[1]
Medium	45.16	7.03	2.28[1]	2.28[1]	2.28[1]
High	136.18	55.68	9.06	5.28[1]	5.28[1]
Conservation Tillage plus Terraces					
Rotation	continuous corn/soybeans	corn, corn, soybeans	corn/soybeans, wheat, meadow	continuous meadow	continuous meadow
Price Scenario					
Low	25.72	-0.72[1]	-0.72[1]	-0.72[1]	-0.72[1]
Medium	47.72	12.88	2.28[1]	2.28[1]	2.28[1]
High	157.72	80.62	10.33	5.28[1]	5.28[1]

Note: corn/soybeans means a choice of either crop

[1]Low input pasture

Finally, under the high price projection a large number of alternative crops will be profitable, especially for land classes II and III. Again, low input pasture is a viable alternative for even the least productive land capability classes.

Now let us turn our attention to the relative profitability of rotations by conservation practice and price scenario (table 10). Noteworthy is the fact that higher returns to land and management, exclusive of the cost of the mechanical conservation practice, can be expected as more intensive rotations are allowed. Likewise, note that the returns decrease for a given conservation practice as the land quality shifts from class II to class VII land. In most cases

the more eroded land capability classes are relegated to low input fescue pasture. Clearly, the alternatives available to the lower quality land classes as a consequence of conservation compliance are quite limited and returns are quite low.

Policy Implications

Several policy implications can be drawn from this analysis, in my judgment. Each deserves elaboration.

First, the economic impacts of conservation compliance will be quite substantial. This will be the case especially for lower quality land both in terms of the returns to land and management and, subsequently, to the value of the land itself. However, this does not mean that conservation compliance is going away. In fact, I believe that it is cruel to suggest to farmers and owners of lower quality land that this problem will go away. Although some efforts may be made to mitigate the consequences of the requirements, I believe it is both naive and cruel to suggest that this "problem" will vanish.

Second, the compliance requirement will be especially important on land classes IV, VI, and VII. The above analysis suggests that much of this land will be relegated to use as low input pasture in the future. More specifically, I believe we are likely to see a considerable acreage of poor quality fescue and oak sprouts produced on this type of land in the future.

Third, a substantial acreage in the state of Missouri is likely to be impacted quite significantly by this program. Given the fact that soybeans have tended to be a dominant crop in parts of Missouri, especially northern Missouri, the shift away from soybeans will be extremely important for the Missouri agricultural economy. In other words, we are likely to experience a very significant change in the agricultural economy for some sections of the state. This "crisis just waiting to happen" needs to be called to the attention of legislators so that research on new technology can be funded to develop more profitable alternatives for land subject to conservation compliance. I need only remind that this state once was an important apple producer, as a basis for suggesting that significant changes can, in fact, happen with regard to the agricultural output of this state.

Finally, these data suggest that if land values are primarily a function of capitalized returns to land, a much wider range of land prices might be anticipated in the future between class II and class VII land. Educational programs to alert the industry to this type of impact would be highly appropriate beginning now and continuing until conservation compliance becomes a reality in 1995.

CONCERNS OF A FARMER

Harold F. Clark
Sumner, Missouri

I can't tell you how happy I am with the state of erosion in the state of Missouri. I live in Chariton county, which is in the foothills of the Green Hills. From what I see, conservation compliance really isn't a problem. However, I think we should remember that along with the 1985 law, we have had in the state of Missouri a constitutional amendment that put some money into the cost-share program to help the farmer to control erosion. I think the continuation voted recently is commendable. Farmers are very appreciative of taxpayers for doing that because it provides what in my estimation makes the erosion-control program go; that is, money.

We have heard it asked whether farmers are going to resent being forced to comply with some conservative practice requirements. I don't really think farmers are viewing it that way. They have always been interested in conservation, stewardship of the land, and would like to have done what is necessary. But there has been a lot of talk about the money, the profitability of conservation. Conservation can be profitable but it is a long time deal. In the short time, no. Conservation is like buying green bananas.

I think conservation compliance is giving farmers the excuse, or reason, for doing what they have wanted to do for a long time. Farmers are funny. Two things drive them. Money, and peer pressure. I have had my farm terraced for a good many years, but I am not a big enough leader to draw my neighbors into following me. That does not mean that they don't really want to. In my community, I doubt more than two farms have no terraces on them. Some people who drew straight rows for a long time have come around to conservation. I am glad to see them go this way. And they are going to the "T". There is not much concern, as I see it, for alternative methods. I am glad of that. For myself, I would be a little leery of putting all my income at risk as to whether a hired man would happen to plow a stalk field too deep and destroy the cover. Some of the alternative practices are not as good, in my estimation, as terracing.

This all came about, motivated by the 1985 farm law. I only wish that farmers could be given full credit for the conservation features of that law, instead of sharing it with the environmental people. I remember back six years ago, when I didn't think there was any chance in the world that we would control erosion in the state of Missouri. It had dragged on and dragged on, and everyone talked about it, but little happened. At a Governor's Conference, when James Boillot was Director of Agriculture, the theme was soil erosion. There was a lot of talk about it, and about how Missouri's was the second worst in the nation. Governor Bond reported that the General Assembly had come up with a million dollars to start a cost-share program in the state of Missouri. That brought jubilation.

But I remember that Larry Harper, of the Missouri Ruralist, helped me voice a concern. His concern was, "If we are going to stand here and talk about how bad things are, and what a terrible state of affairs we have, we had better be prepared to solve the problem. Because, after the big city newspapers and magazines run this through a few times, if we don't solve the problem, someone else will make us solve it."

It seems to me that that is what has happened. We in Missouri have got along pretty well with our new state funding. I don't want to minimize the federal program, because it has long been a help. But the state cost-share money has been the push to get enough people to go along with it, to be the "thing to do."

What concerns me about the people who got Conservation Reserve and conservation compliance into the farm bill is they put other things in the farm bill and are still pressing. There is an endangered species clause that gives the EPA pretty broad power. I understand that the agency has targeted four or five chemicals for removal. Over time, maybe it would like to shut down the whole system of chemical farming and return to the good old days.

"Dear Abby," I am concerned for Missouri. I remember the good old days. I farmed 200 acres and worked hard at it. Now I farm ten times that with the same labor. A lot has happened since those days, but the biggest thing, in my estimation, has been the advent of herbicides. They have allowed us to farm in the way we farm today. I would certainly hate to lose them. It is important to me to be able to use them. But I don't want to use any herbicide if it is going to turn babies blue, or if it is going to put three eyes in my great-grandchildren. What does concern me, or confuse me, is that during all the years I used the chemicals they seemed to be too high priced. Whenever I mentioned that to a chemical representative his stock answer was that it took years and years and millions and millions of dollars to develop the chemical. He went into what all the company had to do to get the chemical passed for use. Eventually, a government agency assured the company that if the chemical were used in the prescribed manner as shown on the label, it would not harm me nor would it harm the environment. I believed that. I paid the bill.

But now, under some provision called special review, the EPA is allowed to go back and review the chemicals. That is all right; if something is wrong, it should be straightened out. But I think that the chemical should be reviewed in terms of its being used according to the label. Test it scientifically, to find out if, when it is used according to the label, it is dangerous or not dangerous. I want that to be done, instead of going out and saying, "We found the chemical in groundwater," or someplace, and therefore the chemical will have to be removed. I suspect this is what the EPA is going to do.

The chemical manufacturers, who are under a lot of fire, are inclined to say that the problem is that farmers do not use the

chemical according to label. Well, maybe they do and maybe they don't. I think farmers are doing better, although I can't speak for everyone. The tolerances are very narrow. If you put too much on you kill the crop, and if you don't put enough on you don't kill the weeds. If you put on too much the carryover will keep you from planting other crops. A farmer must be on the ball if he is going to use a chemical.

If it can be proved that the farmer is the culprit, I think that instead of throwing the chemical away, if we can't educate, we will have to regulate. It could be done. Unpalatable as regulation is, I would rather be regulated than pull weeds on 200 acres.

CONCERNS OF AN AGRIBUSINESS

Burdette L. Frew
President, Missouri Farmers Association

First of all, if anyone thinks my perspective is from what agribusiness is going to do about all that this seminar has dealt with and how my business will be affected from a profitability and marketing standpoint, he is guessing wrong. That is not what I have in mind. Agribusiness, any firm, will take care of itself in that respect. The market sorts out those who can compete from those who cannot. Those of us who work in agribusiness will try to struggle along in the situation -- those who try to serve the market -- and find a place in it or find a way to exit.

My concern, however -- since we are a farmer-owned cooperative -- is basically for the farmer. What is good for the farmer ultimately ends up as being good for agribusiness. Without the farmer, without that individual who tills the soil and takes that resource and turns it into something that is salable and usable and sustainable, agribusiness does not have a place.

As Mr. Clark observes, farmers to our way of thinking are inherently conservationists. They fully realize the value of the resource they are charged with; they manage it carefully, for the most part; they understand the necessity to preserve that resource. It's what they depend upon, year after year. They are not about to squander that, knowingly. They tend to look for ways to improve the situation rather than ignore it. I think that the farmer provides more conservation and ecology for free than any other entity or any other group that I know of.

I know of no one else who leaves four or five rows of soybeans or corn or milo around a waterpond for quail, for birds. I know a farmer who lets 50 or 60 acres of heavy milo just fall and go fallow every year to provide coverage, and habitat, for game. I don't know

of anyone among urban people who comes close to doing that sort of thing in working for conservation. It concerns me a little bit when the people who have a hidden agenda decide that they are going to solve the problem, in this generation, that took two or three hundred years to go to.

I suppose my basic concern is that it is necessary to keep agriculture in this state viable, and to keep the American farmer, and specifically the Missouri farmer, competitive in the world market. A lot of people are working toward that, but it seems that we are getting push coming to shove. I think that when push does come to shove, the American farmer, and the Missouri farmer, will side with good conservation practice every time. What bothers me is that we have been 250 or 300 years getting where we are now, and we are thinking about curing this at the expense of the farmer in one generation.

I guess the basic question is, who's going to pay? Who is going to pay the bill? The bill has to be paid. Just now we are talking about letting the American farmer of this generation go ahead and pay the bill and go on about his business. A result of that would be a rise in land value -- we just went through that. We just took some value out of the land so we could get back to where we could make the operation profitable again, and now we are talking about raising that value again. The other thing that will happen is that certain parts of our agricultural area that we in MFA serve and work in will become less competitive than other areas. For instance, we will spend the money trying to preserve, and meet compliance requirements, in North Missouri and central Missouri, and then try to compete with the Bootheel. We can't do it. We try to compete with central Illinois and we can't do it. Yet are we going to say that we will just go back to fescue and scrub oak? I don't think that is the answer either. I don't believe that the United States government, or rural Missouri, or the community of Columbia or anyone else can handle the results of eliminating agriculture on that scale, because of conservation.

I am not opposed to what is going on, nor am I opposed to a program that ultimately solves the problems we are talking about. What I am suggesting is that it is a long range national commitment, and it ought to be treated that way. That we ought to develop a program that lets the farmer farm the land, requires him to manage the land properly from a conservation standpoint, does not treat the hidden agenda of developing habitat for the endangered species at the expense of the farmer, but really treats the custodianship of the land in the long run! To me that is something that my generation and my son's generation and his children's generation ought to belly up and pay for to a greater and greater degree.

So what am I talking about? I think it has to do with the cheap food policy that our country adopted many years ago and continues to foster. We pay 13 percent of our disposable income for food. Every other developed nation pays 20 to 23, 24, or 25 percent. Is there anything wrong with making an investment to the tune of maybe 20

percent of our disposable income to protect the land that feeds us? I don't believe there is. I don't believe that the consumer would object to that, and I don't believe that the taxpayer would object to that. I believe it can't happen without some discipline, without some control, without some requirements placed upon the people who have the custodianship of the land. But I don't believe they would be expected to do it alone. I think the responsibility is shared. All of us must find a way to participate in it.

I think that what we see today is a rather short-sighted solution to a very long-range problem. And with regard to short-sighted solutions, I am particularly upset with the Conservation Reserve Program. About all we hear about it just now is to put more land in it. I get particularly upset when we take land that is marginal and an absentee landowner puts it in the Reserve and plants it to trees. Then, 10 years from now, we may get another drought, maybe backed up by a second or third drought, and first thing you know we will be looking for any place we can find on which to raise enough food and fiber to take care of the nation and maybe part of the world. Yet we have a program that says we are going to have to go to a slash and burn agriculture in order to get land back in production to support the needs of the nation and maybe the world.

It bothers me that sooner or later we are going to have to face feeding the world. Let's not lose track of the plan, the program, the requirements that will lead us to that point and let us do that when the time gets here. It's not here yet. I have been going to these meetings for 20 years, and I have been hearing that for 20 years, and we have not arrived there yet, but we will some day. It's inevitable; it probably will be geometric when it gets to us. That's why it's difficult to plan for.

What we are doing today, in my opinion, is not leading us in that direction. We are solving a short-range problem with a short-range solution. I think that as a national commitment it behooves all of us to be a part of that. In some way we've got to take some of the financial burden off the man who has to comply, and who will comply, and spread it over time so that at the end of a given period of time we can look at the areas that are highly erodible, that are really a problem, and say, "Look at what we have done the last 20 years in terms of preserving the resource, and how much we have improved the resource." It can be a source of national pride, not simply a burden that is placed upon the man who happens to be using the resource at the time.

AN INTERPRETIVE REVIEW

Harold F. Breimyer
Professor and Extension
Economist Emeritus
University of Missouri-Columbia

Each person attending the seminar being reviewed here, or reading the preceding pages, will have his own ideas as to the highlights. I offer my judgment, and I intersperse my summary with a few comments of my own that will be identified as such.

Professor Blanchard, in reviewing what Charles Cramer calls "the state of water in the state," begins by describing the state's geology. No one can dispute his statement that geology has a lot to do with groundwater. His paper is packed with relevant data. With regard to policy, I suggest that his most trenchant observation is that prevention is cheaper than clean-up and that it requires knowledge and planning. He is apologetic about the state of knowledge. His refrain is, "We don't know enough."

In deploring lack of adequate information about Missouri's water problems Blanchard has company. A theme that comes through loud and clear is that research inquiry into issues in water quality has been begun only recently and cannot yet provide all the information that is needed. Much, though not all, the responsibility falls on public institutions including especially the Agricultural Experiment Stations. In that regard, Roy Carriker sees two complications. One is that the field of inquiry is broad and comprehensive. It requires the expertise of toxicologists, agronomists, engineers, economists, and scholars of yet other disciplines. Secondly, a political support problem arises. Many agricultural interest groups confine themselves to narrowly defined advocacies, which often relate to production or marketing practices for individual commodities. It is difficult to generate strong political backing for a broad issue such as protection of water quality, even though almost no one denies its importance.

My first personal comment is to grant that technical knowledge is far from adequate and that more research effort is needed, but also to urge that we not sit on our hands until all, or nearly all, the deficiency is corrected. It is often necessary to forge ahead, using the best data, and wisest judgment, of which we are capable, even as we work simultaneously to improve our data base.

My old friend Allan Schmid labors valiantly to get across an understanding with which I struggle as I teach farm policy to undergraduates. It relates to the relationship between private and collective interests. He uses such terms as externalities and free ride, as do I. An instance of the free ride is the case of a farmer who takes no steps to clean up run-off water -- he is getting a free ride at the expense of those who do. In cost-sharing (ACP) programs,

says Schmid, voluntary non-participation is the exercise of a right to create problems that participation in the programs would prevent. In a summary word, Schmid tells us that where externalities, that is, a social interconnection, exists, to pitch the situation in terms of property rights versus government is a "cheap shot."

The bits and pieces of useful information presented by both Professor Carriker and Ron Kucera do not lend themselves to summarization. Carriker is prepared to offer advice to the nation's farmers. It is that they would be well advised to use good soil and water conservation practices, and not invite trouble. If they fail to do that, the present public mood is activist. Preventive or corrective steps will be taken without asking "by your leave" of farmers. In fact, a viewpoint running through the seminar papers, and in evidence among persons attending, is that the public is deadly serious about water quality issues and the farming community ought not deceive itself in that regard.

A great many of the problems in water quality originate not with Nature but with Man. It's popular just now to lay all blame to human misconduct. Ron Kucera reminds that some of the water quality problems have a natural origin. Salination is one. The radio-activity found in some places in Missouri is another.

Kucera told the seminar audience that funding for water quality work is made more difficult because Constitutional Amendment 7 to finance conservation and park activity does not extend to water problems. I offer a second personal comment. It is that appropriating by plebiscite, irrespective of how valid or popular the program, makes it more difficult to fund other programs that may be equally important to the state of Missouri. Programs to deal with water quality are an example.

Professor O'Connor confesses to farmers that where water quality is concerned, engineers are not their best friend. The water protection that engineers design is usually expensive and requires controls. His own preference is for ecological and cultural practices that avoid most contamination in the first place.

Professor Bhullar's interest in water for recreation may appeal only to those farmers who like to fish. Nevertheless, serious problems of septic tanks in communities near recreational lakes, recognized by recreation people, are viewed in an even more pressing light by a County Commissioner such as Lloyd Dilbeck of Barry county, Missouri. Mr. Dilbeck must wrestle with the septic tank issue in his jurisdiction. He also grants the mixed blessing of a new poultry processing plant, which offers employment but creates a major problem in disposing of the refuse water safely.

Professor Dennis Sievers extends the Blanchard-Kucera inventory of the Missouri situation. I like two of his other contributions. One is political, and he is joined in it by Professor Wollenhaupt. Unless farm leaders address water issues responsibly, they say, interests outside agriculture will set the policy for agriculture.

Here I throw in my third editorial comment. It is simply, "Yea, verily."

In our culture the values we subscribe to are often expressed in poetry. Allan Schmid reminds of a saying of native Americans, "We did not inherit this land from our ancestors. We are borrowing it from our children." Sievers chooses an Old Testament text: "The earth is the Lord's and the fullness thereof; the world and those who dwell therein." Then he moves to that hardest of all injunctions, "Love thy neighbor as thyself."

To all of which Dr. Gerard Neptune adds that Africans of the sub-Sahara see land as belonging to the many dead, the few who are now living, and the countless numbers still unborn.

I have already referred to Professor Wollenhaupt's comment about the farmer's role in making water policy. The many groups who join in political activism push objectives of water quality, wildlife, and human health to the forefront. Conservation as such tends to be shunted to the back. They are a formidable force, Wollenhaupt observes, and they are prepared to hold the regulatory instrument in reserve in the event education and voluntary practice payments do not prove effective.

Russell Mills offers farmers a reassuring word regarding conservation compliance. The Soil Conservation Service is prepared to be flexible and reasonable. Furthermore, most of the state's highly erodible land responds well to normal conserving practices. Except on the worst lands, the job isn't as difficult as might be supposed.

Professor Melvin Blase, reporting economic feasibility studies, both agrees and disagrees. On Missouri's highly erodible land that is not steeply sloping, reasonably attractive commodity prices will allow the recommended conservation practices to cost out acceptably. However, to bring the steepest land under tight erosion control would be expensive. It might prove uneconomic to keep the land in tillage.

Harold Clark, who is one of Missouri's outstanding farmers, is himself a conservationist and respectful toward the state's soil and water conservation problems. He also is mindful of the dilemma the individual farmer faces. The costs of carrying out conserving practices are immediate but the benefits long term.

Clark is sensitive also to farmers' practices in using herbicides and other chemicals. When some farmers fail to use a herbicide properly, the product comes into question and could be banned. He suggests that it may be necessary, in order to retain herbicides that are acceptable when used according to the label, to enforce proper use by means of regulations.

My fourth comment is just to observe that Mr. Clark's suggestion fits with Allan Schmid's statement of principles. Unwise or careless conduct by one farmer can jeopardize the interests of other farmers.

Burdette Frew's philosophical remarks could have come at the beginning of the seminar, or at the end as indeed they were placed. Policy issues are a matter of weighing and balancing long and short run considerations, he says. He believes that too much of our current soil and water policy is short run. He also notes a balancing equation between public and farmer responsibility for the burden of conservation. He believes the public should accept a considerable obligation.

At this point I offer my last two comments. First, not enough was said about the conundrum of risk. Often, the most difficult or even contentious issues in water policy relate to assessing the actual degree of risk that prevails, and likewise to judging how much risk is tolerable. I suggest that with regard, for example, to chemicals in water, citizens generally exhibit an interesting ambivalence. They will accept old, familiar risks, including those from "natural" sources. They are frightened by anything new that imposes risk. This paradigm is, I believe, a political fact of life.

Secondly, I concur with an observation made from the audience, namely, that we have not tried hard enough to find non-chemical solutions to soil and water problems. The reason is not hard to spot. Until only about 25 years ago little concern was expressed for potential risks in heavy use of chemicals in food production and processing. Research into alternative practices is of recent origin. The moral to be drawn is the same as was expressed above: more intensive research is needed badly.

Finally, I offer a note on the dinner talk given by Professor Neptune. Africa's land institutions are often a major obstacle to development in sub-Sahara Africa, he declares. A parallel with the United States today is drawn easily. The topic of the seminar reported herein is essentially one of institutions for use of land and water. They bear on both custom and law. If our water problems are to be dealt with, many customary practices will have to be modified. The design of farm programs, and the nature and place of regulation, are also intrinsically involved. Hence the timeliness of this seminar; and the gratitude on the part of the University of Missouri for the interest shown in it.