IOWATCH

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

FALL 1996

This issue of IoWatch examines how the concerns and visions of CGRER members direct us toward a healthier environmental future.

Eco-logic

On February 4, 1996, CGRER co-director Jerry Schnoor presented the Thirteenth Annual Presidential Lecture on the University of Iowa campus. This lecture series provides a public forum in which distinguished faculty members share their work with persons from other disciplines and the general public.

Jerry's talk was the first such presidential lecture to focus on the natural environment and its problems. He opened his talk, which he titled Eco-logic: An Environmental Perspective for the 21st Century, *by explaining the root cause of today's problems:*

Humans have always been in tension with their environment as they seek out a better standard of living. Land has been cleared for agriculture or commerce, and animal populations have been exploited. What is different about the situation today is the magnitude of our impacts... Five and three-quarters of a billion people on earth seek out an existence, and we are multiplying. Every six months, there is another population equal to that of France, almost 50 million people for whom to provide food, housing, shelter, and jobs. Every ten years, there is another population nearly the size of China. And coupled with population growth is the problem of an ever-increasing per capita consumption, especially among developed countries. We are powerful. Twin juggernauts: burgeoning population and per capita consumption are driving environmental change.

Jerry went on to briefly outline the evolution of approaches to environmental problems, including the history of improvements in pollution emissions (see figure 1). He included the following discussion of "industrial ecology" or "green design" (see figure 2), which he believes could be the next step toward unification of technology with the needs of our natural world:

Industrial ecology is a new paradigm in which industry is the agent of change for environmental innovation and control... It may sound like putting the fox in charge of the chicken coop, but I believe we need to try innovative approaches. Government would set the goals and monitor for environmental improvement. Industry would innovate using life cycle analysis of its products, pollution prevention programs, changes in operations, materials substitutions, and the three R's (recycle, reuse,

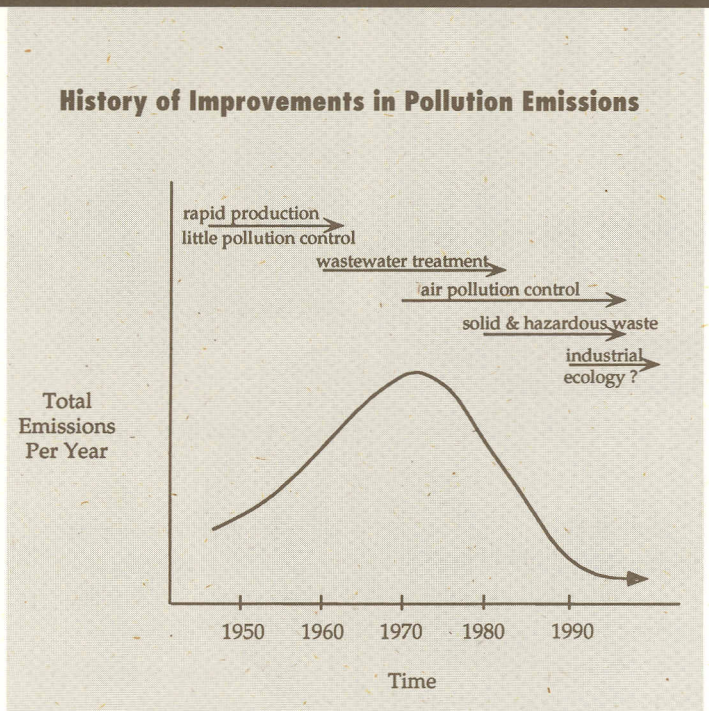


Figure 1. The manner in which our society has dealt with pollutants, the types of pollution that have captured our attention, and the quantity of pollutant emissions have changed through time.

and remanufacture) to achieve the goals. If this concept is to be effective, consumers must become involved. No longer would it be acceptable to simply throw away our old Nike tennis shoes (regardless how they smell)... They would be shipped back to the manufacturer for incorporation into new tennis shoes (remanufacturing) or, less advantageously, into asphalt roads (down-cycling)... In the College of Engineering, we are charged with teaching this new paradigm to our students so that they will become competitive in the world market... The environment is big business. Two percent of our gross national product (approximately $157 billion per year) is spent on environmental controls. Learning how to make products in a cost-effective, environmentally friendly manner will define successful companies in the world marketplace of the future.

Later in the presentation, Jerry described some of the other projects on which he and his graduate students have worked:

One of our students, Richard Ney, and I recently completed a report on emission of greenhouse gases in Iowa. Because of Iowa's sparse population density, continental climate, and high-input agriculture, we are 15th worse among the 50 states in greenhouse gas emissions per capita. Each Iowan emits, on the average, 29 tons of carbon dioxide per year to the atmosphere. Every time we fill up our car with gas (10 gallons), 190 pounds of CO_2 is released upon combustion! On a per capita daily average, we generate 5 lbs of garbage, 5-10 lbs of hazardous waste, 160 lbs of carbon dioxide; and we dispose to the sewer 150 gallons of water (more if you have teenagers). Each person in Iowa generates more than their weight in waste each day! There is plenty of room for improvement. Louis Licht was a student of mine in the mid-1980s, who had a simple idea. He wanted to plant trees. I tried to dissuade him, it wasn't "academic" enough, but he was persuasive, and I acquiesced. At first, we planted trees for agricultural runoff control at Amana, Iowa. Then, we estimated the huge amount of carbon dioxide that fast-growing hybrid poplar trees could remove from the atmosphere and sequester in woody tissue, and we planted more trees for carbon dioxide sequestration. Most recently, we have been planting trees at hazardous waste sites because, it turns out, they are capable of metabolizing a wide variety of toxic organic pollutants. In total, we have planted more than 200,000 trees in six states and three countries.

Much of Jerry's presentation detailed the environmental problems we are facing today. He progressed to outlining the relationship between environmental health and economic development, and then completed his Presidential Lecture with his vision for the future:

Untold future generations have the right to enjoy a high quality of life, as we in the developed world have. This concept embodies the "Sustainable Development" movement which dominates environmental political discussions today... We should not foreclose on our children's future by preemptive utilization of resources that they will need. While conceptually powerful, this is a difficult concept to implement because we do not know exactly how our actions today will affect future generations... Quite anthropocentric, it encompasses the desire for ecological preservation only through the needs of future human generations...

I might go further in defining the needs of future generations. In my kind of "Eco-logic," the following questions would be relevant to any action taken by individuals, government, or industry:

- Is it irreversible?
- Is it persistent? Over what time scale?
- How uncertain are the consequences?
- Is it socially just?

If the action is irreversible, we simply should not do it. Examples include species extinctions, soil erosion, and the clear-cutting of tropical forests (where soil runs off after trees have been cleared). We must make it our highest priority to avoid short term gains which preclude future generations from having access to needed resources.

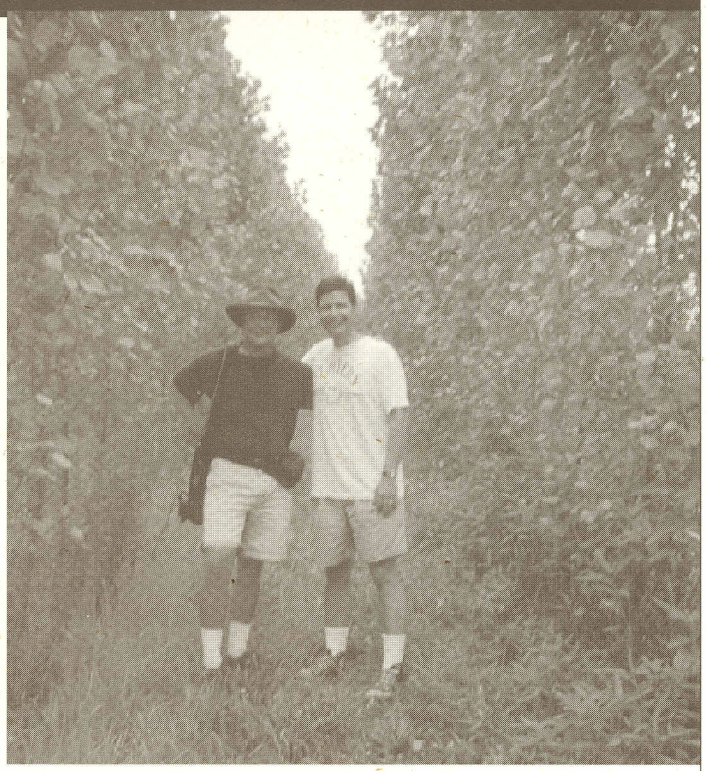
Is it persistent and over what time scale? How many generations will be affected and at what cost? Adam Smith's invisible hand is not so good at incorporating externalities into the cost of goods that pollute the air, water, and soil over long time periods. Examples of persistent chemicals that probably should not have been used include pesticides like DDT, dieldrin, and chlordane, and industrial chemicals such as polychlorinated biphenyls (PCBs) and CFCs...

How uncertain are we about the consequences of a particular action? You see, the problem is that our decisions today impact the next 20 generations, 200 billion unborn people... They have no vote on our referendums and no voice in our deliberations. It is a concern of generational equity. Because of that, we must act with the utmost caution in cases where scientific uncertainty is great and the consequences of the action are large...

Is it socially just?... In the United States, we emit 20-25% of the world's pollution for 5% of its people. Among western countries, it is neither socially just nor politically stable for 20% of the world's population to use 80% of its resources. It is in our own best interests to help developing nations... They are the market for our products in the future, and they will provide us with much-needed nonrenewable resources through trade.

We are in a global race, a race to educate faster than eradicate, a race to improve institutions and the human condition faster than population growth and consumption tear them down. We should view our environmental predicament in its historical context, we should seek solutions rather than blame, and we should seek to understand before expecting to be understood.

Pressure on the planet will increase. We can expect that we will lose more land and more species, but I think that



A decade ago, Louis Licht, a College of Engineering graduate student, and Jerry Schnoor commenced research that has shown how tree plantings control agricultural runoff, remove greenhouse gases from the atmosphere, and metabolize toxic organic pollutants.

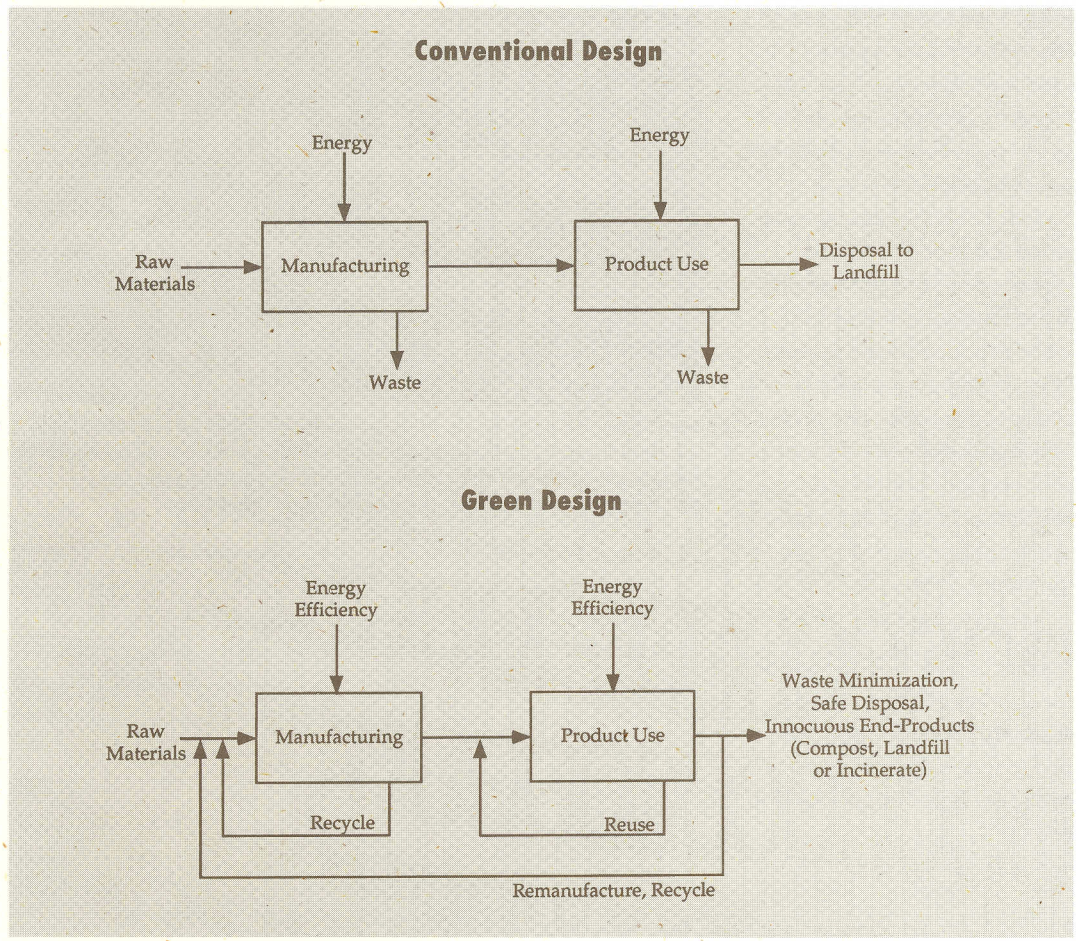


Figure 2. Industrial ecology, in which "green design" sequences replace those of conventional design, is now being taught to College of Engineering students to assure their success in the future world marketplace.

Did You Know:

The following quotes were excerpted from Jerry Schnoor's Eco-logic talk.

Last December, representatives from 120 nations and the Intergovernmental Panel on Climate Change agreed for the first time that while many uncertainties remain, "the balance of evidence... suggests a discernible human influence in global climate."

As humans become ever more numerous and consumptive, our emissions and pollution begin to rival the natural processes of nature's cycles. At first this occurs locally, then at regional scales, and finally globally.

Globally, the clearing of land for agriculture and commerce amounts to ~50,000 mi² per year or roughly the area of the State of Iowa.

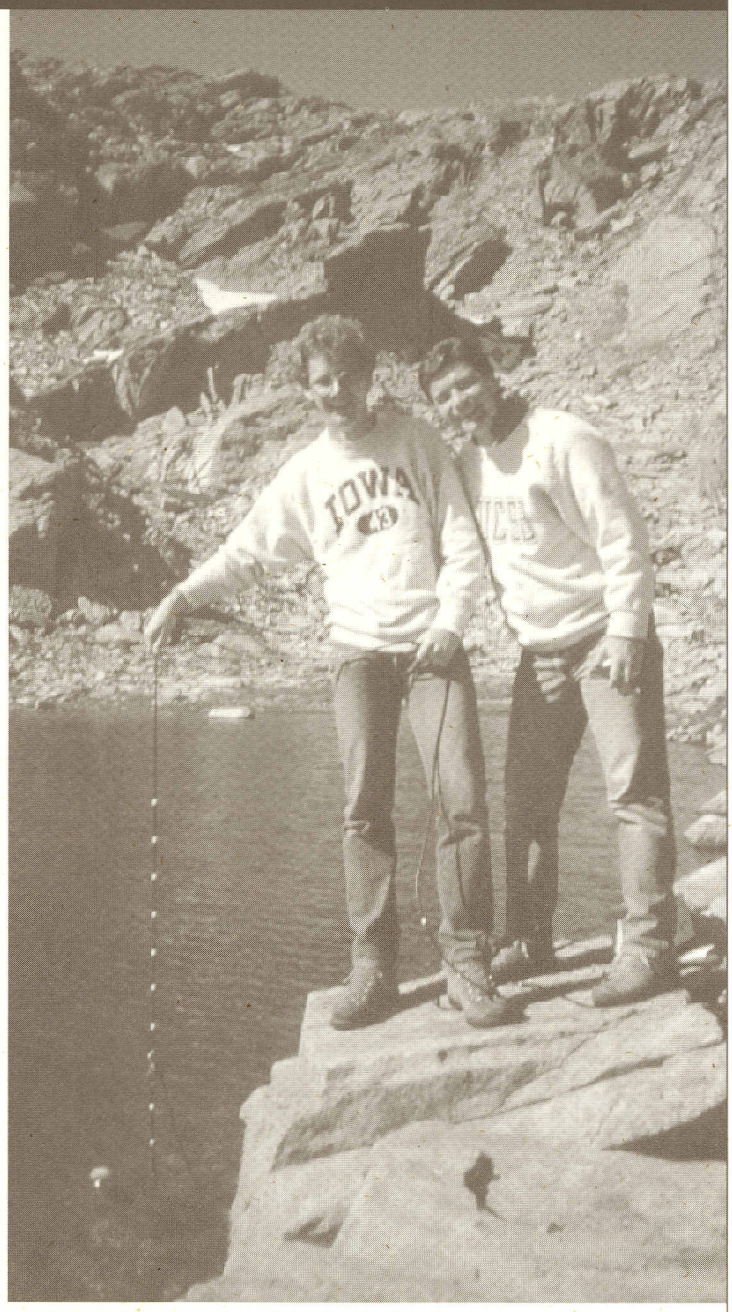
[The disparity in resource use among nations] really hit home for me when one gentleman from a developing country asked me, "Professor Schnoor, how many children do you have?" And I said quite proudly that I had only two. "Well, that would be equivalent to 18 children in resource equivalents for my country," he replied good-naturedly.

This much is clear: Western countries must decrease their consumption patterns, and developing countries must limit their population growth if we are to limit pollution and enhance the quality of life.

we can and must slow the process... If we want developing countries to limit their emissions, to preserve their biodiversity, and to protect their tropical forests so that we (the developed world) may continue to enjoy a high standard of living, then we will have to pay for it in some way. We can gain credibility by helping other countries with technology transfer, development, and by controlling our own consumption patterns... Environment and development must go hand in hand...

I have the best job in the world. I am most grateful to the University of Iowa for all its support during the past 20 years. I have been blessed with creative, hard-working students and wonderful colleagues who pursue these ideas with me. What can we do to assure a successful 21st century? Most of all we can educate. Teaching is a noble profession and, after all, it is teachers who will play a very large role in developing a society with wisdom and opportunity. In the words of Baba Dioum, a noted Central-African conservationist, "For in the end we will conserve only what we love. We will love only what we understand. And we will understand only what we are taught."

These excerpts from Jerry Schnoor's lecture have been edited for inclusion in this newsletter. A complete unedited copy of the lecture is available on request from Jane Frank at the CGRER office.



Jerry Schnoor and Julius Pohlenz, an undergraduate, sample the pH of a Swiss alpine lake. Reducing acid rain pollution (and thus controlling its acidification of natural lakes) would be one signature of a responsible, sustainable development policy that acknowledges the rights and guards the health of future generations.

What's Up at CGRER?

Teaching graduate students the art of creating computer models that track atmospheric chemical processes is nothing new; Professor Greg Carmichael has been introducing these concepts for the past three or four years in a course developed under NASA's Earth System Science Education Program. However this past spring CGRER sponsored a class named Atmospheric Chemistry and Transport, which was offered through the Departments of Chemical and Biochemical Engineering and Civil and Environmental Engineering, that dispensed a more intensive dose of such modeling techniques than has previously been offered either here or at any similar institution throughout the country. What's more, the class itself was taught using innovative technologies that linked two professors to about 15 students split between two widely separated institutions — the University of Iowa and Iowa State. The class was taught by Chip Levy, a visiting professor from Princeton's Atmospheric and Oceanic Sciences Program, and coordinated by Bill Gutowski, a professor in the Department of Geological and Atmospheric Sciences at Iowa State.

Weekly lectures covering the fundamentals of atmospheric chemistry and physics reached students at both institutions simultaneously via the Iowa Cable Network, through which students over a hundred miles from the lecturer could instantaneously witness and question the professor via television links. Each week students also had to complete a hands-on modeling session in the computer laboratory, taking one of a series of steps which, when assembled into a whole, constructed a realistic model of atmospheric chemistry processes.

The class was demanding and difficult for students, heavily emphasizing learning through doing. And that meant that the professors needed to remain accessible to guide students. This was accomplished through the Internet using e-mail and a class Web page as well as a computer technology called "CU-SeeMe," through which participants at ISU and the U of I could instantly see and query one another, working together on problems as if they were at the same desk. Through these technologies, a live link was established between the two campuses, and students at Iowa State were offered a class that they never would have had without these links, since ISU does not currently maintain an atmospheric chemistry faculty. While live bodies remain the optimal teachers, especially when teaching more complex or graduate studies, these technologies have the potential of expanding the university curriculum without increasing the size of the faculty at those institutions. The success of this particular effort was demonstrated by the students' accomplishments: each one managed to complete the demanding task of developing from scratch his or her own computer model which was then applied, using actual data, to examine a specific environmental problem.

This past summer CGRER bade farewell to Prashanti Srinivasan, who for the previous year had worked as a CGRER research assistant investigating the relationships between Iowa's farming practices and emissions of gases from the soil. Soil naturally emits gases such as NO, N_2O, and CO_2, which can cause global warming and in turn alter the atmospheric regime. In agricultural areas, these gas emissions are related to farming practices such as the addition of fertilizers and manure, how and when the soil is tilled, and the rotation of crops. Prashanti worked with computer models that related specific Iowa farming practices to the quantity and type of gases emitted, in hopes that these models might eventually lead to soil management practices that would decrease agricultural greenhouse gas emissions. The models also factor crop yield and the effects of climate change into the gas emission relationships. Prashanti is now at Stanford University, but her research is being continued by Greg Carmichael and his students, who are planning to conduct a statewide comprehensive study of agricultural methods and their relationship to the emission of greenhouse gases.

Faculty Focus

All CGRER members work daily with reshaping the future. In one way or another, through their teaching and research, they assess current trends and then consider how to forge an alternative reality. They may do this by struggling to develop computer programs that are accurately predictive. They may illuminate future changes by examining past environments. Perhaps they outline techniques to deal with expected problems, or design measures which if applied now would decrease the magnitude of those problems. This Faculty Focus looks at the work of three CGRER members concerned specifically with governmental policies that will shape the future of Iowa's environment.

David Forkenbrock is interested in policy issues affecting the state's future development. He is the director of the University of Iowa's Public Policy Center, which examines issues in transportation, health care, and human interactions with technological systems. Dave focuses on transportation. His book, *Transportation and Iowa's Economic Future* (co-authored with Norman Foster at the University of Iowa and Michael Crum of Iowa State), examines policy options to improve the state's environmental and economic future. Working with over 40 Iowa leaders in business and government, Dave and his colleagues made a series of policy recommendations that have been influential in Iowa and other states. One such recommendation is that Iowa build fewer four-lane highways, and instead upgrade two-lane highways to "super-two" levels (wider shoulders, passing lanes on hills, turning lanes, and occasional bypasses of communities). A governor's blue ribbon panel is currently studying this proposal. A second recommendation is that Iowa oppose proposals to double the current 600-foot length of Mississippi River locks. Users of inland waterways do not pay the full cost of this use; if they did, demand for lock passages would be somewhat lower. Several environmental groups including the Sierra Club and the Izaac Walton League have strongly endorsed this recommendation. Dave and his colleagues at the Public Policy Center are now at work on another study that will derive estimates of air pollution and accident costs created by large freight trucks and freight trains. The study team is recommending that these costs be borne by those generating them. Relatively little work has been devoted to measuring these external costs; the study will be useful to federal and state agencies as they determine the magnitude of user charges in the future.

Peter Thorne is lending his expertise as a toxicologist to help reduce industrial air pollutants. As a consultant to the Department of Natural Resources' Air Modeling Task Force, he is helping to revamp the state's industrial emissions permit system. The present permit system does not promote the improvement of emissions systems, even when such modernization may reduce release of airborne toxic substances. Peter is helping DNR and company officials prepare a consensus report that revises the costly and technically-demanding repermit system. The new repermiting system will provide clear guidelines and proper incentives for modernizing air emissions systems, in this way reducing total pollutant emission and improving air quality.

The Public Policy Center and CGRER are co-sponsors of yet another policy-setting document, the *Iowa Greenhouse Gas Action Plan*, which was prepared for the Iowa Department of Natural Resources and published in draft form in June. Written by CGRER affiliates **Dave Forkenbrock** and **Jerry Schnoor** along with Richard Ney and Norman Foster, this document proposes a set of actions for reducing Iowa's greenhouse gas emissions to 1990 levels by the year 2000. This is the target stated for the nation in Clinton and Gore's 1993 Climate Change Action Plan and also the major goal of the United Nations Climate Convention, which was signed by the United States in 1992 and then ratified by our Senate. This plan would slow (but not stop) the greenhouse gas trend which is predicted to make the Midwest hotter and drier within the next half-century. Some of the 17 specific recommendations include large-scale forestation efforts; management of hog manure and the methane it releases when anaerobically decomposing; decreasing vehicle emissions through discouraging single occupancy trips; industrial self-reporting of large-scale carbon dioxide emissions to the public; and a variety of governmental incentives such as the Iowa Energy Bank Program, Motor Challenge, and Rebuild Iowa model communities. The revised *Action Plan* will be published this fall; our state government then will consider which of the recommended actions to adopt and implement. Persons interested in receiving a copy of the final report should contact Jane Frank at the CGRER office.

What one action or policy would most improve Iowa's environmental future? That's what CGRER members were asked this summer. They responded with surprising similarity, addressing issues primarily of governmental policy and land management.

Several members were concerned about hog feedlots. "I would either outlaw or more closely regulate large agribusiness hog lots," wrote **Dick Baker**, pointing out the threats they pose to groundwater as well as their odor problems. Family-owned operations are more likely to be concerned about these problems, he stated. **Gene Parkin** agreed. "Since their pollution load is approximately that of 3 to 5 people, a 10,000-head hog facility produces the waste equivalent of a city of 30-50,000. Shouldn't they be held to the same pollution-treatment requirements as such a city?"

Some CGRER members responded more generally. **Peter Thorne** believes soil conservation and land use management to be paramount, as they affect air and water quality, wildlife habitat, and future agricultural potential, and also increase the use of agricultural chemicals and associated problems. **Paul Greenough** wanted to see public schools shift attention from distant environmental issues (such as tropical rainforests) to Iowa's environmental problems — for example unregulated hog lot expansion, mindless defense of land conversion to industrial use, and uncoordinated growth of housing in rural areas, "something that is happening right now in Johnson County."

Ted Smith hoped to see energy efficiency increased for all human activities — from transportation and agriculture to food processing and entertainment. **Burt Kross** stressed the establishment of numeric groundwater protection standards equivalent to current safe drinking water standards."In addition, action levels (25% of the standard) should be established which mandate specific preventive or corrective activities whenever the groundwater begins to deteriorate."

A number of responders specifically mentioned the planting of trees."Extend the

Seeds

policy of planting trees along stream channels to connect riparian ecosystems, create filters between other land uses and the streams, and reduce bank erosion," wrote **George Malanson**. **Ed Folk** said nearly the same thing, recommending a planting of at least a half million quick-growing aspens. **Richard Valentine** recommended a more general reforestation plan for the state.

Diana Horton expressed the concern about our woodlands but from a different viewpoint: stop selective logging of commercially valuable timbers on public lands, at least until we know what we are disturbing and losing. Land use should be adjusted accordingly. "There may be state-endangered and threatened species... A systematic inventory of plants on all public lands will allow baseline criteria to be established for assessing quality and documenting occurrence of rare species," she wrote. And **Steve Spangler** advocated the present taxing policy which promotes establishment of native vegetation (prairies as well as woodlands) on land withdrawn from agriculture. (Editor's note: Most Iowans know that presettlement Iowa constituted the heart of the tallgrass prairie, which swept like an ocean of flowers and grasses across 85% of the state. But many are surprised to learn that growing research has shown many of our original "forests" were actually savannas, regions of widely-spaced white and bur oaks with a distinctive understory of tall grasses and forbs. Just like the original prairies, these savannas were kept open by frequent fire, which also reduced woody understory. Original settlers could drive a wagon with ease through the vast majority of Iowa's original woodlands.)

In closing, for those of us who think the summer sped by too quickly and are already looking forward to future vacations, **Richard Valentine** sent in the following suggestion: "Improve Iowa's environmental future? This is a hard one? Well, anything we could do to improve the surfing would really help. Also, skiing." Step aside California, Iowa's moving west!

The University of Iowa's Center for Global and Regional Environmental Research (CGRER) promotes interdisciplinary efforts that focus on the multiple aspects of global environmental change, including its regional effects on natural ecosystems, environments, and resources, and on human health, culture, and social systems. Center membership is composed of interested faculty members at any of Iowa's colleges and universities.

Center goals are promoted by encouraging interdisciplinary research and dialogue among individuals whose disciplines touch upon any of the multifaceted aspects of global change. More specifically, the Center awards seed grants, fosters interdisciplinary courses, provides state-of-the-art research facilities and equipment, and holds seminars and symposia. The Center encourages students to broaden their studies and research through considering the multi-disciplinary aspects of global and regional environmental problems. Through such activities, the Center attempts to assist Iowa's agencies, industries, and citizens as they prepare for accelerated environmental change that may accompany modern technologies.

Housed in the Iowa Advanced Technology Laboratory at The University of Iowa, the Center was established by the State Board of Regents in 1990 and received funding from a public utility trust fund, as mandated by the State of Iowa's Energy Efficiency Act.

IOWATCH is published biannually for researchers, employees of state agencies and public utilities, members of citizen action groups, and other Midwesterners interested in environmental change and the actions of the Center. Newsletter articles may be reprinted with proper citation. Comments, questions, and requests for additional copies are welcomed; please contact:

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