

The background of the cover is a map of Michigan, where the landmass is composed of interlocking puzzle pieces. The map uses a color gradient from green to red to represent topography. A hand is shown in the lower right corner, placing a puzzle piece into the map. The word "futures" is written in a large, white, lowercase sans-serif font across the top of the map.

futures

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AGRICULTURAL
EXPERIMENT
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ENVIRONMENTAL
STEWARDSHIP
AND
NATURAL RESOURCES
POLICY AND MANAGEMENT:

*Sorting out the Pieces
for Michigan*

Environmental Stewardship and Natural Resources Policy and Management

Michigan has more than 36 million acres of land with more than 10,000 inland lakes and 36,000 miles of streams. No place in Michigan is more than 85 miles from one of the Great Lakes. Thirty-six million acres sounds like a lot of land, and perhaps to someone conditioned to the pressed-in feeling of New York City or Chicago or Boston, it is a huge space, but consider that this land and water are ultimately the final sources of our sustenance. Then their finiteness is startling. Our land and water support the plants and animals that provide our shelter, food and fiber. They provide us with minerals and other inorganic materials. They are the final repository for all our waste. For many years we behaved as if our land and water supplies were limitless. Today we know that they are not, and we also know that our actions may affect our neighbors and our children — compromises and trade-offs must be made.

Environmental stewardship and natural resources policy and management is one of five target areas driving the MAES research agenda over the next decade. It is a broad area, encompassing land use, air quality, soil conservation, waste management, landscape ecology, ecosystem management and water research. In this issue of *Futures*, we highlight just a small fraction of the MAES research being done in these areas. This is the largest issue ever published, so imagine how much we didn't have room for.

According to the head of MSU's Land Policy Program, Soji Adelaja, everything that people care about — quality of life, income levels, obesity, school funding, the environment, zoning — is related to land use. State leaders have recognized how important land use is to Michigan — in 2003, Gov. Granholm created the Michigan Land Use Leadership Council to study and identify trends, causes and consequences of urban sprawl, and to provide recommendations to the governor and the legislature to minimize the negative effects of current land use patterns on Michigan's environment and economy. The council issued a final report with 150 recommendations on how to deal with the long-term consequences of unmanaged growth. MAES scientists are assisting the effort by providing the necessary research to ensure that new policies are science-based.

The Great Lakes provide a moderating influence on Michigan's climate, allowing the state to produce more than 125 crops. Michigan is second only to California in agricultural diversity. Research by MAES scientists has shown that Michigan's climate has been following a global trend toward warming. Other MAES scientists are studying how this warming trend will affect agricultural crops, weeds, insects and diseases.

One component of global warming, greenhouse gases — carbon dioxide, methane and nitrous oxide are the main ones — are the focus of much discussion and research. To reduce the amount of carbon dioxide in the atmosphere, MAES researchers from a range of disciplines are studying how agriculture can hold carbon in the soil, as well as how world carbon markets may benefit Michigan farmers.

MAES scientist Jack Liu is a non-traditional ecologist. For almost 20 years, he has studied the interactions between human needs, wildlife requirements and policies — specifically, how humans affect natural systems, how changes to natural systems affect humans, and how various policies interact with one another and affect both humans and natural systems. By adding people into the traditional ecology equation, Liu hopes to help governments develop better environmental policies that actually do what the creators intend.

A popular term in the 1970s, acid rain is a phenomenon as old as the industrial revolution. It's still an issue today, though now it's commonly called atmospheric deposition. MAES forestry researcher Rich Kobe oversees MSU's participation in the National Atmospheric Deposition Program, a nationwide effort to monitor the chemical makeup of precipitation. He also studies how the acids in precipitation affect our forests.

Finally, we want to wish Michigan State University a happy birthday. In 2005 MSU celebrates its 150th anniversary. MSU is the pioneer land-grant institution, and its history is closely tied to the history of agriculture, natural resources and rural communities in the state. The MAES was founded on Feb. 26, 1888 — 33 years after MSU was founded — and the MAES has played a significant role in shaping MSU's research legacy and its priorities for the future. Each issue of *Futures* in 2005 will feature a special sesquicentennial article highlighting the intersection of MAES and MSU history.

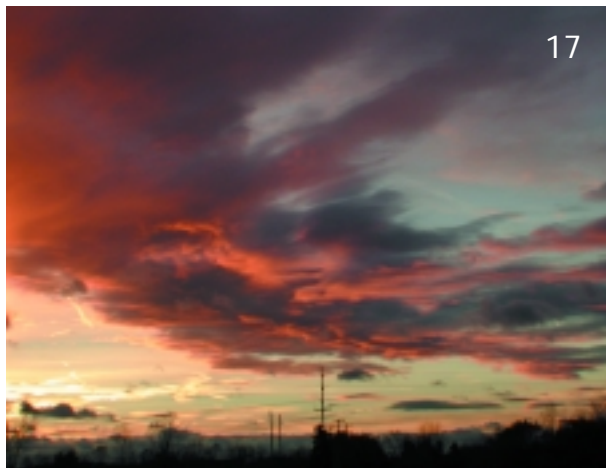
We hope you enjoy this issue of *Futures* and that it helps you understand more about the MAES and the research it funds. If you have comments or questions or would like to subscribe to *Futures* (it's free!), send correspondence to *Futures* Editor, 109 Agriculture Hall, Michigan State University, East Lansing, MI 48824-1039, or send an e-mail to depolo@msu.edu.

For the most current information about the MAES, I invite you to subscribe to the free MAES e-mail newsletter. Sign up by visiting the MAES Web site at www.maes.msu.edu/news.htm. Scroll to the bottom of the page and complete the subscription form.

∴ Jamie DePolo

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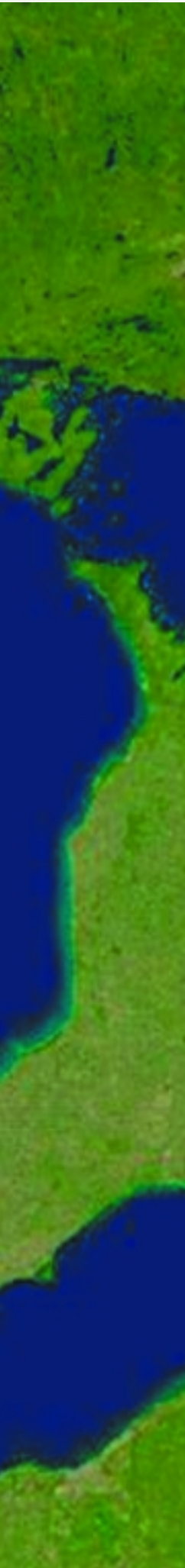


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*My Land,
Your Land,
Our Land*



*Treat the Earth well: it was not given
to you by your parents, it was loaned
to you by your children.*

— NATIVE AMERICAN PROVERB

MAES scientists provide
research and education
to help decision-makers
develop the best
land use policies for
Michigan

Michigan has more than 36 million acres of land nestled among four of the five Great Lakes. No place in the state is more than 85 miles from one of these amazing bodies of water. The state's 10 million residents have access to more than 11,000 inland lakes and 36,000 miles of streams. Michigan's land supports the plants and animals that provide our shelter, food and fiber. It provides us with minerals and fuels our industries and our businesses — our livelihoods.

Though 36 million acres seems incredibly vast, policy-makers, environmentalists and developers are dealing with the finiteness of the state's space. In 1994, urban and built-up lands covered approximately 5.5 percent of the state, according to statistics from the Soil Conservation Service. In 2004, developed and built lands had increased to 9 percent of the state — almost doubling in 10 years. The 2001 Michigan Land Resource Project study projected that if current land use patterns continue, by 2040 — a generation from now — Michigan's built or developed land would account for 17 percent of the state. The same study projected that agricultural land would drop to 9 million acres, a 17 percent decrease. At this rate, it wouldn't take Michigan long to catch up to New Jersey, the country's most built state, which has developed 26 percent of its land.

"Everything we care about — quality of life, income levels, obesity, school funding, the environment, zoning — are all related to land use," said Adesoji "Soji" Adelaja, John A. Hannah Distinguished Professor in Land Use Policy and head of MSU's Land Policy Program. Though Adelaja is not an MAES faculty member, the MAES helps fund the Land Policy Program.

A nationally renowned scholar, Adelaja focus-

es his research on land use, agricultural policy in urban interface areas, and economic development of and emerging issues in the food industry. He came to MSU in January 2004 from Rutgers University in New Jersey, where he served as executive dean of agriculture and natural resources, dean of Cook College, executive director of the New Jersey Agricultural Experiment Station and director of Rutgers Cooperative Extension.



Soji Adelaja, Hannah Distinguished Professor in Land Use Policy, says that everything Michigan residents care about — quality of life, income levels, obesity, school funding, the environment, zoning — is related to land use.

The MSU Land Policy Program was created soon after Adelaja arrived in East Lansing. Its mission is to provide effective, science-based solutions and educational/outreach programs to support various state, national and international stakeholders in land use.

“States are beginning to realize how important land use planning is,” Adelaja explained. “In New Jersey, we saw businesses fleeing the state because the cost of doing business was increasing. There was no master plan. While today’s land use decisions shape the future of our communities, these decisions are often made at the local level, in uncoordinated fashions, and without broader state and national objectives in mind. Michigan is the next state to take land use seriously. The governor has linked the state’s future to land use.”

In February 2003, Gov. Jennifer Granholm created the bipartisan Michigan Land Use Leadership Council through executive order. The 26-member council, co-chaired by former Gov. William Milliken and former Attorney General Frank Kelley, was directed to study and identify trends, causes and consequences of urban sprawl, and to provide recommendations to the governor and the legislature to minimize the negative effects of current and projected land use patterns on Michigan’s environment and economy.

Tom Dietz, director of the Environmental Science and Policy Program at MSU, served as a resource team member to the council as it worked. Like Adelaja, Dietz is not an MAES faculty member, but the MAES helps fund the Environmental Science and Policy Program. Dietz currently chairs the U.S. National Research Council Committee on the Human Dimensions of Global Change and the Panel on Public Participation in Environmental Assessment and Decision Making. He also serves as secretary of Section K (Social, Economic and Political Sciences) of the American Association for the Advancement of Science (AAAS). His research looks at the human forces that drive environmental change, environmental values, and the interplay between science and democracy in environmental issues.

“One cause of environmental conflict is that people differ in their values and will be affected differently by the courses of action we might take to deal with environmental problems,” Dietz said. “Environmental policies produce winners and losers. In that regard, conflicts about environmental problems are like other disputes. But environmental problems also have some features that make them particularly contentious.”

Dietz said these features include mixing facts and values when talking about the problem; the facts associated with the problem may be uncertain; no matter which solution to the problem is chosen, the change that happens is permanent; and the solution chosen causes harm to groups considered innocent.

“Disputes over environmental policy won’t disappear, but an understanding of some of the hidden sources of conflict can lead to less heat and more light in environmental disputes and, ultimately, to better decisions,” he said.

In August 2003, the Land Use Leadership Council released a final report of land use trends and recommendations to improve land use planning and coordination in Michigan. The report outlines more than 150 recommendations to deal with the long-term consequences of unplanned, unmanaged growth for both the environment and the economy of Michigan.

One recommendation, that the state locate its new facilities and buildings in urban areas when at all possible, was implemented immediately by an executive directive from the governor.

“Locating state facilities in communities where infrastructure already exists is a win-win situation,” Granholm said. “If we reuse or rehab an existing building, we will save the taxpayers millions of dollars. It is a win for the community because it gives new purpose to an old building or former brownfield site, and it brings workers into the community on a daily basis.”

Web Site Details Environmental Expertise at MSU



Tom Dietz

It's no coincidence that Tom Dietz unveiled a searchable database of environmental experts at MSU just in time for the annual conference of the Society of Environmental Journalists (SEJ) in October 2004. Dietz, director of the Environmental Science & Policy Program (ESPP), wants to get the word about MSU's world-class

environmental research out to everyone from teachers to local and state government officials to the world's largest association of environmental journalists.

"For 30 years MSU has been an unheralded powerhouse in environmental research," said Dietz, whose work is supported in part by the MAES. "When it comes to the environment, I want to get MSU as well known nationally and internationally as it's known in Michigan."

ESPP's new database is freely accessible via the Web (www.environment.msu.edu/expertise/search.php) to anyone looking for environmental expertise. A high school teacher searching for insect information might click his way to MAES entomologist Doug Landis. A local or state government official with a question on agricultural production economics might find MAES agricultural economist Scott Swinton in the database. A journalist might search for greenhouse gas and come up with MAES crop and soil sciences researcher Phil Robertson.

In all, more than 130 MSU faculty members, many funded by the MAES, are listed in the database. Researchers are organized by the same keywords that SEJ has long used on its Web site, so the new MSU tool should be easy for SEJ members to use. Indeed, anyone who's looked for information online using a search engine or directory should have no problem with the interface, Dietz said.

ESPP is more than a searchable database — it's an attempt to foster collaboration across MSU departments in order to address complex environmental problems.

Dietz's approach to complexity is different from that of the traditional powerhouse environmental programs in the United States — the Yale School of Forestry and Environmental Studies, the Nicholas School of the Environment and Earth Sciences at Duke University

and the Environmental Studies program at the University of California at Santa Barbara.

"If we wanted to emulate them, we'd need to go after a big endowment, build a building and hire 30 new faculty members," Dietz said. "But why do we need to do what they're doing? Our advantage is in our flexibility and our ability to cooperate and coordinate."

Dietz works to focus the efforts of groups of faculty members from existing departments on timely problems. Well-established issues such as toxics in the environment remain important research topics, but today's emerging questions about climate change and water resources are paramount as well. Dietz hopes his decentralized approach will make it easy to respond quickly to these emerging threats.

Joan Rose, an MAES-affiliated scientist who holds the Homer Nowlin Chair in Water Research, illustrates the benefits of this flexibility. When concerns were raised recently about antibiotics, fecal pollution and viruses in Michigan's water resources, the ESPP facilitated collaborations between Rose and other MSU faculty members to study the potential health threats to humans, animals, agriculture and ecosystems.

The collaboration is already producing results. Rose is chronicling instances of fecal pollution and parasites in waters throughout Michigan, including the Great Lakes, and identifying antibiotic-resistant bacteria in soils. Addressing the problem didn't mean creating a new department or hiring a new person, Dietz said. Instead, supporting and linking the work of existing MSU experts proved effective. (Rose's work is featured in the spring 2004 issue of *Futures*.)

MSU's environmental expertise runs deep and extends far beyond traditional sciences, even to departments such as journalism. For example, Jim Detjen holds the Knight Chair in Journalism, the nation's only endowed chair in environmental journalism.

Detjen, a three-time Pulitzer Prize finalist, also is intimately familiar with the SEJ — he was one of the founders of the organization in 1990 while working as a reporter for *The Philadelphia Inquirer* and is still an *ex officio* board member. Today SEJ has 1,500 working journalists in 32 countries as members.

As of October 2004, these journalists have 130 new sources of environmental expertise at MSU.

∴ Geoff Koch

Other recommendations include:

- Directing the Michigan Department of Transportation (MDOT) to look for context-sensitive solutions to all aspects of transportation design and implementation to ensure that roads, bridges and other transportation entities fit well within their surroundings.
- Recognizing and expanding live-where-you-work programs.
- Directing the Department of Environmental Quality (DEQ) to begin an internal review process to evaluate programs it conducts for potential impacts on sprawl, and directing MDOT to continue its “preserve first” transportation strategy.
- Streamlining and simplifying the process for both state and local governments by transferring the authority for handling tax-reverted properties from the Department of Natural Resources (DNR) to the Department of Treasury.
- Directing the DEQ to design a Web-based, one-stop information shop for grant and loan programs targeted at preservation efforts.

■ MSU’s Role

After the Land Use Leadership Council’s final report was released, Adelaja worked with the steering committee of the Kellogg Land Policy Grant to organize a faculty meeting in October 2003 and a faculty/stakeholder retreat in December 2003 to develop program areas and specific projects in high priority areas in the report that would help state residents and decision makers create land use policies.

“MSU definitely has a role to play in shaping land use policy,” Adelaja said. “Land-related policy decisions are complex, and sound choices require a wealth of information. We can do the research that is used to create science-based policies. We’re unique in the breadth of expertise we can bring to bear on problems. We are also unique because we can help to address land use from so many angles — viable agriculture, urban revitalization, healthy communities, natural resources and water quality, education.”

Adelaja sees the Land Policy Program as a one-stop warehouse full of information for various stakeholders interested in land use. Since coming to East Lansing, he has regularly traveled across the state, establishing contact with local officials, regional planning agencies, representatives of land-based industries, state policy makers and other Land Policy Program stakeholders.

“We have about 500 MSU faculty members [many of them affiliated with the MAES] and MSU Extension agents who are involved in the Land Policy Program,” he explained. “One of our goals is to help faculty members come together to form interdisciplinary teams to do research and education around our 10 theme areas. Our staff members support faculty members and help reduce the costs associated with collaboration.

We also help faculty teams identify funding opportunities, develop project strategies and pull together grant proposals for external funding. The Land Policy Program also offers seed grants to get research going in our theme areas.”

Based on the Land Use Leadership Council’s report, the Land Policy Program’s 10 theme areas are:

- **Revitalizing Michigan cities** — With 75 percent of Michigan’s population residing in or near urban areas, quality of life for the majority of the state depends on the health and vitality of cities. This area’s goal is to provide information, technical analysis and research to citizens, policy-makers, developers and state agencies that support Michigan’s urban revitalization efforts.
- **Market solutions to land use problems** — One of the obstacles to adopting smart growth (development that enhances the economy, the community, and the environment) strategies is the lack of market options that allow developers, farmers, landowners and others to make money while following sustainability principles. Research and outreach in this area focuses on developing and communicating ways of sustainably developing Michigan’s land resources from a market perspective.
- **Maintaining viable agriculture for the future** — For agriculture to prosper and be sustainable in the future, long-term viability and advancements in agriculture, along with the communities in which it exists, must go hand-in-hand with preservation efforts. Research and outreach, including information and technical analysis, focus on finding ways to preserve agricultural farmland and create viable agricultural policies and institutions for both large and small farms.
- **Sustaining Michigan’s water, natural resources and related industries** — Michigan is blessed with bountiful natural resources, which are being threatened by current development patterns. The goal of this area is protection and sustainable development of Michigan’s natural resources. This requires balancing the needs of current stakeholders with one another as well as with the needs of future generations. Research and outreach cover a range of issues — including the ecological, water quality, habitat and ecosystem implications of land use, and enhancing the performance of land-based industries (forestry, mining, agriculture and tourism) — to help state and local decision makers better plan for the future use of Michigan’s natural resources.
- **Enhanced planning and coordination in land use decision making** — More than 1,800 government entities are responsible for land use planning in Michigan. Local planning acts have been amended, and communities now are required to notify nearby governing bodies when changes are being considered, giving neighboring communities the opportunity to comment on proposed plans and make joint planning commissions legal. But



According to Adelaja, MSU definitely has a role to play in shaping land use policy because the university can address the issue from so many angles.

the state does not require local governments to coordinate plans, zoning or infrastructure with their neighbors or with the county, region or state. Research and outreach aim to increase coordination between government entities, as well as create an information clearinghouse and decision support system for the state to enhance local planning efforts.

- **Creating healthy communities** — Community design has both positive and negative influences on physical activity levels, mental health and social networks. A person's physical environment and the policies that created it directly affect his or her ability to adopt healthy behaviors. Michigan's history is closely tied to the auto industry, and the structure of many of the state's communities makes it difficult to walk or bike as a main mode of transportation. Other policies make it hard to develop innovative community designs that encourage physical activity and human interaction. This area focuses on the relationships between the built environment, social capital and human health. Research and education provide information and technical assistance to policy-makers and state agencies so they can make community design decisions while considering the effects on citizens' health.
- **Equipping state policy-makers in land use** — Land use issues in Michigan have historically fallen under the jurisdiction of local governments. The sprawling pattern

of development has increased boundary conflicts, affected natural resources, and eroded the vitality and infrastructure of the state's cities. As a result of these pressures, land use has become a large enough issue that local communities need and ask for increased guidance from the state. According to Adelaja, this is a critical time, and the state can choose to provide assistance and incentives to local communities or not. Because the governor and the legislature have implemented some of the Land Use Leadership Council's recommendations, other states will be looking to Michigan as an example. This area focuses on educating state decision-makers and providing balanced, objective policy recommendations on land use issues.

- **Empowering Michigan's citizens in land use** — Although information and education make up the cornerstone of each Land Policy Program theme area, the primary focus of this one is to reach the general public. More than trying to increase public awareness about land use issues, the goal is to provide education that changes people's attitudes and behavior, and helps all people understand the important role that land use issues play in their quality of life.
- **Data collection, information and analysis for improving land use policy** — Michigan's land was last inventoried and classified in 1978. Since then, updates have focused on specific projects and areas and are frequently incompatible. This area's goal is to update and unify the state's land use and land cover change information at all scales, and to analyze the data so more comprehensive and unified decisions can be made.
- **National leadership profile** — The Land Policy Program wants to make Michigan and its universities, especially MSU, recognized national leaders on land policy issues, from revitalization of cities to farm viability to natural resources stewardship.

In February 2004, Adelaja presented the Land Policy Program's theme areas at a land use summit attended by researchers from around the state, as well as local and state government officials. He also met with Granholm's senior staff members to discuss how MSU research could support the issues the governor felt the state would be moving on first.

"One of the criticisms universities hear from policy-makers," Adelaja said, "is that we're too pie-in-the-sky — our research is too idealized, takes too long and doesn't offer any immediate practical applications. Well, knowing how critical science can be in the process of developing sound public policy, we decided to jump in and provide assistance for the decisions that were about to be made. It is important to

demonstrate that academic research can be timely, relevant, responsive and yet rigorous, and that we take our role in state policy development very seriously. In a way, I view the Land Policy Program as the bridge between state government and academia.”

In his research program, Adelaja is working on various projects related to land use policy in the state. He recently received a grant from the W. K. Kellogg Foundation to support some of these projects. Many of the initial projects funded by the Land Policy Program are studying the governor’s priority areas, which include farmland preservation, agricultural sustainability and creation of commerce centers.

“The expansion of the farmland preservation program is not as simple as it sounds,” Adelaja explained. “What are our state’s vision and goals in farmland preservation? How do we fund achieving those goals? How will this affect our state budget and the revenue and tax bases of municipalities?”

“Agricultural sustainability requires a vision for agriculture in Michigan,” he continued. “We need to know where the good soils and best climates are, where the markets are, water availability — all the infrastructure that agriculture requires. Working with MAES faculty members such as Mike Hamm, C. S. Mott Chair for Sustainable Agriculture; Jim Bingen, agricultural development scientist; and Stu Gage, entomology researcher, we are developing an algorithm to rank the acreage in the state for its suitability for farming based on these variables. Then we’ll have a better idea of where to preserve farmland that will be sustainable.”

As farmland is developed for other uses — many times housing or business — the new development pressures agriculture and also stresses cities and existing businesses as residents follow the development out of town. The concept of commerce centers would designate certain communities for growth on the basis of a number of demographic, economic and social criteria.

“The idea behind commerce centers is putting economic development infrastructure in areas that are ready for it, can sustain it and can amplify its benefits to the state, rather than eating up natural resources randomly around the state,” Adelaja said. “It is focused development that allows us to grow smartly and not at the expense of existing businesses. In assisting the state in planning commerce centers, we are evaluating the strategic economic development resources of various locations in Michigan and developing tools to assist policy-makers. We are also looking at what types of business development strategies might be good for an area and if the right incentives are in place to attract the people that start those businesses.”

Adelaja has been working with the Michigan Environmental and Economic Roundtable, providing information and analysis in the commerce center designation process. Earlier this year, he testified before the Senate Committee on Commerce and Labor on state incentives to foster business development.

“If strategically conceptualized, commerce centers could be an effective vehicle for smart economic development,” Adelaja said.



MAES scientist Pat Norris found that people in Kent County tremendously valued the Fruit Ridge area and were more likely to support preserving farmland if it were located there.

■ Why Should We Preserve Farmland?

Patricia Norris, MAES environmental and natural resources economist, is one of the faculty members affiliated with the Land Policy Program. She is currently studying two areas of land use: farmland preservation and the concept of a land banking program.

“In Michigan, we supposedly have a lot of people interested in farmland preservation,” Norris said. “But no one had ever asked them what exactly it was they wanted to preserve.”

So she and colleague B. James Deaton, assistant professor in the Department of Agricultural Economics and Business at the University of Guelph, surveyed residents of Kent County about their concerns about the loss of farmland as well as the benefits of preserving it. The scientists also asked if the residents would be willing to pay for a program to buy the development rights of county farmland to preserve it.

Norris said the literature in agricultural economics journals suggests that people want to preserve farmland for four general reasons: food security (including access to food and access to locally produced food and the ability to know where the food is coming from); the rural economy, which will suf-

fer if agriculture disappears; the value of open space and the way farmland makes the area look; and environmental benefits (trees, runoff prevention).

“So our hypothesis was that if people were going to preserve farmland, they would want it to be farmland they could see — along highways or main roads — that was highly productive agricultural land with good environmental benefits,” Norris explained.

Norris and Deaton chose to survey Kent County because it traditionally has been one of the top counties in the state in agricultural revenue. It also includes a growing metropolitan area, Grand Rapids. According to U.S. census data, the population growth rate in Kent County between 1990 and 2000 was nearly twice that of the state.

Almost half of the survey respondents reported that at least one of their parents lived on a farm and 62 percent supported the involvement of Kent County government in land use issues.

The researchers found that about 50 percent of Kent County residents would support farmland preservation as long as the cost of the program was relatively low. The respondents said they would pay less to preserve low productivity farmland and would pay more to preserve farmland with greater environmental benefits. They didn't care if the farmland was along main roads, an opinion that was surprising to Norris.

“We found that people really liked the ‘Fruit Ridge,’ which is an agricultural area in the northwest part of the county,” she explained. “We weren't surprised that the Fruit Ridge was important, but we were surprised by how much emphasis people seemed to put on it. There's a lot of apple production there. People were 20 percent more likely to support preserving farmland if it were located on the Fruit Ridge. Everyone seems to value the Fruit Ridge as an agricultural area within the county.”

The researchers also found that people strongly believed that farmland provided a sense of local heritage, an idea that hasn't really been considered when farmland preservation is discussed.

“We made the link between how important local heritage was and how important the Fruit Ridge was, and we think that people see the Fruit Ridge as part of Kent County's agricultural heritage,” Norris said. “I want to do more research on the benefits of farmland preservation. There may be a disconnect between what the state farmland preservation statute wants to preserve and why people actually want to preserve farmland.

“We have to think about whether we want to preserve farmland or farming,” she continued. “If we want to preserve farming, we have to do it in a logical way. You can't preserve

one farm here and one farm there across the state. The infrastructure of suppliers and processors will go away if there is only one farm in the area — it's difficult to farm if you have to go 100 miles to buy supplies or get something fixed.”

■ Banking Land in Flint

Located in the center of Genesee County, Flint is the birthplace of General Motors and the now-defunct Auto World theme park. Its woes were chronicled in Flint-native Michael Moore's 1989 documentary, “Roger and Me.” In 1970, GM employed 80,000 people in factories around the city, and Flint's population was 193,000. By 2000, Flint had lost more than 60,000 high-wage jobs, and its population had fallen to 120,000. According to the last U.S. census, more than 12 per-



Dan Kildee, Genesee County treasurer, has developed an innovative land bank program to revitalize Flint. It is the only such program in the state.

cent of Flint's housing is empty — abandoned by residents who fled the city looking for work in other locales. Abandoned property creates many problems for city government — fire, squatters, crime, disease, rats, illegal drug houses — but the decrease in the tax base is particularly painful.

“Abandoned properties diminish the value of surrounding property,” said Daniel Kildee, Genesee County treasurer. “This directly reduces property tax revenue that could be used to address the problems caused by abandonment.”

Until 1999, it was difficult to stop the downward spiral of tax-foreclosed property. Abandoned properties were either transferred to private speculators through tax lien sales or became state-owned property through foreclosure. But the property still stood vacant for about five years because it took that long to clear the title.

“If people have just abandoned property, they’re usually difficult to find,” Norris said. “And they had to be contacted



The Genesee County Land Bank has allowed Kildee and the county to take the titles of more than 3,300 abandoned properties — almost 6 percent of the land in Flint.

before the title could be cleared. This was a big problem for cities such as Detroit, Grand Rapids and Flint.”

In 1999, state legislation was passed that made it easier for state and county governments to take control of vacant abandoned land. Titles could be cleared in a year or two, putting property back on the tax rolls much sooner. The legislation, P.A. 123, also provided some funding to help counties manage tax-foreclosed properties. In 2003, additional legislation strengthened and expanded the powers of county government to handle vacant properties and allowed the governments to hold the land in tax-exempt status — essentially, allowing them to create a land bank.

“The state created the Land Utilization Fund from the profits from the sale of abandoned properties and used that to help counties pay for managing the inventory of foreclosed land,” Norris explained.

These new rules allowed Kildee, who served on the Michigan Land Use Leadership Council, to develop an innovative program designed to revitalize Flint.

“Dan had an idea for a land bank program,” Norris said. “It

evaluates the abandoned property and decides what the best use of the land is, keeping the community’s needs in mind. It’s the only program like this in the state.”

The Genesee County Land Bank has allowed the county to take the titles of more than 3,300 abandoned properties — almost 6 percent of the land in Flint. Money from sales of the properties is returned to the program. The land bank also has set up a foreclosure prevention program, which gives owners or occupants facing foreclosure a one-year grace period and active assistance and counseling from Kildee’s office. So far, 900 foreclosures have been prevented.

“One nice thing about the 2003 legislation was that it qualified every land-bank-owned property as a brownfield,” Kildee explained. “This means we can use brownfield redevelopment tools such as rehabilitation or demolition to clean up and redevelop the properties. It expands the definition and gives us more options to get the properties back into use. We can donate the land to a non-profit group for redevelopment. We can also hold the land in tax-exempt status and decide what to do with it. We couldn’t do this before the legislation was passed.”

If a property is not classified as a brownfield (meaning it is not owned by the land bank), the land bank gets half of the property tax for five years. If the property is considered a brownfield, the land bank gets all the property tax for the next five years. This money is also used to fund and expand the program.

“The land bank gives us the power to find value in urban land and put it back into development,” Kildee said. “It allows us to treat the whole roster of properties as a single commodity. The higher value properties, which are in the minority, are sold and

the proceeds are used to rehab or demolish structures on the lower value properties.”

A number of properties owned by the land bank are occupied by tenants. These are now managed by the land bank rather than being sold. If the land bank were not involved, these foreclosed properties often are bought by slumlords who make no effort to maintain them and rent them out until they are uninhabitable.

The land bank also created a “side lot” program, which allows people who live next door to a vacant lot to take ownership of the lot. Other vacant lots are maintained by non-profit agencies. The land bank is also demolishing dilapidated houses, rehabbing other houses, and combining land parcels and selling them as one unit to make them more attractive to developers.

Norris’ role is to evaluate the impact of the land bank’s work on surrounding property values. She began her research last July and expects to finish the work by the end of June. She will then report her results to the Land Policy Program, which funded the research, as well as to Kildee.

“Dan wants to know if there’s an economic benefit from the land bank program. So I’m going to use data from Genesee County and the city of Flint to determine whether all this work is having a positive effect on the values of the surrounding properties,” she said.

“This is a significant piece of research,” Kildee said. “We want to justify making an investment in redeveloping these properties. Sometimes state government is concerned because this program takes some of the property tax money — it’s not all going to the state. My hypothesis is that it’s a win-win situation. The redevelopment raises the value of the surrounding properties, which means more property tax money for the state. This research will allow us to create a business input-output model for the land bank program.”

Norris will look at characteristics of houses that have been sold in Flint over a designated period of time — including selling price, size, location, school district, etc., as well as proximity to abandoned properties, rehabbed properties or parcels with decrepit houses that were demolished by the land bank program.

“We may find that poor surroundings influence the property value more than having an abandoned property next door,” Norris said. “We’re not sure which comes first — do areas with lower property values accumulate more abandoned properties, or do abandoned properties cause the value of an area to slide?”

■ Mixed-income Neighborhoods May Ease Gentrification and Blight Fears

Other MAES-funded research is looking at ways to help Grand Rapids ease its growing pains. As one of two Michigan cities that grew in population in the past decade (Ann Arbor is the other), Grand Rapids faces a unique set of challenges.

“The good news is that we’re gaining population,” said Carol Townsend, Michigan State University Extension (MSUE) urban community development agent in Kent County. “We still have community development needs — I don’t want to minimize that. But people are worried about gentrification. We have more middle-income people moving back into the city, and as the prices rise, some others are being priced out.”

Townsend’s concerns about gentrification and displacement of low-income households came from her work with two inner-city neighborhood groups: the South West Area Neighbors (SWAN) and the South East Community Association (SECA). Both are primarily low-income neighborhoods, and both are experiencing gentrification pressures. Residents and business owners appreciate the revitalization that new middle-income households bring to their neighborhoods, but they are worried about the long-term impact and fear that affordable housing for lower income households might no longer be available. There is also a concern that some long-time neighborhood businesses would be forced out of the neighborhood eventually.

Townsend had heard about the concept of mixed-income neighborhoods and thought that it might be a good model for Grand Rapids to consider as it grows. But information about the idea was limited, so she contacted Urban Collaborators, an MSUE initiative. Its mission is to link MSU’s research and outreach resources with the needs of urban communities in several Michigan cities. Urban Collaborators connected Townsend with June Thomas and John Schweitzer, professors in the Urban and Regional Planning Program at MSU, and they developed a research project that was funded by the MAES. The results were distributed to neighborhood leaders last June.

This seamless movement from community issue to research project to results that can be used in outreach and education perfectly embodies the land-grant philosophy and demonstrates the strong partnership between the MAES, MSUE and scientists throughout MSU.

Though there is no standardized academic definition of a mixed-income neighborhood, Townsend described it as a neighborhood with various types and prices of housing, allowing people with a range of incomes to live close to where they work in affordable, safe housing.

The researchers’ project had two parts. In the first, they analyzed census data to find stable mixed-income areas — areas in which the numbers of households in the two lowest economic classifications remained stable over 10 years.

“This meant that the lower income population was not being priced out by gentrification,” Thomas explained. “And it also meant that there weren’t too many lower income people moving in, which would have meant the neighborhood would have been moving downward in socioeconomic status.

“Basically, people don’t want to go down in income level because that leads to perceptions of blight and flight from the area,” Thomas continued. “They also don’t want income to go up too fast because then people feel that they can’t stay.”

Thomas and Schweitzer then conducted focus groups in four of these stable mixed-income neighborhoods to determine their common characteristics. The scientists also asked residents what they saw as stabilizing influences in the neighborhood as well as threats to neighborhood stability.

“We found that the stable groups were slightly different from other block groups in the city,” Thomas said. “They tended to have less vacant housing, less rental housing, lower median income for families compared with metropolitan median income, lower proportions of families in poverty and fewer people of color.”

Stabilizing influences were:

- Religious communities, such as Catholic parishes, which have kept people in neighborhoods.
- Positive feelings about schools in the neighborhood.

- Strong social networks between neighbors.
- Emotional or familial connection to the neighborhood. Some residents inherit or buy from relatives; others buy in the neighborhood because of family.
- Neighborhood associations.

Threats to stability were:

- Poor school quality.
- Problem neighbors, including poorly monitored or maintained rental properties.
- Economic decline. People may have to move away to follow employment opportunities.
- Racial or ethnic change.

“This information from the focus groups gave us data that we can use as an early warning system,” Thomas said. “We know what to look for to determine if a neighborhood is changing, either up or down.”

After a summary report was written in June, Townsend scheduled meetings with focus group participants and community leaders so Thomas and Schweitzer could discuss their findings.

“My first goal is to share the information,” Townsend said. “We want to educate people about the concept. Now we’re



Carol Townsend, MSUE urban community development agent in Kent County, thought the concept of mixed-income neighborhoods would be a good model for Grand Rapids.

working on a newsletter about mixed-income neighborhoods that will be widely distributed. Both SWAN and SECA would like to be redeveloped as mixed-income neighborhoods — where housing would be available to households of all income levels. Once we get feedback about the idea, we’ll formulate our next steps.”

In their report, Thomas and Schweitzer lay the ground-

work for these next steps.

“Keeping mixed-income neighborhoods stable will require making sure the proportion of low-income residents doesn’t become overwhelming,” Thomas said. “Means will have to be found to maintain middle-class residents. Supporting home ownership also will be an important part of a strategy needed to maintain mixed-income housing. Tapping government or private programs that support home ownership could be an important strategy for maintaining a balanced population. Also, in 2000, our selected neighborhoods actually had lower median family income; this suggests that it’s still possible to maintain mixed-income neighborhoods that are not wealthy or even middle-class when compared with the city as a whole.”

■ Transferring Development Rights — What Makes a Good Program?

Transferable development rights (TDR) programs are being widely discussed and initially implemented by many states, including Michigan, as a good solution to land use issues. The programs are based on the idea that development rights are one of many rights associated with land ownership. The land development rights may be used, not used, transferred or sold by the landowner. Once a parcel of land’s development rights have been transferred or sold, a conservation easement is placed on the property, which limits the land’s future use.

In TDR programs, the development rights for a piece of land that a community has decided it wants to preserve and protect from land use change are transferred to another area that has been designated for development. Landowners who transfer their development rights typically receive money for them. Developers who use TDR to acquire development rights are rewarded with bonus densities in the development area — meaning they can put more houses or stores in the area than they could if they didn’t use TDR. Purchase of development rights (PDR) programs are similar — instead of transferring the rights, a group or individual buys the development rights from the landowner and simply holds onto them. The original (and subsequent) landowner may continue to use the property as outlined in the conservation easement. The purchaser of the development rights does not have to use them and often has no way to use them. In many cases, PDR programs are run by local governments, which buy the development rights with the specific intent of preventing development on certain lands.

“TDR programs may provide a systematic, market-based tool to help communities achieve their long-range environmental and economic goals,” said Michael Kaplowitz, MAES environmental law and policy researcher. With degrees in both resource development and law, Kaplowitz has spent his career studying what it is that people value about natural resources and the environment, and how this value can be

assessed, tabulated and included in legal and economic analyses.

In 2002, he and Patricia Macheimer, a scientist in the MSU Urban and Regional Planning Program, reviewed a number of TDR programs and closely examined three case examples to develop a framework for a successful TDR program.

“TDR is an alternative to traditional land use management techniques,” Kaplowitz said. “But because it’s not widely used yet and because it is complex, it’s not very well understood. We wanted to describe the components of a good TDR program so policy-makers would have a guide if they wanted to create one for their area.”

The scientists reviewed 14 established TDR programs across the country, including those in California, New York, New Jersey and Kentucky (none were in Michigan) to create an evaluation tool. They then evaluated in depth three well-documented TDR programs: one in Manheim Township, Pa. (established in 1991), one in Montgomery County, Md. (established in 1980), and one in the New Jersey Pinelands (established in 1981). Success was measured by the number of development rights transactions that took place and the number of acres that were preserved.

“We picked these three for several reasons,” Kaplowitz explained. “They were in the same region of the country and had been extensively documented, so we had a lot of good data to review. The programs’ staff members were all very helpful during our research.”

Kaplowitz and Macheimer found that successful TDR programs had the following characteristics:

- **Good legal and political foundations.** This includes TDR enabling legislation and inclusion of the TDR program in the community’s master plan or a state regulatory plan. If there is no political foundation, the TDR plan will probably not be as successful as it could be.
- **Consistent regulatory processes.** Areas with consistent and stable land use regulatory processes had greater TDR participation, and people in the program felt more confident that the TDR program would be maintained over time.

“Regulatory consistency sends the signal that zoning for TDR-preserved areas will not change,” Kaplowitz said. “It also lets people know that they will have to participate in the TDR program to get greater density in development areas — this won’t come through zoning changes or variances.”

- **Sense of place.** Communities that had a positive



Townsend (center) found limited information on mixed-income neighborhoods, so she contacted the MSUE Urban Collaborators and was introduced to researchers John Schweitzer (left) and June Thomas (right). The research project was funded by the MAES.

sense of place about both the preserved land and the developed land in the TDR areas had successful TDR programs.

“TDR programs affect everyone in the community, not just the people who trade and use the development rights,” Kaplowitz said. “If residents appreciate the benefits of preserving certain sections of land as well as the benefits of directing growth to specific areas, the program will be successful.”

- **Land resources seen as valuable.** For a TDR program to be successful, it is important that the land being preserved be seen as valuable by the community. When the land has multiple sources of value (aesthetic, economic) and its preservation is supported by a variety of stakeholders, it is viewed as being even more valuable.
- **Rapid growth.** TDR programs in and around rapidly growing areas had more demand for development rights and increased concern about losing land-based amenities.

“This and other research has shown that TDR programs need to encompass a diverse real estate market to be successful,” Kaplowitz said. “They seem to work best in rapidly growing fringe areas where there are opportunities and demands for developers to use development rights that are transferrable.”

- **Knowledge of land use demands and patterns.** For TDR programs to work, there must be a demand for TDR use in areas where development is permitted.

“To design a good TDR program, you have to understand

the development demands and patterns in an area,” Kaplowitz said. “That way you can appropriately locate the areas to be preserved and the areas to be developed. Having this understanding also helps you establish appropriate densities for each area.”

- **Appropriate areas for development.** Viable TDR programs must have areas that are appropriate for the intensity and type of development allowed with the use of TDR. The development areas must be politically acceptable, have the necessary infrastructure (sewers and water) and meet the comprehensive plan, zoning conditions and design standards.
- **Public support.** It’s logical that TDR programs with strong public support are successful. To garner local support, the stakeholders must be well informed about the program and TDR concepts in general.
- **TDR leadership.** Strong, supportive leadership within various stakeholder groups (agricultural community, developers, lending institutions and real estate brokers) is important to TDR success.
- **Mandatory vs. voluntary program.** Mandatory TDR programs seem to be more successful than voluntary programs. This does not mean landowners must transfer rights. In a mandatory TDR program, there is a downzoning requirement for either the preserved or the developed areas. Downzoning reduces the baseline development potential of a parcel of land by rezoning it. In a preservation area, this is an incentive for landowners to sell their rights because they can’t be easily used on that property. In a development area, downzoning is an incentive for developers to participate in the TDR program because they can then take advantage of the higher bonus densities through TDR.
- **TDR bank.** TDR banks serve several important functions, including buying and selling development rights, acting as a buyer of last resort, strengthening the program’s credibility with banking institutions and functioning as a facilitator. In many cases, a TDR bank increases public acceptance of and confidence in a TDR program.
- **TDR/PDR compatibility.** In areas that have both programs, it is important that they be compatible.

“TDR and PDR are complementary programs,” Kaplowitz said. “TDR allows market factors to determine which parcels to preserve, and PDR allows communities to target specific parcels for preservation. TDR and PDR may be used in tandem to maximize community resources. Because PDR funds come from public revenue sources — taxes, fines and

fees associated with state land preservation programs — the funds are limited and can only target specific parcels in need of protection. By using PDR funds strategically, communities can use PDR efforts to help maximize their community’s efforts to preserve open space, agricultural lands and his-



Michael Kaplowitz, MAES law and environmental policy researcher, has spent his career studying what people value about natural resources and the environment.

toric areas. TDR uses private funds and market pressures in concert with communities’ land preservation efforts by placing additional conservation easements throughout a preservation area, perhaps strengthening or widening the buffer zone.”

- **Simplicity and cost efficiency.** TDR programs that are too complex to be understood and too expensive to participate in did not have many sellers and buyers. Programs should be clearly structured, and each element should be as simple as possible.

Though he and Machemer created a framework for evaluating TDR programs, Kaplowitz is quick to point out that communities can’t simply pick out a couple of components and expect their program to be successful.

“We tried to classify all the components of a TDR program and suggest ways that TDR programs have been successful,” Kaplowitz said. “While communities may find that certain TDR elements are more important in their areas than others, I think good TDR programs combine most, if not all, of these programmatic features.

“TDR is based on the idea that land development and preservation interests are served best when they are accommodated simultaneously,” he continued. “Communities will continue to wrestle with development and preservation pressures, and TDR seems uniquely suited to address both of these seemingly contradictory goals.”

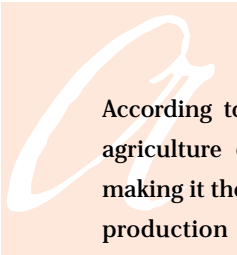
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Climate Change

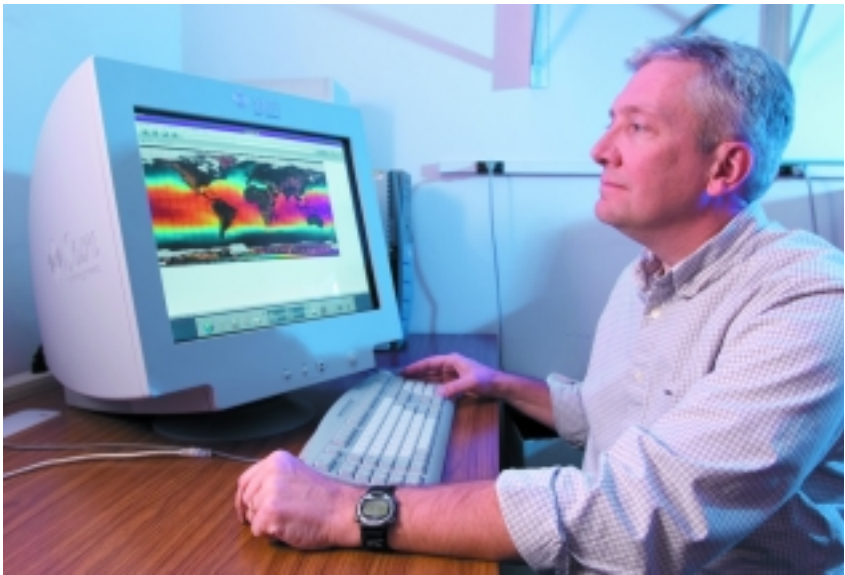
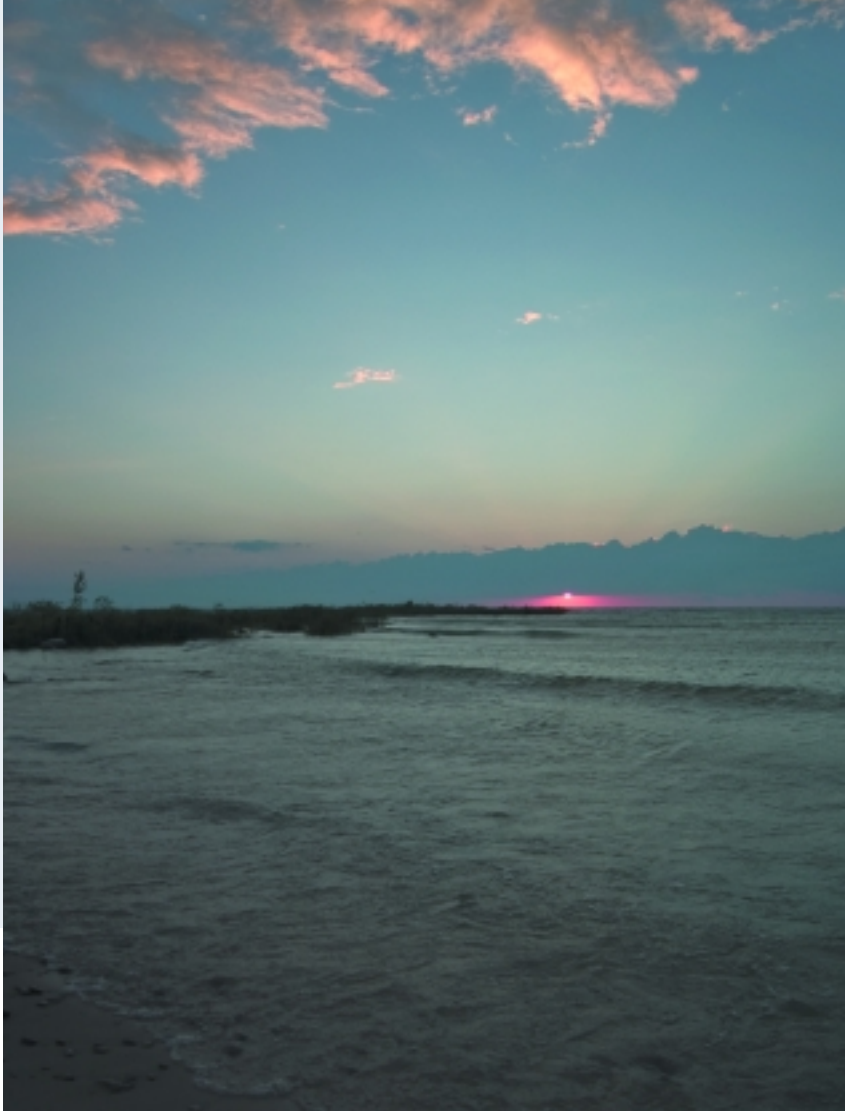
and AGRICULTURE

Temperature affects just about every variable in agriculture:
crops, weeds, insects and diseases.

What will happen in Michigan as the climate warms?



According to statistics from the Michigan Department of Agriculture, agriculture contributes \$37 billion annually to the state's economy, making it the state's second largest industry. The state leads the nation in production of 11 commodities, including dry beans, tart cherries, impatiens, flowering hanging baskets and pickling cucumbers. Michigan produces more than 125 commodities, making it second only to California in agricultural diversity. About 500,000 people work in agriculture in Michigan, and the state is home to 53,300 farms. Average farm size is 189 acres. >



Jeff Andresen, MAES agricultural meteorologist and state climatologist, has found that Michigan's climate has been following a global trend toward warming. Michigan has had less ice formation on the Great Lakes over the past 50 years because of warmer winters.

This agricultural abundance is due, in part, to the moderating influence of the Great Lakes on the state's climate. It's not coincidence that fruit-growing operations are clustered along the shores of Lake Michigan.

"Lake Michigan keeps the temperatures warmer in the winter and slightly cooler in the summer," said Jeff Andresen, MAES agricultural meteorologist and state climatologist. "Combined with some favorable topographical features, that's why fruit production is there."

Andresen and several other MAES scientists in various disciplines are studying how climate change could affect Michigan agriculture as a whole and whether specific crops will be particularly affected.

The potential consequences of a warmer climate in Michigan depend on the magnitude, timing and severity of any temperature changes.

Using computer modeling and historical weather data, Andresen's research has found that Michigan's climate basically has been following a global trend toward warming.

"A significant portion of the increase in temperature during the past few decades has been during the evening," he said. "This is due at least in part to an increase in cloudiness. Clouds keep nights warmer and days cooler, and there is evidence that Michigan is following this pattern."

"The effects of any changes in the future will vary, depending on the type of crop being grown," Andresen continued. "If the warming is smooth and orderly, people will be happy because we'll have a longer growing season. But if we have warming and increases in temperature variability — such as an increase in extremes — it would be much more difficult for agriculture to adapt."

Spring 2002 was an example of the devastation that agriculture can experience when temperatures zoom up and down over several days. The Michigan cherry industry had the smallest crop in its history that year because of abnormally mild early spring temperatures that were followed by several devastating frosts.

"When fruit trees are dormant in the winter," Andresen said, "they have resistance to cold winter temperatures. But if it warms up for a few days, the trees come out of dormancy and their cold tolerance decreases dramatically. It takes only slightly subfreezing temperatures for a couple of hours to significantly reduce yields."

Based on recent research results, Andresen said that there is reason for concern, for as the average regional temperature has risen in recent decades, spring warming has happened earlier, bringing the trees out of dormancy and into active developmental stages earlier. But the frequency of spring freezes is the same as it was in the past. This translates into a relatively higher risk of loss because the trees will be further along in development and more susceptible to cold injury when frosts occur.

"Recent trends in regional temperature appear to be linked to the frequency of ice on the Great Lakes," Andresen said. "For example, in the mid-

and late 1800s, ice formation across Grand Traverse Bay occurred in 80 to 90 percent of the years, but now it's only about 20 percent of the years. We've had less ice formation because the winters have been warmer. The reduced incidence of freezes is also associated with lower water levels in the Great Lakes themselves. When you have ice or ice floes on the lakes, you don't have as much evaporation. And when the past few years have been very dry, the extra evaporative loss during the winter can make a major difference in lake levels."

Another trend of the past 50 years involves precipitation. Andresen said that despite drier than normal conditions during the past couple of years, much of the Great Lakes region has become wetter over time, with more precipitation in all seasons and more days with precipitation.

"Our research suggests that at least a portion of the dramatic yield increases of many field crops grown in the region during the past 50 years was associated with wetter, less stressful growing seasons," he said. "Projected trends of precipitation in the future are far less clear than those of temperature, with some computer models suggesting wetter conditions and others a drier climate. Regardless, all aspects of precipitation must be taken into account because the timing and frequency of growing season rainfall may be just as important as the amount of rain that falls."

Pulling back and looking at a slightly larger view, Andresen said that warming in middle and high latitude areas of the northern hemisphere might lead to increased food crop productivity, while some tropical areas may become too warm and dry for many crops. Rice, for example, will not grow if the weather is too hot and dry. Production areas and crops could shift successfully to other geographical areas given advanced agronomic technology. However, soil quality and other factors still will have to be considered — food can't be grown in rock.

Though the increase in agricultural production initially sounds positive, the warmer, wetter weather is also the perfect environment for a host of diseases, insects and weeds, the ramifications of which are being examined by other MAES scientists.

Weeds and Warming

As long as plants have been cultivated, there have been weeds. They come back, year after year — in cornfields and apple orchards, in front yards and perennial flower gardens. In the variability of agriculture, weeds are an annoying constant.

"About 80 percent of pesticide use in agronomic crops is for weeds," said Jim Kells, MAES weed scientist. "They're present every year and have to be controlled to avoid serious crop yield loss."

"Insects and diseases are less consistent, but they can be devastating," added Doug Buhler, former chairperson of the Department of Crop and Soil Sciences and newly appointed MAES acting associate director, whose expertise is in weed management. "More money is spent on controlling weeds, but there's more worry and heartburn about

insects and diseases because no one knows what to expect from year to year."

Both Kells and Buhler agreed that a warmer climate wouldn't mean more weeds — it would mean different weeds. Weeds that are a problem now for Michigan, such as lambsquarters, pigweed and ragweed, might not be as great a problem; weeds that

Resistance to herbicides and species shifts caused by herbicide use patterns are what we're most concerned about.

aren't currently a problem might become more important.

"We don't always understand why weed distribution is the way it is," Buhler explained. "It is very complex and is related to weather, type of crops grown, tillage and past weed seed introductions. But climate is clearly a factor. The northern boundary of many weed species is limited by weather."

The scientists said that weed movement would happen gradually over the course of many years.



MAES weed scientist Jim Kells says a warmer climate wouldn't mean more weeds — it would mean different weeds.

"Changes in weed species will likely happen very slowly in response to climate change," Kells said. "We're not going to have an epidemic of a new weed in one year from climate change. Generations of farmers may see changes."

Weather, like tillage and other agricultural pro-

duction practices, exerts selection pressure on weeds. If they do not adapt to the environmental conditions, they won't survive. But climate change alone won't usher in new weed species — the



Doug Buhler, former chairperson of the Department of Crop and Soil Sciences and MAES acting associate director, says weed distribution is complex, and climate is clearly a factor.

plants' seeds or rhizomes also have to be brought into the warming areas. Wind, animals, tillage and harvesting practices have always played a role in distributing weed seeds far and wide, and this will continue regardless of climate change.

As with colds and football, the best defense against weeds is a good offense.

"The best way to fight weeds is prevention," Kells said. "Growers generally know what types of weeds are present in their fields and can take steps to control them."

Kells and Buhler agreed that of all the factors that could cause a shift in weed species, global climate change is fairly low on the list.

"Herbicide resistance in weeds is at the top," Buhler said. "That's the greatest threat. A great deal of research is currently focused on this issue."

"Changes in cultural practices, herbicide use and crop rotations are also important," Kells added. "But resistance to herbicides and species shifts caused by herbicide use patterns are what we're most concerned about."

Diseases and Warming

As would happen with weeds with climate change, the number of diseases that would occur in Michigan might not go up, but the kinds of diseases seen in Michigan would change, said Ray

Hammerschmidt, chairperson of the Department of Plant Pathology, who studies plants' resistance to diseases.

"Besides climate, diseases also depend on the types of crops grown," he said. "Because we grow so many crops in Michigan, it's fair to say that Michigan is more at risk for disease outbreaks as the climate warms than some other states."

Michigan has a large nursery and bedding plant industry, and most of these producers depend on transplants from other states. Most of these transplants come from southern states or areas outside the United States, where certain diseases flourish in the warmer weather. Because Michigan is colder, some of these diseases are not as severe or may not be able to establish themselves here.

"It is likely that pathogens arrive in Michigan from warmer climates each year, but they can't overwinter and establish here because it is too cold," Hammerschmidt said. "If it warms up, new diseases could establish here. We need to look at the environmental conditions that allow specific pathogens to survive and then do a risk assessment for Michigan."

The USDA Animal and Plant Health Inspection Service (APHIS) is funding a pathogen risk assessment for the United States that Hammerschmidt, MAES plant pathologist Gene Safir and research associate Brandon Horvath are developing. With a list of pathogens to watch for in each state, everyone involved in agricultural production can be aware of the conditions to watch for in specific crops that might be affected.

"One way we can look at this is to see which pathogens are able to survive in the climate zones just south of us," Hammerschmidt explained. "For example, an important root pathogen of trees, *Phytophthora cinnamomi*, could become established if the winters become milder. Climate change models in Europe have shown how this pathogen may become established in areas where it currently cannot survive as the annual temperature rises by a few degrees Celsius. Warming could potentially increase the risk of *Phytophthora ramorum* [which causes sudden oak death or ramorum blight in parts of the Pacific Northwest] becoming established here."

Hammerschmidt said that soybean rust is unlikely to overwinter in Michigan because the pathogen cannot survive the cold winter temperatures. The disease has the potential, however, of being a continual problem in the United States because the pathogen can also infect other hosts, such as kudzu. Kudzu can overwinter in parts of the South, so infected kudzu plants could serve as a source of the disease for the next year. The spores of the soybean rust fungus can be blown every which way by wind, and new infections in the South each spring might provide spores that could eventually move north on wind currents.

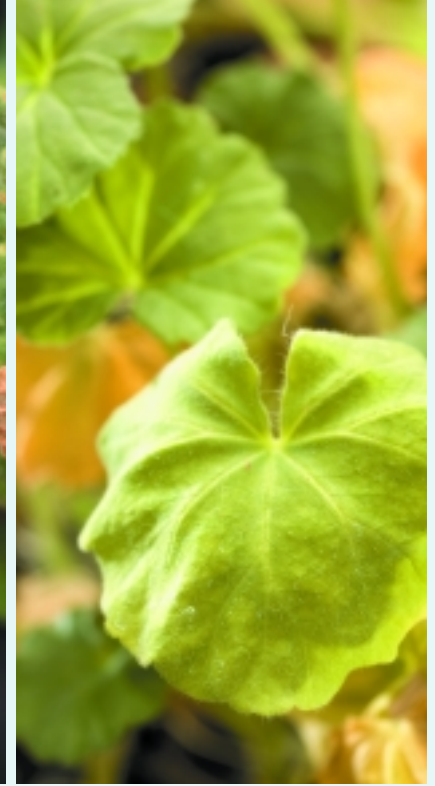
The bacterial pathogen *Ralstonia solanacearum* race 1 is a problem potato disease in warmer climates, but it doesn't overwinter in Michigan because winter temperatures are too cold. But plant

pathogens have the ability to mutate. A new strain of the bacterium, known as *R. solanacearum* race 3 biovar 2, has the potential to overwinter in colder climates and would be a threat to geranium, potato and tomato production in Michigan. A warmer climate would provide conditions that could allow all races of this troublesome pathogen to become established. If other pathogens mutate, a large outbreak could occur quickly because plants that are resistant to one strain are usually not resistant to the new mutation.

“Assessments of climate change in relation to what we know about the biology of individual pathogens are needed to help us predict which pathogens may become worse or which new pathogens can become established,” Hammerschmidt said. “We need to be vigilant.”

As the climate changes, Hammerschmidt said there are several pathogens that Michigan growers should be watching for:

- *Peronosclerospora philippinensis*, a water mold that causes Philippine downy mildew in corn and sugar cane. Downy mildew primarily attacks young, tender leaves and can spread rapidly through fields when conditions are right. *Sclerophthora raysisiae* var. *zeae*, another water mold that causes brown stripe downy mildew in corn in India, Nepal, Pakistan and Thailand, is another potential threat to corn production. So far, these diseases are not in the United States, but scientists are concerned they may become established in the future.
- *Phakopsora pachyrhizi*, which causes soybean rust on soybeans and many other legumes. The fungus is spread primarily by windborne spores and has been confirmed in nine states since it was discovered in the United States on Nov. 10, 2004, in Louisiana. (Other states with the fungus include Alabama, Arkansas, Florida, Georgia, Mississippi, Missouri and South Carolina.) “In Michigan, we are preparing to meet this threat through education programs and increased diagnostic capacity,” Hammerschmidt said.
- Plum pox potyvirus (PPV), also known as sharka, is the most devastating viral disease of stone fruit in the world. The various strains of the virus infect a variety of fruit trees, including peaches, apricots, plums, nectarines, almonds, and sweet and tart cherries. The virus can also infect certain weeds. The disease is spread by aphids or infected nursery stock and has no cure. Once a tree becomes infected, it must be destroyed. Extensive survey work by MSU and the Michigan Department of Agriculture has been able to show that this pathogen is not in Michigan.
- *Ralstonia solanacearum* race 3 biovar 2, a bacterium that causes a wilt disease in potatoes, tomatoes, peppers, geraniums and eggplant. The disease is known as southern wilt, bacterial wilt and brown rot of potato. The



The types of plant diseases in Michigan would change as the climate changed. The verbena plant (top left) is showing necrotic, lesion-like spots caused by an abiotic agent. The geranium (top right) is showing wilt caused by *Pythium* root rot. Both are in a research greenhouse on campus. Ray Hammerschmidt, chairperson of the Department of Plant Pathology, is working with other scientists to create a plant pathogen risk assessment for the United States.



MAES entomologist Mark Scriber found a new species of swallowtail butterfly in the mountains of West Virginia. He believes the hybrid survived because of warming.

bacterium's presence was detected and confirmed in February 2003 in some U.S. greenhouses that received imported geranium plants from Kenya. It was eradicated, but in December 2003 the bacterium again was detected in a greenhouse. APHIS is determining how far and wide the potentially infected plant material was distributed. The facility in Guatemala where the geraniums originated has stopped shipping to the United States.

- *Synchytrium endobioticum*, a soil-borne fungus that causes potato wart. The disease appears on all underground parts of the plant except the roots. The aboveground part of the plant usually has no symptoms. The potato warts are white, soft and pulpy, and they darken and decay as they age. The disease is in Canada and Europe and was detected and then eradicated in the United States.

“Computer models to study how the pathogens might spread and education of the industries will be very important,” Hammerschmidt said. “A pathogen could get here because of commerce or wind or an insect. We have to be prepared.”

Insects and Warming

MAES entomologists Mark Scriber and Stuart Gage are both studying how climate change will affect insect populations in Michigan. Scriber is using butterflies and moths as models to examine how insects can adapt to climate change. Gage is using insects as a model to understand the process of climate change, and he thinks the concept can be applied to humans.

“You can draw some interesting parallels and analogies between insects and humans,” he said.

Both scientists agree that several general things will happen as the climate warms:

- More insects will survive over the winter because the temperatures will be warmer.
- Insects will emerge earlier in the spring and start eating plants earlier.
- Insects will grow faster and more of them will survive in the spring because of higher temperatures.
- Because of increased temperatures, insects will be more mobile.

“Climate change is doing a big experiment for us,” Scriber said. “At the end of the ‘80s, we noticed some climate change in the Long-Term Ecological Research (LTER) site at the Kellogg Biological Station (KBS). [Established by the National Science Foundation, the LTER site is part of a national network studying ecology and environmental biology through long-term research projects. The KBS LTER site is the only agricultural site in the network.] There is a ‘climatic legacy’ built into LTER, so we can compare temperatures over the years. We noticed that Japanese beetles were in Michigan and they didn’t used to be here. We also saw that our degree-days were going up.”

Insects are cold-blooded and require a certain amount of heat to develop from one point in their life cycle to another. This amount of heat doesn't vary, and each insect has a range of temperatures above and below which it won't develop. Scientists use degree-days to predict when insects will emerge each year. One degree-day is one day (24 hours) with the temperature above the lower developmental threshold by 1 degree. For example, if the lower threshold for an insect is 51 degrees F and the temperature remains 52 degrees F (or 1 degree above the lower developmental threshold) for 24 hours, one degree-day would be accumulated. If the temperature were 53 degrees for 24 hours, two degree-days would be accumulated.

"What this means for many insects," Scriber explained, "is the potential for two generations instead of one."

The European corn borer is one example of a pest insect that can have more generations in warmer climates. A moth whose larvae like to feed on corn, sorghum, cotton and many vegetables, the European corn borer costs U.S. farmers more than \$1 billion annually. The borer can have two, three and sometimes up to four generations in the South. The second and later generations affect larger plants because the corn has grown through the season.

"The later generations do more damage than the first generation," Scriber explained. "The larvae feed at the spot where the corn ear connects to the plant and the ear falls off. Or they eat the stalk and the whole plant falls over. We mapped degree-days of several states, and we could see the line marking the second generation of corn borers was moving north. Swallowtail butterflies follow the same pattern."

Scriber's research has found that there are genetic differences between the insects that produce one generation and those that produce two. Those with the ability to produce a second generation feed on different host plants that are available to them longer in the season so that the second generation has enough food to survive.

"We've found a new species of swallowtail butterfly in the mountains of West Virginia," he said. "Traditional genetic theory says that these hybrids wouldn't survive because hybrids are often evolutionary dead-ends. But they have. The corn borer has done the same thing. They emerge later in the spring than the non-hybrid species and are attracted to different plants — they like peppers. So these hybrid species may cause problems in crops and plants that they were not a problem in before."

Scriber described this as genetic traits moving north, rather than species. Some hybrid insects may actually be new species, reflecting the diagnostic traits of two parental species.

"Our definition of species needs some discussion," he said. "It doesn't take a long time to get a changed species. And then we need different agricultural practices to control these new species because their traits are different: they're emerging later, they're eating a wider variety of plants, they're

having multiple generations and attacking plants when we're not accustomed to them attacking."

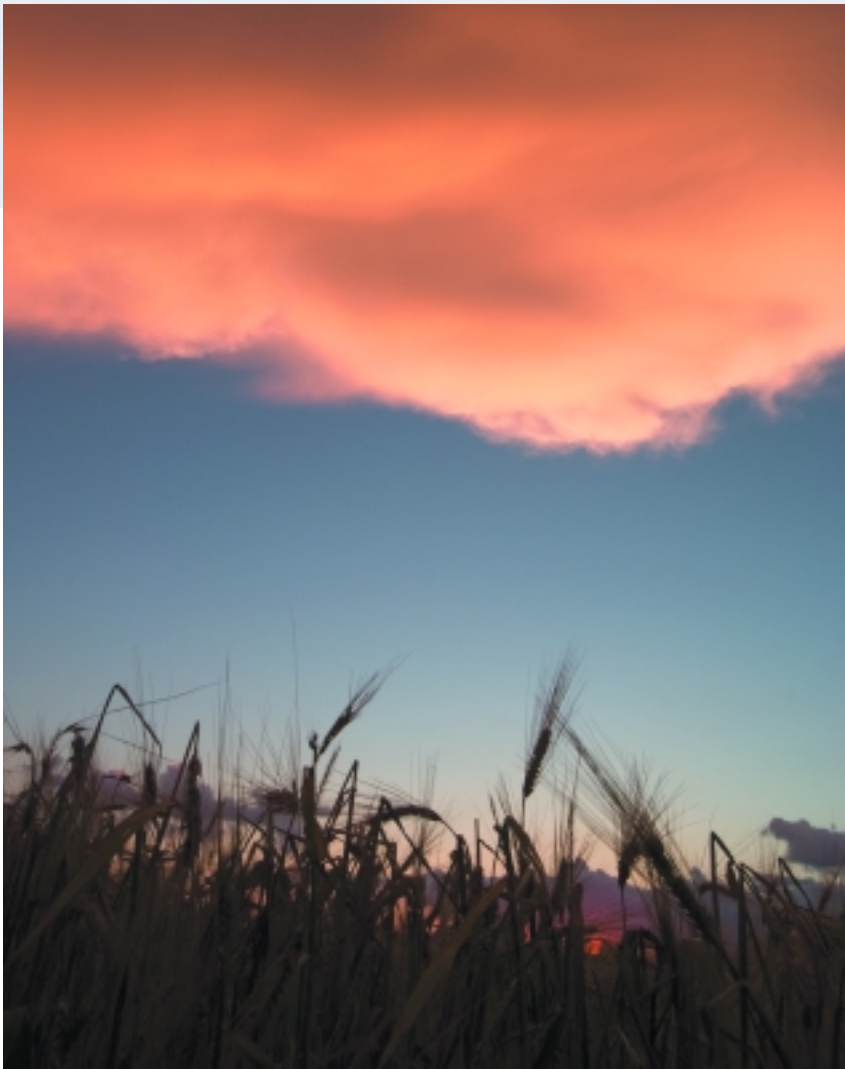
"Insects are the most resilient and adaptive organisms on Earth," Gage said. "They can and will adapt to climate change much faster than humans or plants."

A pathogen could get here because of commerce or wind or an insect. We have to be prepared.

Gage is one of the pioneers of aerobiology — the study of how living things use the atmosphere to move from one habitat to another and how this affects the dynamics of their populations. Insect population cycles are influenced by a complex interaction of temperature, moisture and host characteristics. Insects are cold-blooded — they depend on temperature for development and movement. Below certain temperatures, insects can't fly, eat or mate. Insects also have the ability to reproduce in



Stu Gage, MAES entomologist, is a pioneer of aerobiology — the study of how living things use the atmosphere to move from one habitat to another and how this affects the dynamics of their populations.



Michigan's agricultural abundance is due, in part, to the moderating influence of the Great Lakes on the state's climate. The potential consequences of a warmer climate in Michigan depend on the magnitude, timing and severity of any temperature changes.

large numbers — many can lay up to 200 eggs at a time. Whether all those insects-to-be develop depends in part on temperature.

“As the climate gets warmer, more insects will survive,” Gage said. “We will have more insects, and they will come out earlier in the spring. The insects are flexible and the plants are stuck — they can't change as quickly.”

In the spring, insects get ready to move — some through flight and others more passively, traveling by air currents that take them where they will. In his aerobiology studies, Gage has found that insects use the air flow over the Mississippi Valley and other places to move north. Studying their movement through the atmosphere is a large, long-term project that requires a global, holistic outlook. Many insects are tightly tied to specific hosts; others can use many species as hosts. Insects perform a number of functions, some helpful to humans and some not so helpful, including pollinating plants, consuming waste and spreading disease. To help follow insects' movement, smaller and smaller tags have been developed, including a compound called “smart dust” that is being used to track Africanized honeybees.

One early aerobiology theory is that the insects can sense where the air flows will go. This would explain how certain insects follow predictable patterns year after year without seeming to make a special effort to have each generation end up in the same place.

“We're examining how climate change will influence these airflow patterns,” Gage said. “The insects may not come from the same corridors or pathways because the temperatures will be warmer. Also, it might be drier, we're not sure yet. If it is drier, the insects will have to eat more to get the same amount of nutrients and so will do more damage because they'll need more food.”

Climate Change is Part of Global Change

To Gage, insects are the canaries in the coal mine of climate change.

“Insects are the indicators that tell us things are changing,” he said. “Climate change is a component of global change — land use change and the hydrologic cycle are the two other components. The Intergovernmental Panel on Climate Change [established by the United Nations Environment Program and the World Meteorological Association] estimates that the temperature will go up between 2 and 6 degrees F in the next century. This doesn't sound like much, but the increase since the last Ice Age has been 9 degrees Fahrenheit — this would be the fastest increase since that time.

“Climate change is a long-term process, and Western societies are geared toward short-term fixes to problems,” he continued. “We have good records of what has changed but not good records of how these changes have affected the Earth. We need to look at and work with the larger systems and see how it all fits together to find solutions.”

∴ Jamie DePolo

How Do YOU



Affect the Environment?

By integrating ecology and socioeconomics, MAES scientist Jack Liu has paved the way for the study of “biocomplexity” — how the interactions of human actions and policies change the environment over time.

According to a report released by the World Watch Institute in 2004, there are more private vehicles on the road in the United States than people licensed to drive them. The average size of our refrigerators increased by 10 percent between 1972 and 2001, and the number per home rose as well. New houses in the United States were 38 percent bigger in 2000 than in 1975, despite having fewer people in each household on average. >

In the past 20 years, average household size has fallen to 2.58 people. More than one generation living together is rare, and four-generation families living together is almost non-existent. Four generations of one family: from left, Lorraine Banks visits with grandson Steven Lehman, great grandson Jack Lehman and daughter Barb Lehman.



The number of households nationally continues to increase faster than the population.

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New homes in the United States were 38 percent bigger in 2000 than in 1975, despite a decrease in the average number of people per household. As this happens, the impact on the environment increases.

In 1980, there were 80,776,000 households in the United States, according to census data. One-person households made up 22.7 percent of the total, and two-person households accounted for 31.3 percent. The average number of people per household was 2.76. In 2002, there were 109,297,000 households in the United States, an increase of 35 percent. (The number of households is increasing faster than the population. From 1980 to 2002, the U.S. population increased by 21 percent.) The average number of people per household was 2.58, and one-person households accounted for 28.8 percent of the total, and two-person households, 36.2 percent. Sixty-five percent of homes have only one or two people in them.

“The number of households nationally

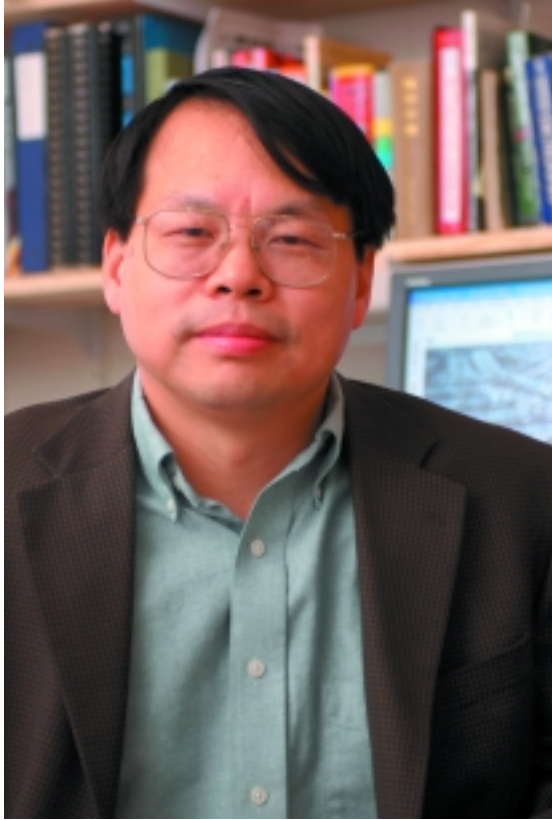
continues to increase faster than the population, and Michigan shows a similar pattern,” said Jiango “Jack” Liu, MAES ecologist, who holds the Rachel Carson Chair in Ecological Sustainability in the Department of Fisheries and Wildlife. “And as that happens, we use more land and more materials. The impact on the environment increases.”

Liu is not a traditional ecologist. He has spent almost 20 years studying the interactions between human needs, wildlife requirements and policies — specifically, how humans affect natural systems, how changes to natural systems affect humans, and how various policies interact with one another and affect both humans and natural systems. The area of study is called biocomplexity.



"I'm an ecologist by training," Liu said. "Most ecologists usually stay away from people and focus on 'pristine' ecosystems. But there are not very many natural areas that don't have direct or indirect human impacts on them. If we want to develop good environmental policies, we need to consider people explicitly."

Liu, who has been at MSU since 1995 after completing postdoctoral work at Harvard, grew up in China. His initial biocomplexity research focused on how human activities interacted with panda habitat in southwest-



MAES ecologist Jack Liu holds the Rachel Carson Chair in Ecological Sustainability. He has spent 20 years studying the interactions between people, policies and the environment.

ern China. His research team, which included colleagues from MSU and Chinese institutions, did a 32-year analysis of the Wolong Nature Reserve in Sichuan province. Using data from a declassified spy satellite and NASA's Landsat satellites, as well as information about the human settlements in the preserve, the study showed that panda habitat inside the Wolong reserve was being destroyed quicker after the reserve was established.

Only about 1,000 giant pandas remain in the wild. About 10 percent of these live in the Wolong reserve. Created in 1975, the reserve is

a flagship effort to preserve and protect biodiversity in important natural regions — a movement that has led to nearly 13 percent of the Earth's land surface being designated as protected.

His research in the Wolong reserve laid the foundation for Liu to study how increases in the number of households in 141 countries, even when the actual population declines, have a significant effect on biodiversity and the environment. The research is bringing to light the complex relationships between humans and natural systems, and between one policy and another. Though individual policies may work to solve an area's problems, they may conflict over time or create conditions that evolve into new challenges for both humans and nature.

"It is necessary to focus on the interactions of different policies," Liu explained. "Each policy may look really good, but if you put them together, they might have some unexpected negative impacts. We are learning to change the way we make policy and the way in which we evaluate policy."

Households and Panda Habitat

The Wolong reserve, the world's most high-profile protected nature reserve, encompasses 2,000 square kilometers (about 1,243 square miles) and is home to both wildlife and people. Liu's research has shown that only half of the reserve is panda-friendly, and one-quarter of that is occupied and affected by humans.

To survive, giant pandas need forest canopy, bamboo, elevations that allow for comfortable temperatures and slopes that are not too steep to be uncomfortable. This same high-quality habitat is also good for humans.

Towns and settlements have flourished in the reserve — the local resident population has increased 70 percent and the number of households has more than doubled since the reserve was established in 1975. Creating the reserve has drawn tourists to the spot, and tourists need hotels to stay in, restaurants to eat in, and souvenirs to remind them of their face-to-face encounter with the pandas.

The Chinese government recently instituted three policies to protect and restore panda habitat: a natural forest conservation program to stop illegal tree harvesting, a "grain-to-green" program that returned cropland to forestland, and construction of a hydropower

station to provide energy so people wouldn't have to rely on burning wood.

According to Liu, each policy was carefully structured and considered, but once they were implemented, they caused some unexpected outcomes.

"The forest conservation program paid people to monitor the forestland and make sure no one was illegally harvesting the wood," Liu explained. "The money was given per household, so some people were splitting up their households and creating new ones so they could get more money. More households use more resources and are less efficient."

Liu and his colleagues also found that while the hydropower station was functioning well, the electricity was too expensive for many people to buy, so they were still relying on wood for fuel.

"The government hoped that people would use the money from the forest conservation program to buy electricity," Liu said. "But it's human nature to buy what you like. Because it's illegal to cut down trees in the reserve, people were cutting branches off the trees and taking out dead trees to use as fuel, all of which would affect the panda habitat in the long run."

Liu said a solution is to consider the interactive effects of various policies rather than the effects of policies in isolation. It places different demands on policy making, forcing experts to look beyond their own fields and requiring various government agencies to work together.

"What we've done in Wolong is a starting point so we can apply the same methodology and ideas to other areas," Liu said. "We integrate ecology with socioeconomics as well as human demographics and behavior. Eventually we want to scale up from one place to a regional scale...a national scale...an international scale."

Households and the Global Environment

The scaling up has begun.

Working with researchers at Stanford University, Liu looked at how an increase in the number of households in 141 countries affected biodiversity and the environment. The research made the cover of the British science journal *Nature* in January 2003 and was featured in news stories all over the world.

"Having fewer people in more households means using more resources and putting more stress on the environment," Liu said. "Freedom and privacy come at a huge environmental cost."

Liu and his colleagues examined household dynamics and population changes worldwide and then focused on six areas with biodiversity "hotspots" — areas with high densities of plant and animal species: Florida, Brazil, Rodrigues (Africa), New Zealand, Italy and Wolong, China.

Across the world, in both developed and developing countries, households are getting smaller and their numbers are increasing. Multigenerational living arrangements — grandparents, parents and grandchildren all living together — are being supplemented by couples or individuals moving out on their own. Rising divorce rates mean that families that used to live in one dwelling now live in two.

The result is often urban sprawl. As a household shrinks and as more households form, the economy of scale is lost. Each household requires resources to construct it and takes up space. It requires energy to heat and cool it. A refrigerator uses roughly the same amount of energy whether it belongs to a family of four or a family of two.

"In larger households, the efficiency of resource consumption will be a lot higher because more people share living space and other resources," Liu said. "Usually, many people will share living space and other resources. This is true in all countries."

The number of people in each household may be shrinking, but houses are growing in square footage. Fewer people are living in more space, using up more resources.

In Indian River County, Fla., the average area of a one-story, single-family home increased 33 percent in the past 30 years, from an average of about 1,800 square feet for houses built before 1970 to an average of about 2,400 square feet for houses built between 1970 and 2000.

In biodiversity hotspot countries, the annual rate of growth in the number of households — 3.1 percent — was significantly higher than the population growth rate — 1.8 percent — between 1985 and 2000. More than 80 percent of hotspot countries demonstrated this pattern.

The difference in household size between hotspot and non-hotspot countries is decreasing, with households in hotspot countries getting smaller faster. In 1985, the average household size was 4.7 in hotspot countries and 3.7 in non-hotspot countries. By 2015, the average household size in hotspot countries is expected to be 3.4 people. In non-hotspot countries, it is expected to be 3.6 people.

"The issue of the number of households and their impact on the environment basically has been ignored," Liu said. "It was even difficult to unearth the data. Most people looked at population size and growth rate, but the number of households and household size are crucial factors affecting the environment."

... Jamie DePolo



AGRICULTURE'S ROLE

in CARBON SEQUESTRATION

MAY HELP the ENVIRONMENT

and OFFER NEW MARKETS

for FARMERS.

In the past decade, global warming went from being considered a far-fetched scare tactic to a scientific reality. Greenhouse gases — carbon dioxide, methane and nitrous oxide are the main ones — have been steadily increasing in the atmosphere since the beginning of the Industrial Revolution. Released from various natural and industrial sources, greenhouse gases absorb heat and help maintain the atmosphere's climate. Without these gases, the planet would be a large ice cube. But if their concentrations become too high, research has shown that these gases may cause a dramatic increase in temperature. Toward the end of 2004, the Bush administration said that greenhouse gases played a role in climate change, an idea that it had resisted earlier.

In 1997, more than 160 nations met in Kyoto, Japan, as part of a United Nations conference on climate change. The representatives discussed limiting the emission of greenhouse gases, espe-

Capturing Carbon to Help Slow Global Warming

cially carbon dioxide, a gas that had not been regulated before. The report that was issued at the end of the conference became known as the Kyoto Protocol. It created target greenhouse gas emission levels for each of the participating developed countries, relative to 1990 emissions levels. The target for the United States was 7 percent below 1990 levels. The United States and Australia were the two biggest industrialized countries that did not consider ratifying the protocol, for a variety of economic reasons. The protocol was scheduled to take effect 90 days after no fewer than 55 countries, which had to account for 55 percent of total carbon dioxide emissions in 1990, ratified it. On Nov. 18, 2004, Russia ratified the protocol, tipping the emissions percentage to 61.6 percent. This means the Kyoto Protocol became binding on Feb. 16, 2005.

“The Kyoto Protocol brought attention to global warming and greenhouse gases,” said Kurt Thelen, MAES crop and soil sciences scientist, whose research focuses on keeping carbon in the soil through agricultural practices. “As more policy-makers focus on global warming, it’s allowed us to develop some innovative management practices that we think will benefit both farmers and the environment.”

“Agriculture can be a sink for carbon because crops and trees use a lot of carbon dioxide in the process of photosynthesis and store carbon in the soil over time,” said Doo-Hong Min, MAES

crop and soil scientist, who conducts research at the Upper Peninsula Experiment Station in Chatham. “One of the key components of keeping carbon in the soil is tillage management. In particular, no-till makes more stable soil aggregates that increase water- and nutrient-holding capacity, resulting in potentially better crop production.”

“Russia’s ratification of the Kyoto Protocol is focusing more attention on carbon,” said Phil Robertson, MAES crop and soil sciences researcher, who oversees the Long-Term Ecological Research (LTER) site at the Kellogg Biological Station (KBS). Established by the National Science Foundation, the LTER site is part of a national network studying ecology and environmental biology through long-term research projects. The KBS LTER site is the only agricultural site in the network. With Thelen, Robertson is studying how agricultural management practices can keep more carbon in the soil and out of the atmosphere.

“Two dominant greenhouse gases, carbon dioxide and methane, are carbon-based,” said Merritt Turetsky, MAES plant biology and fisheries and wildlife scientist. Her research focuses on permafrost and high latitude wetlands, such as those in Alaska, northern Canada and Siberia, and these areas’ ability to store carbon. “For many thousands of years, these cold wetland areas have been a sponge for carbon,” she explained. “But as the climate is warming, these areas are melting. We’re studying what happens to the carbon when permafrost melts.”

Thelen, Min, Robertson and Turetsky are all looking at greenhouse gases from slightly different angles, but all have the goal of reducing their emission by keeping (or sequestering, as the practice is technically known) more carbon in the soil.

“MSU is considered a national leader in carbon sequestration research,” Thelen said. “We have expertise in agriculture and ecology, so we can look at all sides of the issue.”



Kurt Thelen, MAES crop and soil sciences researcher, studies how to keep carbon in the soil through agricultural practices. Using cover crops is one way to increase plant residue in the soil.

Wetlands and Warming

According to plant biologist Turetsky, wetlands cover just 3 percent of the Earth's surface but are considered one of the most valuable terrestrial ecosystems because of the variety of goods and services they provide. She believes that carbon sequestration should be counted as one of these services. Peatlands are a specific type of wetland that accumulates layers of dead biomass (parts of plants and other living things) in soils. These layers of dead biomass are called peat, and peat is about 50 percent carbon. In Canada, Alaska and other parts of northern North America, peat layers can be up to 5 meters thick. Researchers estimate that peatlands around the globe hold 30 percent of the world's soil carbon pool.

"Carbon storage in peatlands may become a complex climate change issue," she said. "These high latitude frozen wetlands have been a persistent sink for carbon. The ground is saturated with water, so decomposition is slow. Also, the species that grow in peatlands, mostly sphagnum mosses, are resistant to decomposition. But what happens to the carbon when the temperature goes up?"

Turetsky's initial thinking was that the warming would increase decomposition. The resulting increase in carbon dioxide, would, in turn, warm the atmosphere more and cause more of the frozen land to melt.

"We were worried that we were getting into a loop that we couldn't get out of," she explained.

But after she analyzed her data, she found that as the permafrost melted, the vegetation loved the water.

"In Canada, there were different species of sphagnum mosses

that grew in a disturbed and wetter environment," she said. "These plants took up more carbon, so our fears about the loop were unfounded. But I'm not sure how fast the species across the entire landscape can adapt to the warmer climate. We're studying that now. Plus, there are a lot of places with infrastructures that depend on permafrost. In Siberia, Alaska and Canada, buildings are sinking as it melts."

As the climate warms, plants get drier and burn more easily. Studying the amount of carbon released by wildfires in northern locations is another facet of Turetsky's research.

"Dry peatlands will burn," she explained. "Especially in large fires like those that Alaska experienced in 2004. A colleague of mine flew over some burned areas in Alaska last fall and saw smoke coming out from under 6 inches of snow. Fires can smolder in peatlands over the winter and then flare up the following year. As the climate warms, we almost certainly will have more fires in the future."

Peatlands have more carbon than trees, but no one had studied how much of this carbon is burnable. So Turetsky is researching that question.

"This raises questions about management," Turetsky explained. "Should peatlands be protected from burning in remote areas to keep carbon out of the atmosphere? Is that even a viable management option? Right now, in Alaska, many fires are allowed to burn unless they directly threaten buildings or other structures. It is clear to me, however, that we shouldn't be doing anything to make peatlands drier, such as lowering water tables to promote carbon sequestration in trees for potential forestry operations. In North America, a lot of that carbon simply will go up in smoke."



Phil Robertson, MAES crop and soil sciences researcher, oversees the Long-Term Ecological Research site at the Kellogg Biological Station. He would like to see carbon markets develop enough to pay farmers to keep more carbon in the soil.

Agriculture's Role in Carbon Sequestration

Crops and other plants use carbon dioxide from the air during photosynthesis. When leaves, stems and other plant residues fall to the ground, the carbon in that material is either converted by microbes to carbon dioxide during decomposition or becomes part of soil organic matter. Certain agricultural practices, such as no-till (which means the ground is not plowed or turned over every year), increase the amount of carbon in the soil by slowing decomposition.

"It's easy for agriculture to get carbon dioxide out of the air," Thelen said. "Ag is kind of the low-hanging fruit as far as carbon sequestration is concerned. We can use agricultural production practices as a short-term solution while alternatives to fossil fuels are studied. I think agriculture could account for about 20 to 40 percent of the emissions targeted in the Kyoto Protocol, which would be about 8 to 10 percent of total emissions."

"Soils have the ability to hold a lot of carbon," Robertson added. "Farmed soils originally had 40 to 50 percent more carbon than they do today."

Using practices such as cover crops, which are planted and then cut down, allowing more residue to work its way into the soil, and no-till and other conservation tillage practices in which the soil is disturbed as little as possible means more carbon is added to the soil instead of being converted to carbon dioxide in the atmosphere.

"No-till is the biggest way to sequester carbon," Thelen explained. "You also use less fuel because the tractor isn't driving across the field as often, and this also reduces emissions."

According to Robertson, keeping carbon in the soil also makes that soil better for agricultural production.

"There are lots of benefits to storing carbon for farmers," he said. "More organic matter in the soil makes the soil more porous, so it holds more water and drains excess water better, which is good for farming. It also allows the soil to hold on to more nutrients that plants need and makes the soil a better habitat for microbes and beneficial invertebrates such as earthworms, all of which are good for agricultural production."

"Farmers understand the benefits of having more carbon in the soil," Thelen said. "And they're interested in carbon sequestration. For a long time, farmers were pointed to as causing problems for the environment. Now they're excited to be part of the solution."

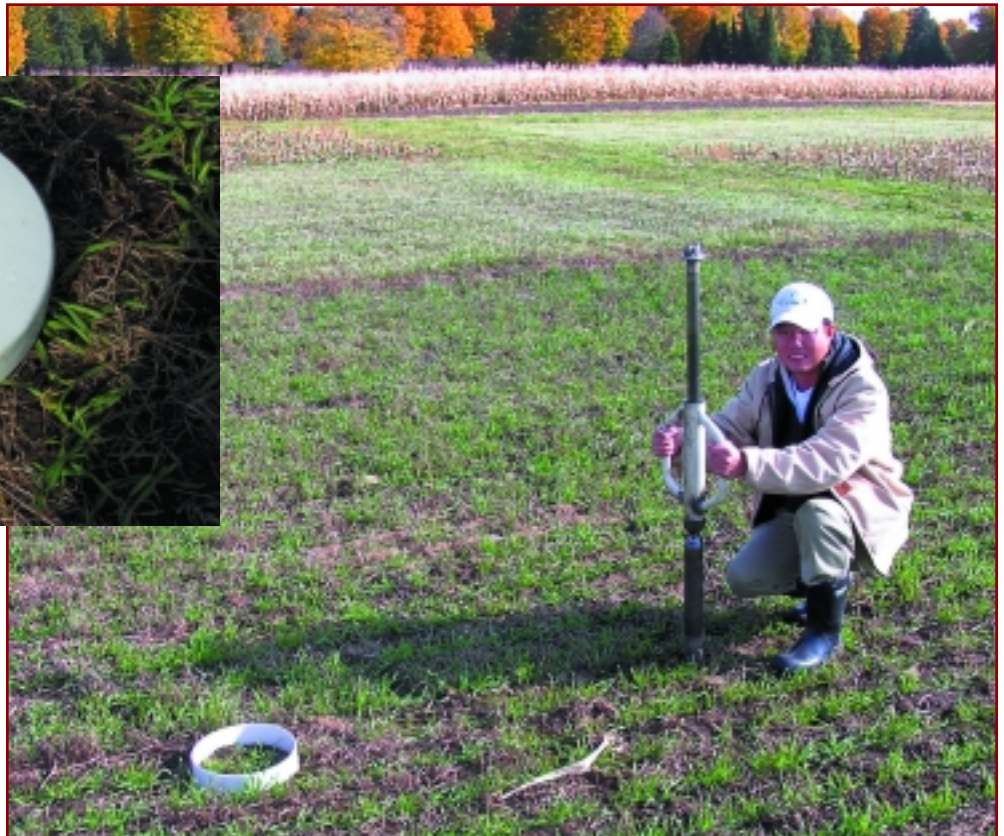
Michigan State is part of the Consortium for Agricultural Soils Mitigation of Greenhouse Gases (CASMGs), a group of 10 states working together to develop tools and provide information to agricultural producers to lower greenhouse gas levels. Fifteen MSU researchers are conducting research through the consortium, a collection of the nation's top researchers in the areas of soil carbon, greenhouse gas emissions, conservation practices, computer modeling and economic analysis. Robertson is the lead investigator for CASMGs at MSU.

Robertson's research at KBS is examining how the rate of carbon gain in managed land, such as agricultural fields, compares to carbon gain in unmanaged lands — lands that are abandoned from agriculture or have never been plowed.

"We've found that fallowed lands gain carbon twice as fast as managed no-till lands," Robertson explained. "But one of the big



Doo-Hong Min conducts research on carbon sequestration at the Upper Peninsula Experiment Station in Chatham. He is studying whether higher latitudes and cooler soils affect soil's carbon sequestration ability.



unanswered questions is the soil's ability to hang on to that carbon. Right now, most Conservation Reserve Program (CRP) lands have a 10-year contract on them. What happens if those lands are plowed after 10 years? How fast will the carbon leave the soil?"

A national program administered by the Farm Service Agency, the CRP is a voluntary program that pays farmers an annual amount to plant a resource-conserving cover crop.

Some preliminary research by Stuart Grandy, a graduate student working with Robertson, is providing some interesting results that may help answer these questions.

Two years ago, Grandy plowed an area at KBS that had never been plowed before. The scientists believed the soil carbon levels were similar to those that would have been found 150 years ago.

"The results showed that this single year of plowing caused a loss of carbon that negated the equivalent of seven to 10 years of no-till storage," Robertson said. "Policy-makers may have to rethink the way some of these conservation programs are structured to ensure that we're accomplishing our goals."

The scientists are also planning to study the effect that no-till has on the carbon in the soil after CRP land returns to production.

"Do you set it back a little or not at all? That research hasn't been done yet," Robertson said.

Much of Robertson's research has been aimed at documenting the actual greenhouse gas cost of agriculture. The studies have looked at every nuance of production — from the fuel use by a tractor to the carbon dioxide required to produce nitrogen fertil-

izer. When all the numbers are crunched and analyzed, conventional agriculture contributes about 110 greenhouse gas units per year to the environment. Organic farming systems contribute 40, and no-till systems contribute about 10.

"The ideal is to get a negative number," Robertson said. "No-till gets us close to zero, which is much better than business-as-usual but is still only a neutral effect. CRP land is negative 200, which is great, but we can't eat CRP production. The more negative the number, the more positive the impact on the atmosphere. Ideally we want to design cropping systems that are as negative as CRP lands."

In the Upper Peninsula, MAES crop and soil scientist Min's work is studying whether higher latitudes and cooler soils have an effect on the soil's ability to sequester more carbon, as well as how dairy-based forage cropping systems can sequester more carbon, an idea that involves what it is known as full-cost accounting for greenhouse gases.

Other greenhouse gases such as methane and nitrous oxide trap more heat than carbon dioxide does, so small amounts of those gases can affect the environment the same way that large amounts of carbon dioxide do. Methane and nitrous oxide have 21 and 310 times, respectively, higher global warming potential than carbon dioxide does over a 100-year period.

But because carbon dioxide is much more abundant in the environment, most policy-makers are seeking to control levels of that gas first. Limiting emissions of methane and nitrous oxide is talked about in terms of carbon dioxide equivalents — in other



PHOTO: MERRITT TURETSKY

Merritt Turetsky, MAES plant biology and fisheries and wildlife scientist, studies how wetlands can hold carbon. Her research found that certain sphagnum mosses took up more carbon as the climate warmed, but she is unsure how fast other species across the landscape will be able to adapt.



words, 1 pound of nitrous oxide is equivalent to 300 pounds of carbon dioxide. The gases are usually talked about in terms of global warming potential (GWP), which is measured in carbon dioxide equivalents. The GWP of carbon dioxide is one, nitrous oxide is 300 and methane is 30.

Like Robertson's research documenting the greenhouse gas cost of farming, Min's research on full-cost accounting for dairy-based forage systems looks at the amounts of all three gases released by a dairy operation and then compares those to the amount of carbon sequestered in the soil through various forage crop production practices.

"Practices that promote efficient nitrogen use to reduce nitrous oxide emissions include applying fertilizer or animal manure in the spring as close as possible to the active crop growth period," Min said. "You can also do a split application of fertilizer or animal manure for hay and pasture fields, use cover crops, and place nitrogen fertilizer strategically in bands on corn, rather than broadcasting it."

Other strategies that farmers can use to reduce nitrous oxide emissions are using nitrification and urease inhibitors, storing animal waste anaerobically (without air) in liquid form or in a covered lagoon, not applying manure to fallow fields in fall or winter, maintaining optimum stocking density on pasture, and planting filter strips to reduce surface runoff, erosion and nitrate nitrogen leaching.



PHOTO: MERRITT TURETSKY

Wildfires in northern locations are another facet of Turetsky's research. Her work may have implications for fire management in these areas.

Practices believed to reduce methane gas emissions, Min said, include balancing feed rations, improving the quantity and quality of pasture and hay, using feed additives, and using manure management practices such as covered lagoons and methane digesters, and limiting the amount of bedding in the manure.

"Carbon sequestration and greenhouse gas emissions can't be separated in dairy-forage systems," he said, "and these two challenges should be considered as a full-cost accounting at the whole-farm or regional landscape scale."

The Market for Carbon

The worldwide impetus for agricultural carbon sequestration will be carbon markets. As the Kyoto Protocol took effect in February, and Thelen, Min and Robertson all are expecting global carbon markets to heat up and provide additional monetary incentives for farmers to store carbon.

Countries or industries with high carbon emissions could buy emission credits from someone — say, a Michigan farmer — who is able to store more carbon than he or she emits. Using Robertson's results, a farmer who implemented no-till would have 100 carbon credits that a high-emitting industry such as a power company could buy.

"Policy-makers need to make sure that the carbon markets are viable enough to compensate farmers fairly for their carbon storage," Robertson explained. "Otherwise, it won't work. Right now, the issue everywhere is compensation. Until the markets develop over the next few years, we won't know how much per acre income farming for carbon will bring in."

Robertson would like to see carbon markets develop enough to pay farmers to use no-till, cover crops and other practices that keep more carbon in the soil. He also thinks allowing farmers to earn carbon dioxide equivalent credits for reducing the amount of nitrous oxide in the atmosphere would be an incentive for Michigan farmers to participate in the carbon markets. Plant biologist Turetsky is interested in whether landowners can receive money for carbon gained in wetland restoration projects.

"MSU research has shown that agriculture can affect the amount of nitrous oxide in the atmosphere," Robertson explained. "Changing fertilizer application rates and timing can have a big effect on the nitrous oxide levels released. It suggests that farmers should be paid for reducing nitrous oxide emissions to the atmosphere in addition to being paid for carbon storage."

All three scientists emphasized, however, that carbon sequestration is a short-term solution. As the world, and especially the United States, continues its love affair with big cars, big houses and other energy-consuming, greenhouse-gas-emitting products, the soil eventually will not be able to absorb any more carbon.

"Carbon sequestration is not a panacea," Robertson said. "It's good in the short run, but after a few decades, the carbon levels will reach equilibrium and the soil won't be able to hold any more. Sequestration is a bandage that may give us a little more time to develop a low-carbon economy. Storing carbon in places other than the soil is possible, but it is either very risky or very expensive — more than \$100 per ton — which makes soil carbon storage very appealing in terms of cost."

∴ Jamie DePolo

What GOES UP



MAES SCIENTIST RICH

HOBBS STUDIES THE

CHEMICAL MAKEUP OF

RAIN, SNOW AND SLEET

AND HOW CONTAMINANTS

IN PRECIPITATION AFFECT

OUR FORESTS.

MUST

COME DOWN

In the 1960s, commercial fishermen in North America and Europe noticed that the numbers of fish in their nets were going down. One possible explanation was a phenomenon known as “acid rain” — any kind of precipitation (rain, snow, sleet, hail, fog) that is acidic. Most rainwater has a pH of 5.6. (The pH scale ranges from 0 to 14 and measures the acidity or alkalinity of a substance. Seven is considered completely neutral, anything



below 7 is acidic and anything higher than 7 is basic or alkaline.) Rain is made more acidic by air pollution, mainly sulfur dioxide and nitrogen oxides from coal-burning power plants, car exhaust and industrial boilers. The pollutants rise through the air, reach the atmosphere, mix with water vapor in the clouds, and turn into sulfuric acid and nitric acid. When it rains, snows, etc., the acids come down from the clouds in the precipitation. Lakes and streams are normally slightly acidic, but acid rain increases their acidity levels to the point that fish and other aquatic creatures can't survive. Acid rain also affects forests, farmland and soil.

What's in the Precipitation

Though the term became popular in the 1970s, acid rain is a phenomenon as old as the industrial revolution. In 1872, Robert Angus Smith, chief inspector of the alkali industry under the United Kingdom's Alkali Works Act of 1863, wrote a book called *Acid Rain* describing similar occurrences in England and Scotland, even though the pH scale had not been invented at that time.

Today, according to MAES forestry researcher Rich Kobe, acid rain is still an issue, but it is more commonly described as the atmospheric deposition of acidifying chemicals. Kobe oversees Michigan State University's par-

ticipation in the National Atmospheric Deposition Program (NADP), a nationwide effort coordinated and funded by agricultural experiment stations across the country to monitor the chemical makeup of precipitation, including acidity and chemicals such as ammonium, nitrate, calcium, magnesium and phosphorus, all of which are both pollutants and important plant nutrients. Each Tuesday morning at 9 a.m., samples of precipitation are collected from more than 200 sites around the country and sent to a national lab in Illinois to be analyzed. Michigan has 10 monitoring sites in the state (as far north as Isle Royale and as far south as the Kellogg Biological Station in Hickory Corners). All the information is made public on the NADP Web site, <http://nadp.sws.uiuc.edu>.

"The amount of sulfate ions in precipitation started to decrease in the early 1990s, just after the reauthorization of the Clean Air Act," Kobe explained. "The NADP really shows the effectiveness of that legislation. But nationally, both nitrogen emissions to the atmosphere, largely from combustion of fossil fuels, and nitrogen deposition in precipitation have continued to increase. In Michigan, we saw a slight decrease in nitrates right after the Clean Air Act was reauthorized, but nationally they continued to increase."

Kobe oversees MSU's participation in the National Atmospheric Deposition Program, a nationwide effort to monitor the chemical makeup of precipitation.

Kobe speculated that nitrogen in precipitation has continued to go up because the sources are more scattered over the country. Nitrogen enters the atmosphere from agricultural sources, such as ammonia, and from the combustion of fossil fuels. Sulfur comes mainly from large coal-burning plants, which tend to be located in specific areas.

"Many scientists are arguing that we need stronger controls on nitrogen emissions," Kobe said, "because atmospheric deposition of nitrogen has not decreased as sulfate has."

Atmospheric Deposition and Forests

Forestry researchers are required to be patient people. Their subjects' lives span hundreds of years, and changes happen at an agonizingly glacial pace.

"The effects are subtle," Kobe said. "I work with computer models a lot to scale the information that I can collect in three or five years to the lifespan of a forest, which could be hundreds of years."

Kobe has been using models to study how forests are responding to atmospheric deposition of acids and their indirect effects on soil nutrients.

"When soils become more acidic, compounds such as calcium, magnesium and potassium can be leached out of the soil," he explained. "Plants need these compounds to grow. As these compounds decrease, levels of aluminum in the soil increase, and aluminum is toxic to plants."

For three years, Kobe and colleagues studied sugar maple, American beech, yellow birch, balsam fir and red spruce trees in the Hubbard Brook Experimental Forest in the White Mountains in New Hampshire. They suspected that atmospheric deposition was having an effect on the composition of the forest and set out to determine what was happening.

"We wanted to assess the indirect effects of acidic deposition," Kobe said. "What were the lower levels of calcium and higher levels of aluminum in the soil doing to the trees?"

The sugar maple seedlings in the forest were not doing as well as the seedlings of other trees, and older, more mature trees were starting to die. Sugar maple is an economically important tree — the trees are tapped for maple syrup, and their wood is prized for furniture.

In a test plot, the researchers applied extra calcium to the forest soil to bring the levels back up to where it was estimated they were in the 1960s. After three years, they saw a 50 percent increase in the growth of sugar maple seedlings. Incorporating these results into forest models suggests that sugar maple trees in the Northeast are likely

to decline more because there will be fewer seedlings to replace the long-lived canopy trees.

Other researchers at Hubbard Brook found that sugar maples have a symbiotic relationship with mycorrhizal fungi that live in the soil next to the tree roots and help extend the tree's root system and access nutrients bound in the soil.

"The fungus has the ability to get calcium out of mineral rocks in the soil," Kobe explained. "We thought that larger trees, which have more extensive root systems and would have more fungi colonized around them, would be able to get enough calcium from the soil through the fungi — the seedlings wouldn't have as many fungi colonized around them. But the big trees are dying even with the fungi's ability to digest calcium from rocks. Together with the dramatic seedling growth responses to calcium fertilization, this is fairly good evidence that low calcium levels are contributing to the decline of sugar maples in the

The NADP really shows the effectiveness of the Clean Air Act.

Northeast. And although the atmospheric and soil chemical reactions are complex, it appears that atmospheric deposition of acids is causing decreased calcium availability, which in turn is influencing our forests."

Kobe has collaborative experiments underway with MAES forestry researcher Mike Walters to test the influence of nitrogen and calcium availability on forest physiology and dynamics in northern Michigan. Kobe said that soil calcium levels at some of these research sites in northern Michigan are the same as those that are causing concern in the Northeast.

"We don't even see sugar maples at our lower fertility Michigan sites," he said. "We may serve as a warning to the Northeast about what may happen to their forests. If we find that soil calcium is influencing forest dynamics the same way as in the Northeast, then our low-fertility sites may also foreshadow the future of Michigan forests under continued acidic deposition from the atmosphere. But we can only assess future scenarios of forest health and species composition with NADP's continued monitoring of precipitation chemistry and through careful experiments of forest responses to that deposition."

∴ Jamie DePolo

MICHIGAN STATE UNIVERSITY SESQUICENTENNIAL

Michigan State University is celebrating its 150th anniversary in 2005. MSU is the pioneer land-grant institution, and its history is closely tied to the history of agriculture, natural resources and rural communities in the state. The Michigan Agricultural Experiment Station was founded on Feb. 26, 1888 — 33 years after MSU was founded — and the MAES has played a significant role in shaping MSU's research legacy and its priorities for the future. Each issue of Futures in 2005 will feature a special sesquicentennial article highlighting the intersection of MAES and MSU history.



In the first half of the 19th century, European farmers began integrating more science into their agricultural production. At the same time, Michigan agricultural producers began advocating for agricultural education at the university level to ensure the state's producers knew about modern practices and could remain competitive. This led to the establishment of the Agricultural College of the State of Michigan in 1855. *Michigan Farmer*, a leading agricultural periodical at the time that continues to publish today, and the Michigan State Agricultural Society (MSAS) sponsored public discussions about the virtues and benefits of an agricultural college for the state's farmers and economy.

In 1850, the state constitutional convention adopted Article 13, Section 11, calling for the creation of an "agricultural school." The constitution, however, specified that this school could be either a separate institution or part of the University of Michigan. This provision sparked a heated debate between supporters of U-M and proponents of a new, independent institution.

John C. Holmes, secretary of the MSAS, worked diligently to persuade the legislature to create a new college focusing on agriculture. Henry P. Tappan, president of U-M, disagreed and worked just as diligently for the creation of a department of agriculture at that university. Tappan argued that since his school already had the necessary pieces in place — a faculty, buildings, library and other facilities — it would be less expensive to start an agricultural program in Ann Arbor. Holmes and those who favored a separate institution were afraid that agricultural studies would be an ignored, second-class program at U-M, which put great emphasis on the study of medicine, law and classical literature. Seeming to underscore Holmes' point, Tappan had made no plans for a model farm at U-M, a learning tool considered absolutely essential by farmers.

In the early part of 1855, Holmes' arguments persuaded the legislature to pass an act establishing a state agricultural school that would be located on a site selected by the MSAS within 10 miles of Lansing. The State Board of Education was designated as the new institution's governing body.

The new agricultural college's enabling legislation called for a curriculum that went well beyond practical agriculture: "The

course of instruction in said college shall include the following branches of education, viz. an English and scientific course, natural philosophy, chemistry, botany, animal and vegetable anatomy and physiology, geology, mineralogy, meteorology, entomology, veterinary art, mensuration, leveling and political economy, with bookkeeping and the mechanic arts which are directly connected with agriculture.”

From the beginning, the Agricultural College of the State of Michigan offered courses that would come to be known as the land-grant philosophy of higher education after the passage of the Morrill Act in 1862. The goal was to produce graduates who were well-informed citizens as well as good farmers. Many legislators used the Agricultural College of the State of Michigan as an example as they were seeking federal support for the Morrill Act.

The Morrill Act was passed the same year as the Homestead Act, which permitted any citizen, or any person who intended to become a citizen, to receive 160 acres of public land and then buy it at a nominal fee after living on the land for five years. These terms were the most generous of any land act in U.S. history and allowed many people to settle and own their own farms. These new farmers needed education, and the Morrill Act made it possible for almost all young Americans to receive some sort of an advanced education.

Sponsored by Vermont Congressman Justin Morrill, the act gave every state that had remained in the Union after the southern states seceded a grant of 30,000 acres of public land for every member of its congressional delegation. (Every state had at least two senators and one representative, so even the smallest states received 90,000 acres.) The states were to sell this land and use the money to create colleges in engineering, agriculture and military science. (This is why some land-grant schools, such as Texas A&M have “A&M” in their titles — it stands for “agriculture and mechanical.”)

More than 70 land-grant colleges were established through the original Morrill Act. A second act in 1890 offered the land-grant opportunity to the 16 southern states. But the Morrill Act did not specify research activities. Because resources were limited, many land-grant colleges couldn’t conduct systematic experiments.

Manly Miles, professor of agriculture at Michigan’s State Agricultural College — the first professor of agriculture in the United States — and Willard Flagg, of the Illinois Industrial College, organized a meeting of agriculturalists from land-grant colleges in 1871. The group developed a list of experiments and research areas that they felt were most needed. Flagg introduced the idea of experiment stations based on the European model.

But it wasn’t until 1887, when Congress passed the Hatch Act,

that a nationwide network of agricultural experiment stations at the state’s land-grant colleges was created. The agricultural experiment stations were charged with conducting research and development projects in behalf of farmers. The results from this research helped modernize and update agricultural practices and allowed them to be tailored to each state’s unique geography and needs. Theophilus C. Abbot, president of Michigan’s State Agricultural College from 1862 to 1884, and his successor, Edwin Willits, president from 1885 to 1889, were both persuasive advocates of agricultural colleges’ roles in economic development. These two men were instrumental in gaining congressional approval for the Hatch Act.

In 1914, Congress passed the Smith-Lever Act, which created the third and final arm of the land-grant tradition: the Cooperative Extension Service (known today in Michigan as MSU Extension). A partnership between the U.S. Department of Agriculture and the land-grant institution in each state, Extension was created as an educational outreach arm to extend the results of research programs at the land-grants and affiliated state agricultural experiment stations to all citizens who might benefit from them. Each county has an Extension office focused on the needs of that area.

Today, Michigan State University, the Michigan Agricultural Experiment Station and MSU Extension work together to provide the state’s citizens with strategic research, education and outreach to enhance agriculture; natural resources; children, youth and families; and community and economic development.

Celebrating our sesquicentennial, we look back at just how far this university has come in 150 years. From a small scientific agricultural college among the fields on the outskirts of Lansing — a new idea in higher education and uniquely American experiment — to the world-class, globally-engaged powerhouse that we are today, it’s really been an amazing journey.

But we also look ahead and recognize that all of us here today will become part of the history of this great institution as well. And like those who came before us — those whose names we hear every day because they’re on the streets, the buildings and the land where we live and work, names like Williams, Abbot, Snyder, Kedzie, Butterfield, Shaw, Wharton, the legendary John Hannah, and all the rest — we have a responsibility not only to those who are here today, but those who will come after us. The vision and tireless efforts of our predecessors helped make Michigan State University the kind of place it is today. Ours must make it the place we want it to be tomorrow.

— MSU President Lou Anna Kimsey Simon

::: Jamie DePolo

Research *in the news*



Gary Lemme

MAES Associate Director Appointed South Dakota State University Dean

Gary Lemme, associate director of the MAES, has been named dean of the College of Agriculture and Biological Sciences at South Dakota State University (SDSU), effective in May.

In his five years at the MAES, Lemme has worked extensively with Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs), a coordinated effort among plant-based commodities and businesses, the MAES, Michigan State University Extension, the Michigan Department of Agriculture and the Michigan Farm Bureau to improve Michigan's plant and agriculture industries, the economy and the environment.

Lemme has also worked on efforts to expand the regional impact of MAES-supported research. He's encouraged collaboration with scientists in nearby states to better address problems throughout the Upper Midwest. Additionally, Lemme has advanced efforts to leverage MSU intellectual property through extensive shepherding of MAES-generated patents and licensable technology. He's continued to do research, as well, including a recent project funded by the U.S. Department of Agriculture exploring how to secure the nation's food supply.

Prior to joining the MAES in October 1999, Lemme was professor and head of the West Central Research and Outreach Center at the University of Minnesota for

seven years, beginning in 1992. From 1990 to 1992, he was assistant dean of academic affairs in the College of Tropical Agriculture and Human Resources at the University of Hawaii. From 1981 to 1990, Lemme was assistant professor, associate professor and professor in the Department of Plant Science at SDSU, and from 1979 to 1981, he was an assistant professor in the Department of Crop and Soil Sciences at MSU.

The move back to Brookings, S.D., is a homecoming of sorts for Lemme. In addition to his time as an SDSU professor in the 1980s, he received both his bachelor's degree in agricultural education and his master's degree in agronomy from SDSU, in 1974 and 1975, respectively. He received his doctorate in agronomy from the University of Nebraska-Lincoln in 1979.

Buhler Named MAES Acting Associate Director

Doug Buhler, chairperson of the Department of Crop and Soil Sciences, joined the MAES March 15 as acting associate director, a position he will hold through December 2005. Buhler also will serve as acting associate dean for research for the College of Agriculture and Natural Resources (CANR). He replaces Gary Lemme (*see story above*).

In his new role with the MAES, Buhler acts as liaison with Michigan commodity groups and assumes Lemme's leadership role in Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs). Project GREEN is a cooperative effort between plant-based commodities and businesses together with the Michigan Agricultural Experiment Station, MSU Extension and the Michigan Department of Agriculture to advance Michigan's economy through its plant-based agriculture.

As CANR acting associate dean for research, Buhler provides oversight for and coordination of the CANR's research program. The majority of research in the CANR is MAES-related.

Buhler was born and raised on a small dairy farm in southern Wisconsin. He received his bachelor's degree from the University of Wisconsin-Platteville and his master's and doctoral degrees (both in

agronomy) from the University of Nebraska.

After receiving his doctorate, Buhler returned to the University of Wisconsin, where he taught and advised undergraduates and conducted research on weed biology, management and conservation. He joined the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) in St. Paul, Minn., in 1989 with research responsibilities in weed



Doug Buhler

management and water quality. In 1993, Buhler was transferred to the USDA-ARS National Soil Tilth Laboratory in Ames, Iowa, where his research responsibilities included weed biology, ecology and management in corn and soybean production systems.

Buhler joined MSU as professor and department chair in 2000. In 2003, he also became MSU Extension's state leader for agriculture programs.

Buhler's research and outreach activities focus on the responses of weed populations and weed control practices to various crop and soil management systems. His research results are being used to develop and implement improved weed management systems and have resulted in more than 330 publications, including 125 refereed journal and review articles.

Buhler has been the author or editor of three books and an invited presenter at 90 seminars, symposia and workshops. He has served as an associate editor for *Weed*

Research in the news

Science and Weed Technology and is a consulting editor for the *Journal of Crop Production*. Buhler is a fellow of the North Central Weed Science Society, the Weed Science Society of America, the American Society of Agronomy, and the Crop Science Society of America. He received the Outstanding Researcher Technologist Alumni Award from the University of Wisconsin-Platteville, paper of the year honors from *Weed Science* (as a co-author), the Raymond and Mary Baker Agronomic Excellence Award from Iowa State University, the Outstanding Young Weed Scientist Award from the Weed Science Society of America, the T.W. Edminster Award and the Midwest Area Early Career Scientist of the Year honors from the USDA-ARS, and he was named Distinguished Young Scientist by the North Central Weed Science Society.

The MAES is currently conducting a national search for a permanent director. The process for naming a permanent associate director will occur after the new director is selected.

MSUE Director Named

Tom Coon, associate dean for graduate and international programs for the College of Agriculture and Natural Resources (CANR), has been appointed director of Michigan State University Extension (MSUE), effective March 1, pending confirmation by the U.S. Department of Agriculture (USDA).

He replaces Maggie Bethel, who served as acting director, then director of MSUE for more than four years. During her tenure, MSUE focused resources to meet the needs of Michigan communities despite significant and sustained budgetary pressure due to reduced state support and other factors. Under Bethel's leadership, MSUE undertook a process to identify key issues and deploy its resources to address areas of importance to the people of Michigan: building strong communities, strengthening agricultural profitability, encouraging responsible land use, building healthy families and helping youth succeed.

Coon has been a member of the MSU faculty since 1989 and has been associate dean for graduate and international programs for the CANR since November



Tom Coon

2002. As associate dean, he was closely involved in the budget process for MSUE, MAES and the CANR. He also co-chaired the strategic investment review for MSUE in 2002.

Before becoming associate dean, Coon was a professor affiliated with the MAES and associate chair of the Department of Fisheries and Wildlife. He served as acting department chairperson from 1999 to 2001. He has an extensive background in teaching and research, and he serves in numerous professional societies concerned with aquatic habitat, wildlife ecology and fisheries. He has also served on many college and university committees. He participated in the Liberty Hyde Bailey Scholars program from 1997 to 2002 and received a Phi Kappa Phi Excellence Award for Interdisciplinary Scholarship for his work with the program in 2000. He received the Distinguished Service Award from the American Fisheries Society in 1998; a Distinguished Faculty Teaching Award from Alpha Zeta Society, Kedzie Chapter, in 1994; an Outstanding Faculty Award from the University of Missouri School of Forestry, Fisheries and Wildlife Student Council in 1988; and the Distinguished Faculty Award from the MSU CANR Alumni Association in 2003. Coon received master's and doctoral degrees in ecology from the University of California-Davis, and a bachelor's degree in biology from Luther College, Iowa.

New MAES Faculty Members

The MAES is pleased to announce the appointment of the following new faculty members.

Hui Li was named assistant professor of crop and soil sciences in January. His research focuses on environmental soil chemistry, with an emphasis on investigating the environmental physicochemical processes and ecological impacts of organic contaminants containing complex structures, and applying these basic findings to minimize negative impacts on the environment. He plans to study the environmental fate, transport and effects of emerging contaminants associated with animal manures, composts and biosolids, and develop agricultural practices that reduce any negative effects on land and water.

From 2000 to 2004, Li was a postdoctoral research associate in the Department of Crop and Soil Sciences at MSU. He received his doctorate in soil chemistry from Purdue in 1999 and his master's and bachelor's degrees in environmental chemistry from Nanjing University, China, in 1993 and 1990, respectively. He is a member of the Soil Science Society of America; the American Society of Agronomy; and the American Chemical Society, Environmental Chemistry Division.

Joanne Riebschleger was named assistant professor of social work in January. Her research focuses on rural social work practice and children of parents with psychiatric disabilities. She is also the chair of the Research Committee of the National Institute on Social Work and Human Services in Rural Areas, also known as the National Rural Social Work Caucus.

Before coming to MSU, Riebschleger was an assistant and associate professor of social work at Central Michigan University from 2000 to 2004. From 1995 to 2000, she operated her own counseling services organization. Before that, she held numerous positions in the social work field, including medical social worker, research coordinator, outpatient services supervisor, program coordinator, client services manager, case services manager and resident services worker, and she was regional director of the

Research *in the news*

Northern Michigan Community/University Health Partnerships Project for MSU.

Riebschleger is a member of numerous professional organizations and has published many articles and presentations. She received her doctorate in social welfare from Case Western Reserve University in 2001, her master's degree in social work from MSU in 1990 and her bachelor's degree in human services from Ferris State University in 1979.

MAES Scientists Awarded \$1 Million for Swine Research

Meeting consumers' expectations for meat quality while keeping pork production profitable is one of the biggest challenges facing Michigan pork producers. Over the years, researchers have looked at various management strategies to produce leaner pork to increase consumer appeal. Genetic selection methods to improve lean growth rate in pigs, however, have caused a decline in meat quality.

Now a team of MAES scientists is looking at DNA markers and gene expression patterns to determine the genetic components that control lean growth and meat quality traits. The research team, led by Cathy Ernst, MAES animal science researcher, was recently awarded a \$1 million grant from the U.S. Department of Agriculture to conduct the study.

"This grant gives us the opportunity to broaden the scope of the research we have been doing here at Michigan State University," Ernst said. "Locating and utilizing specific favorable genes for lean growth and meat quality will help overcome the natural antagonistic relationship and allow improvement in both efficient production and product quality."

Collaborators on the project are MAES animal scientists Ron Bates, Matthew Doumit, Guilherme Rosa and Robert Tempelman; Udaya DeSilva, assistant professor of animal science at Oklahoma State University; and MSU animal science graduate student David Edwards.

"This particular research is an excellent example of how the investment made in the Animal Agriculture Initiative continues to benefit Michigan producers," said Karen Plaut, chairperson of the Department of Animal Science.

2004 Spartan Innovator Award presented to W.K. Kellogg Forest Experiment Station

Greg Kowalewski, manager of the W.K. Kellogg Experimental Forest field station, received the 2004 Spartan Innovator



Greg Kowalewski (*right*) accepts the 2004 Spartan Innovator Award from Ben Darling in February.

Award at the 24th Annual Farm Manager Seminar in February.

Kowalewski received the award on behalf of Kellogg Forest staff members for ingenuity and innovation in designing and implementing a safety feature for their transportation wagons. Called the Safe Step, the new feature provides non-slip steps and a handrail to visitors and volunteers when they are boarding transportation wagons during Kellogg Forest activities and events, such as the maple syrup open house. The Safe Step is also designed to pivot over obstacles that may be encountered when moving through the trails.

The Innovator Award recognizes the outstanding efforts, positive contributions and achievements in the field by farm, station, and property staff members to meet the ever-changing and continually-growing challenges of regulations, safety, technology, research, and funding.

"We have many conscientious, creative and talented people in the MSU/MAES farm, station and property family," said Ben Darling, assistant director of the Land Management Office. "This award is

one small way to let them know that we notice and appreciate what they are doing and that it truly does make a difference. Through the recognition process, numerous ideas and concepts are demonstrated for all of the farm, station and property managers, enhancing their ability to solve common challenges and issues."

MAES Scientists Honored at Founders' Day Celebration

Four MAES scientists and the acting director of the Kellogg Biological Station were honored with Distinguished Faculty Awards at the Founders' Day celebration and award ceremony in February.

An MAES agricultural economist received a Teacher-Scholar Award and a researcher at the Kellogg Biological Station received a Distinguished Academic Staff Award at the same ceremony.

The Awards Convocation followed President Lou Anna Kimsey Simon's State of the University speech.

Stuart H. Gage, MAES entomology researcher; Katherine L. Gross, acting director of the Kellogg Biological Station; Stephen B. Harsh, MAES agricultural economics scientist; G. Philip Robertson, MAES crop and soil sciences researcher; and Alvin J.M. Smucker, MAES crop and soil sciences researcher, received Distinguished Faculty Awards. Judith M. Whipple, MAES agricultural economics researcher, received a Teacher-Scholar Award. Dale R. Mutch, MSUE district crops pest management educator at the Kellogg Biological Station, received a Distinguished Academic Staff Award.

Each Distinguished Faculty Award recipient receives a stipend of \$3,000. The award is presented in recognition of a comprehensive and sustained record of scholarly excellence in research and/or creative activities, instruction and outreach.

Teacher-Scholar Awards, which carry a \$2,000 stipend, are given for devotion to and skill in teaching and scholarly promise.

Distinguished Academic Staff Awards, which carry a \$2,500 stipend, are given for extraordinary academic achievement, excellence and exceptional contributions.

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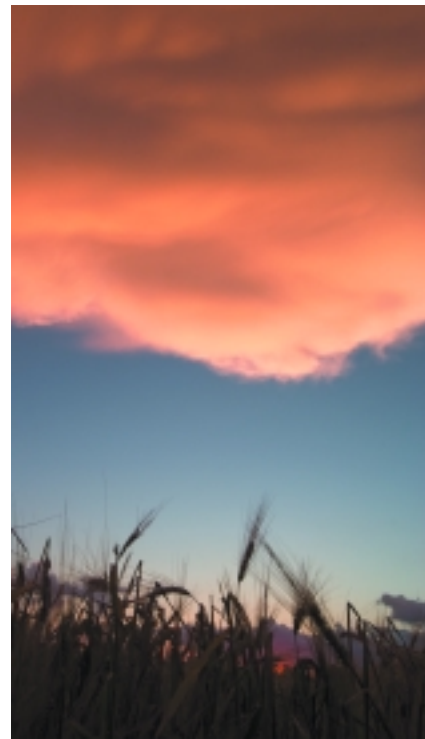
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