

## Appendix F: Global Environmental Strengths at MSU

The words international and environment connote a variety of definitions to people. Although no one standard definition of environment exists, it generally includes the sum of all external conditions (including physical, chemical, biological, geographic, social, economic, cultural and political) that affects the life, development, and survival of an organism or ecological community. International refers to those issues that relate to or affect two or more sovereign nations. Michigan State University (MSU) has historically been identified as an institution with a global outlook and a committed leader in international and environmentally related activities. The purpose of this paper is to provide an overview of MSU international activities (teaching, research, outreach/extension) as related to the environment. In this report we provide a *sampling* of the current international environmental activities that are occurring in different units within MSU and provide suggestions for how the University can further facilitate international environment activities based on discussion we had with various segments of the University community. Additionally we identify topics and regions around the world, as shared by MSU faculty and staff, where MSU could become a leader as related to global environmentally related activities.

### MSU's Current International Environmental Activities

Michigan State University has more than a 50-year legacy of international engagement that has resulted in more than 200 major research and technical assistance projects in more than 20 countries.<sup>1</sup> Among these projects has been the significant presence of a broad commitment in all aspects of its mission (i.e., teaching, research, and outreach/extension) to protecting, enhancing and sustaining the environmental conditions of the global community.

#### Research—

Information about research activities that are conducted under a thematic **international environment** umbrella can be obtained from data gathered by Office of International Development and the Office of Contracts and Grants. We have chosen the colleges of Agriculture and Natural Resources, Natural Sciences, Engineering (Environmental Engineering), Social Science and Veterinary Medicine as those entities most closely aligned to environmentally related issues. From 1997 – 2001 almost \$1 billion was awarded to MSU for international activities. Of that, almost 90% was funds derived from the U.S. federal government entities with USAID providing the largest percentage (48%). The College of Agriculture and Natural Resources received the greatest amount of internationally focused research funding (~42%, \$41,498,761), followed by the College of Social Science (14.3%) and the Institute of International Agriculture (11.4%) (Memorandum to M. A. Walker from L. Lee dated May 1, 2002). International research on the environment has focused predominately over the past 5 years on countries in Africa and Latin America / Caribbean (MSU, Current International Development Projects, June 2004, MSU Current Projects Matrix 0604.xls). Country specific environmental projects are also in progress. MSU is involved in projects in 14 African countries, 10 Asia / Near East countries, 11 Latin America / Caribbean countries, and 8

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<sup>1</sup><http://www.acenet.edu/programs/international/collaborative/research/michiganstate.cfm#general>.

Eastern European countries (MSU, Current International Development Projects, June 2004, MSU Current Projects Matrix 0604.xls).

### Teaching—

Information available from the Office of International Scholars and Students (OISS) can provide insight into the number of international students and scholars interested in environmentally-related disciplines (MSU, OISS, Statistical Report, January 2004). We have chosen the colleges of Agriculture and Natural Resources, Natural Sciences, Engineering (Environmental Engineering), Social Science and Veterinary Medicine as those entities most closely aligned to environmentally related issues. The following table depicts the number of international students enrolled in each of these colleges for 2002 – 2003.

College	Undergraduate	Master's	PhD	Total
<b>CANR</b>	31	114	178	323
<b>CNS</b>	86	74	396	556
<b>CSS</b>	69	84	69	222
<b>CE (Environ. Only)</b>	0	15	7	22
<b>CVM</b>	1	6	23	30
<b>Total</b>	187	293	673	

Since 1999, international student enrollment trends have increased 12% (CANR) to 113% (CVM) in environmentally related disciplines. Although not specific to an environmental focus, the top 5 countries sending students to MSU in 2003 included Korea (20.7%), China (16%), India (11.4%), Japan (5.2%) and Canada (3.7%).

Michigan State University has an international reputation for the quality and quantity of its Study Abroad programs. Currently there are 83 courses which have an environmental emphasis offered in 39 countries.<sup>2</sup> As such, it is clear that MSU excels in many disciplines related to international environmental sciences and is engaged in partnerships with colleagues in many regions of the world. We expect this engagement to considerably broaden and deepen in the next decade as MSU is currently developing signature programs that initiate exciting new opportunities for research, education and outreach related to the environment (e.g., Environmental Science and Policy Program (ESPP; [www.environment.msu.edu](http://www.environment.msu.edu)), Land Use Policy Program ([www.landpolicy.msu.edu](http://www.landpolicy.msu.edu)), Center for Systems Integration and Sustainability ([www.csis.msu.edu](http://www.csis.msu.edu)), and the

<sup>2</sup> <http://studyabroad.msu.edu/programs/listbycountry.html>.

Science, Technology, Environment and Public Policy Specialization (STEPPS; <http://www.fw.msu.edu/undergraduates/specializations/STEPPS/>)).

### **Outreach—**

Outreach/extension is based in many programs across the MSU campus. MSU Extension (MSUE) is the largest unit on campus with a specific mission to coordinate and implement extension related activities. MSUE has a specific strategic planning element targeting international extension programs. In 1979, through Title XII Strengthening Grants, MSU created a formal program to build capacity of extension personnel (International Extension Training Program – IETP) to help serve international development assistance (Andrews no date).

### **The University's Role**

Classically, the three major tenets guiding the land grant universities in our country have been the development, innovation and integration of teaching, research, and outreach activities to provide for an informed, engaged citizenry and enhanced standard of well being. MSU has embodied this mission, not only for the State of Michigan but also for the world. As such MSU has historically provided a leadership role in participation in and promotion of understanding the global nature of human interactions with the environment. The interaction of humans across the globe has been and continues to be a guiding principle of MSU core educational mission. As stated in our mission statement, one role MSU sees for itself as a land grant institution is to strive “to discover practical uses for theoretical knowledge, and to speed the diffusion of information to residents of the state, the nation, and the world (MSU 2004).”

Michigan State University views the facility for research and its application to be a catalyst for positive intellectual, social, and technological change (MSU 2004). This component of the university educational philosophy is an important part of what enables international connections to be made; the common language of discovery for better living for all resonates to all peoples and serves as a bridge between cultures and their embedded institutions. This is particularly true for evaluation of environmental issues. By necessity, environment knows no bounds and while management is practiced at local levels, its impact often reverberates through the global community (e.g., global change, water security).

Research by itself is impotent if not delivered through a medium that makes it culturally relevant and responsive to a broad segment of society. Thus, a second major role of the university is instruction, both in and out of the classroom. Michigan State University has become an internationally esteemed university, offering a comprehensive spectrum of programs and attracting gifted professors, staff members, and students from around the world (MSU 2004). MSU has recruited faculty and programs based on the international environmental theme and new programs such as ESPP, CSIS and STEPPS have been leading contributions to this initiative. The exchange of faculty and students help create long-term links with other institutions and cultures which further strengthen MSU's ability to effectively link environment issues and their management from a local to a global scale. Such activities include the development of new internationally focused curriculum (e.g., FW / MC 481 – Global Issues in Fisheries and Wildlife), outreach

activities and joint conferences (e.g., International Association for Landscape Ecologists (IALE)).

Innovation and leadership in the extension of knowledge to the state, the nation, and the world is a hallmark of the university (MSU 2004). Outreach activities provide a bridge between the university and the citizenry of the world. As such, MSU has adeptly become a university without walls, making its expertise available worldwide and providing opportunities for our students, faculty and staff to become meaningfully involved in the world community's welfare. This has been done in partnership with many disciplines which integrate the discovery of knowledge, with the transmission and use of this knowledge to all people, thereby empowering people to make a difference in their home communities and beyond.

### **Selected Case Studies**

A series of case studies have been included to document internationalization related to environmental issues concerning research, teaching, and outreach. These case studies are a *limited example* of projects relating to the environment and internationalization. They were chosen to represent the diversity of international environmental involvement currently occurring on the MSU campus in teaching, research, and outreach/extension. The case study information was derived from interviews with MSU faculty.

#### **Teaching—**

##### *1. IIA WorldTAP*

The Institute of International Agriculture (IIA) (<http://www.iaa.msu.edu/>) serves as one of MSU's focal points to facilitate exchange of knowledge, information and technologies related to agriculture development and food security with the global community. The IIA, during the last 10 years, has designed and implemented international training programs to improve the productivity of agricultural sectors in an environmentally friendly manner - referred to as "WorldTAP." This program offers international training programs and facilitates transfer of agricultural technologies identified through IIA's training and capacity building programs. WorldTAP links training and technology transfer and enhances the capacity of developing countries in accessing new and emerging technologies from both public and private sectors. Countries around the world are trying to access technologies to improve the productivity of their agricultural sectors in an environmentally friendly manner. The WorldTAP programs offer training courses on MSU's campus through distance learning capabilities and in the field related to intellectual property rights, biosafety, food safety, integrated pest management, agricultural biotechnology, and technology transfer. More than 500 international scientists, policy makers, senior administrators from both public and private sectors have received training through these programs. The WorldTAP utilizes expertise and experience from MSU and around the world to assist the global community.

##### *2. EPIQ II*

EPIQ II (<http://www.epiq2.com/index.shtml>) has been designed to develop and implement policy and institutional governance programs to enhance environmental quality, strengthen natural resource management, and promote sustainable and equitable economic development in a wide variety of development settings. EPIQ II enables

USAID missions, bureaus, and the Department of State to rapidly access top-notch technical expertise in three outstanding consortia that support policy reform and institutional governance, improvements in environmental quality, and sustainable natural resource use. International Resources Group (IRG) is one of the three prime contractors of the three EPIQ consortia. IRG is an international professional services firm that helps governments, the private sector, communities, and households manage critical resources to build a cleaner, safer, and more prosperous world. Michigan State University is one subcontractor associated with IRG and offers expertise in agricultural and natural resources development, including creating incentives for adoption of environmental technologies in agriculture; developing and evaluating policy instruments for controlling non-point sources of water pollution, particularly from agriculture; community based natural resource management; institutional and human capacity building; analysis of the human dimension of GCC-related changes in land use and cover; and conducting international field research in gender, justice, and the environment.

Projects funded through EPIQ II deal with a wide variety of environmental and natural resource related policy formation and institutional governance activities at the national and local level—and with any related technical assistance, training, research, or other initiative that improves a host country's ability to support economic growth, participate in international agreements, and strengthen public-private sector partnerships.

### **Research—**

#### *1. Development and Management of Resistance to Potato Tuber Moth*

The potato (*Solanum tuberosum* L.) is an important food crop worldwide. The potato tuber moth (PTM) (*Phthorimaea operculella* Zeller) is a serious pest in sub-tropical and tropical regions of the world. The tuber moth mines leaves and feeds on tubers. The PTM is a serious pest of potatoes in both field and storage facilities affecting both yield and quality of potatoes.

Through funding from USAID, MSU's potato breeding program started a special project with the Agricultural Genetic Engineering Research Institute (AGERI) in Egypt in 1993 to develop transgenic Bt (*Bacillus thuringiensis*) potatoes for PTM resistance. This project started as a collaborative project under the Agricultural Biotechnology Support Project managed by MSU. The ABSP Project licensed the codon-modified *cryIIa1*Bt gene from the ICI Seeds Company in October 1994. This gene was licensed, for research purposes, only to develop transgenic potatoes resistance to PTM. MSU currently has a research license for use of this gene in potatoes. MSU faculty in collaboration with the AGERI scientists developed Bt potato lines using the *cryIIa1* gene. The potato variety "Spunta" was one of many lines or varieties transformed using this gene. The Bt Spunta lines performed very well during field testing in Egypt and provided excellent control of PTM both in the field and storage. Egypt regularly exports potatoes and other agricultural commodities to European Union (EU). Due to trade concerns with the EU over GMOs, the Egyptian government has decided not to commercialize Bt potatoes at this time.

In 2001, the ABSP project started a new collaboration with the Agricultural Research Center (ARC) in South Africa with an initial goal to commercialize PTM resistant Bt potatoes for the resource poor farmers. The Spunta Bt potato lines were transferred to ARC's Vegetable and Ornamental Plant Institute (VOPI) in Roodeplaat under a material transfer agreement for a field trial in South Africa. VOPI has excellent infrastructure and serves as the only national potato breeding program (in all of Africa). South Africa also has a vibrant potato industry. The first field trial was conducted at VOPI in 2001; field trials were repeated in 2002 and 2003 at two locations and in 2004, field trials were planted at five locations in South Africa. The field and storage trials in South Africa have produced excellent results in terms of PTM control, and have generated interest among both small scale and commercial farmers for growing the Bt variety.

The MSU team is currently developing a regulatory file for submission to the South African government. As a part of this effort, MSU and VOPI are working together and gathering environmental biosafety, food safety and toxicology data in collaboration with local and international experts. A local South African team is also conducting an *ex-ante* socio-economic assessment. The goal is to assess potential socio-economic impacts of this technology in South Africa. MSU potato team in collaboration with VOPI scientists are currently transforming three additional potato varieties that are very important to small scale and commercial farmers in South Africa (BP1, Mnandi and Darius). VOPI is also engaged developing a road map for seed production, commercialization and distribution of this technology to farmers in South Africa. Since 1993, USAID has invested more than 2.5 million dollars in this project. It is expected that it will take 3 - 4 more years to commercialize this technology in South Africa, provided a commercial license and regulatory approvals are granted for this technology.

## *2. Great Lakes Research Partnerships*

Michigan State University is an integral partner to Great Lakes education and management activities. The Michigan Sea Grant College Program, arising from a partnership between MSU and the University of Michigan is one of the many programs that aim to enhance Great Lakes education and research. This program provides research funding to qualifying projects focusing on Aquatic Nuisance Species, Great Lakes Tropic Change, Sustainable Coastal development, Great Lakes Coastal Wetlands, Great Lakes Education, and Food-Web Disruption. MSU faculty are involved in several Great Lakes research project funded by the Michigan Sea Grant College Program. During the 10-year period between 1993 and 2003, MSU faculty received almost \$3 million in research funding from Sea Grant.

The Partnership for Ecosystem Research and Management (<http://www.fw.msu.edu/PERM/>), established in 1993 between MSU and the Michigan Department of Natural Resources (MI DNR), is another successful Great Lakes related program. PERM has provided a pathway through which MSU has been increasing its collaboration with various fisheries organizations, including the Great Lakes Science Center, MI DNR, US Geological Survey and the Great Lakes Fishery Commission (GLFC). Faculty positions at MSU funded by these partner agencies are located in the departments of Agricultural Economics, Fisheries and Wildlife, Forestry, and Geography.

The PERM program provides a platform on which the partnership between MSU and the GLFC has blossomed and continues to grow. The GLFC was established in 1955 by the Canadian/U.S. Convention on Great Lakes Fisheries ([www.glf.org](http://www.glf.org)). The GLFC supports research in the biological and social sciences to support information needs essential to achievement of a healthy Great Lakes ecosystem. One of the more prominent programs is the sea lamprey research program which provides information important to decision making for the GLFC's sea lamprey control program. GLFC sponsors through grants research projects focusing on improving sea lamprey control methods that is conducted by researchers from the USGS and universities, including MSU, located around the Great Lakes basin. Combined implementation of pest control and research on improving these control mechanisms have proved to be effective in reducing the sea lamprey population by 90%, allowing for the rehabilitation and enhanced productivity of important Great Lakes fisheries (<http://www.glf.org/lampcon.asp>).

This MSU-GLFC partnership which has grown under PERM has resulted in the advancement of our knowledge of the Great Lakes ecosystem, their fisheries, and has provided venues for students, faculty and staff to become actively involved in providing internationally relevant research and outreach to partners on the Great Lakes fish communities. In 2003 and 2004 MSU faculty were co-authors of several published articles in the *Journal of Great Lakes Research* whose research were funded by the GLFC, including articles on estimating parasitic sea lamprey abundance in Lake Huron, and sex pheromone communication in the sea lamprey: implications for integrated management. Additionally, the PERM scientists at MSU are an important source of expertise frequently sought by the PERM partners. For instance, PERM partners have sought this group of experts to assist with external reviews including that of the Great Lakes Science Center's research program and of the assessment programs of the Great Lakes Fishery Commission. These above partnerships have substantially contributed to the work accomplished by MSU faculty on Great Lakes research and education.

### **Outreach—**

#### *1. Partnership for Enhancing Agriculture in Rwanda through Linkages (PEARL)*

Michigan State University is the lead partner in PEARL, Partnership for Enhancing Agriculture in Rwanda through Linkages, a project to help rebuild and link agricultural institutions and rural communities of Rwanda. The project has given faculty of Rwandan universities access to new educational opportunities and helped to revive the country's floundering coffee industry. PEARL began in 2000 and is funded by the USAID. Other partners are Texas A&M University (TAMU), the Universite Nationale du Rwanda (UNR), and the Institut des Sciences Agronomiques du Rwanda (ISAR).

One of the primary results of the PEARL project has been graduate education at MSU and TAMU for 16 faculty members from the two Rwandan agricultural partner institutions. As of spring 2004, nine of these Rwandans had already finished their graduate degrees and returned to their home institutions. In addition to a solid academic foundation, they returned with experience of the agricultural extension concept, and will,

in their new roles, help establish closer links between their institutions and Rwandan farmers.

A PEARL Outreach Center has been established in Rwanda to facilitate the efforts of these faculty members and others to establish a land-grant approach. PEARL has also focused on the reconstruction of the coffee industry as the best opportunity for raising the standard of living of the country's many farmers and addressing Rwandans' needs for housing, education, and healthcare. Rwanda's moderate climate, rich volcanic soil, abundant rainfall, and large proportion of land at high elevations provide the most ideal conditions for growing coffee. But coffee production diminished drastically after the 1994 war because of the country's refugee crisis and a continued slump in world coffee prices. The PEARL project devised an aggressive strategy for enhancing the quality of Rwanda coffee to a level where it could compete in world specialty coffee markets.

In 2001, PEARL partners began working with the coffee growers' cooperative of Maraba, the poorest district of Rwanda, to develop a high-quality specialty coffee that would sell for higher prices under fair-trade agreements. The Maraba coffee cooperative was able to construct a state-of-the-art coffee washing station, and technical upgrades have been put in place. Co-op members have been trained to do the meticulous hand sorting of beans, operate the washing station, and shepherd the beans through the careful drying process. Through project linkages, Community Coffee, the largest coffee company in the southern US, became the first US buyer of "Café Maraba Bourbon," with containers being shipped to New Orleans after every harvest. In fall 2004, 31 Whole Foods stores in Illinois carried Rwandan specialty coffee for the first time. On the basis of the Maraba model, and with the active support from Rwanda's President and the National Coffee Board, PEARL is now working with ten cooperatives/enterprises across Rwanda to improve infrastructure quality and management of the supply chain. PEARL began a second three-year phase in October 2003 with the acceptance of the Phase II proposal by the USAID/Rwanda mission.

## *2. Nepal: Understanding the Rivers, Environments, and Cultures*

The Seti River in Nepal has much in common with Lake St. Clair just north of Detroit. Both waterways are not only home to the same type of aquatic insects; they also have similar pollution problems. In June of 2001, a team of Nepalese educators journeyed to Macomb County to learn how to test the Seti for water quality and find out how insect life is faring in their mid-Asian homeland. The information learned was taken back to Nepal to implement similar water quality testing procedures for use with Nepali school children.

In the fall of 2003, a group of educators from Southeast Michigan traveled to Nepal as Fulbright-Hays Seminar Abroad Fellows (<http://www.isp.msu.edu/nepal/>). The educators were linked with Nepali teachers already engaged with Michigan high school teachers through the water quality monitoring exchange and were able to visit those teachers in their classrooms and observe students conducting water quality monitoring in the Seti River. The proposal for the Fulbright-Hays Nepal Seminar Abroad Study Program grew out of water quality monitoring programs for selected middle schools in Macomb, Wayne, Oakland and Ingham counties sponsored by Michigan State University

Extension. An MSU Extension Agent partnered with MSU's Study Abroad Program coordinator, to link Michigan and Nepali schools in a program to share water quality monitoring and cultural information. The success of that effort led to the Fulbright-Hays proposal to bring Michigan teachers to Nepal to interact with their teacher counterparts and to strengthen international studies for students in both countries. This water-quality testing program for school children is the first step toward raising Nepali environmental consciousness.

### **Challenges**

While documenting international case studies relating to environmental topics, we asked a sample of MSU faculty: (1) what makes an international environmental project successful? (2) how do you make internationalization a priority at MSU? and (3) what are some obstacles to internationalization? Faculty members provided a diversity of answers to the above questions, but the answer most often heard for all questions was “department and university support” – both monetarily and through recognition during reviews and promotion and tenure. This statement became a credo for the future of global engagement in international environmental affairs; faculty, staff and students will engage in this only if the university and department provide the needed support for success; not only financial support, but incentives to participate in international activities.

Widespread faculty, staff and student involvement and leadership in partnership with our colleagues in other regions of the world is essential to enhancing our excellence in understanding and improving the world environmental issues. Successful environmental internationalization begins with innovative ideas, is fostered by associations, cooperatives, and partnerships with other countries, and endures through a commitment by the faculty and university.

The PEARL model for agricultural outreach and technology transfer can also be applied as a way which has successfully provided a recipe for meaningful internationalization of the University community. According to the PEARL model, to be successful on an international environmental front, it is important to:

- Work through partnerships to strengthen associations around key economic opportunities to add value and respond to market demand
- Be “action oriented” in program initiation
- Understand and accept risk; be prepared for failure
- Reduce risk through demand orientation
- Focus on complete product supply chains
- Ensure local government buy-in and support
- Place emphasis on local ownership and management
- Build an integrated program of applied research that will address practical needs
- Never overlook indigenous human resource training - build institutions that will continue to train

To make environmental internationalization a priority at MSU, there needs to be support and recognition from the department and university. The university must prove that it values internationalization. One suggestion includes incentives (e.g., monetary, promotion and tenure, value-based) to participate in international work (see NCA Self-Study Working Paper - Faculty - Sustaining and Expanding International Faculty Excellence). By providing incentives (e.g., release time) for faculty, it shows that the university has been deliberate in creating a culture that embodies internationalization. For internationalization to be a priority at MSU, it requires supportive structures and resources. The university must recognize an individual's abilities and strengths and value their participation in international activities. Internationalization is a lifetime venture that should provide opportunities for faculty and students alike.

### **Future Environmental Issues & Regions**

#### **Key issues—**

Munn et al. (2000) defined an emerging environmental issue as “an issue (positive or negative) which is not yet generally recognized but which may have significant impact on human and/or ecosystem health. Emerging issues are often not ‘new’ issues, but the intensification, wider extension, transformation or changed perception of familiar issues.”

Emerging issues have many characteristics that often make them difficult to manage (Byer 1999):

- they involve complex science and technologies with significant uncertainties
- they often occur at the same time as many other environmental and socioeconomic trends are taking place
- they have significant social and economic implications
- they have varying time frames from unforeseen accidents with immediate effects to slowly growing problems with long-term impacts
- they cut across and integrate disciplinary areas
- they cut across and demand partnerships with numerous government agency
- they cut across sovereign jurisdictions

Overarching emerging environmental issues include unsustainable use and changing climate conditions. This results in alteration and loss of critical habitats and biodiversity. These emerging issues deal with human demographics (abundance and location) which may lead to an unsustainable lifestyle based on alteration of the land, water and air resources of the world. Unsustainable use can be characterized by inefficient use of our resources that ultimately threatens its viability. Managing ecosystems to maintain human existence and wellbeing while maintaining biodiversity requires a mixture of different approaches including: protecting natural ecosystem reserves, combining biodiversity conservation and commodity production; managing cultivated and built ecosystems to ensure that they efficiently provide for human well-being without having a negative impact on other ecosystems; and restoring degraded ecosystems (Hunter 1996). Climate change (temperature, precipitation, storms, and extreme climate events) will likely drive other environmental issues that threaten our and our co-habitants sustainability and

livelihood. Thus it will be important to gain a greater understanding of the underlying mechanisms that drive climate change and how changes in the global climate may influence the biotic populations, communities, and ecosystems of the world. In addition, we selected a group of MSU faculty and graduate students to provide their ideas concerning emerging issues affecting our global environment; their issues included:

- **Water and food security** (safe and sufficient water and food supplies; quantity and quality)
- **Emerging zoonotic diseases** affecting human health
- **Environmental pollution** (GMOs, invasive species, heavy metals, antibiotics, antibiotic resistance, release of antibiotics into the environment; persistent organic pollutants and heavy metals diffused widespread; long range atmospheric transport of pollutants i.e., contribution of industrial emissions, erosion and fires in East Asia to air quality in Western North America.)
- **Harmonization of policies** (ethics, economies, markets; developing appropriate institutional arrangements for governing commons and other critical resources).
- **Habitat alteration** (land use and land cover changes, habitat degradation, exploitation, over-harvesting the world's forests - impacts on biodiversity, food and energy resources, and increased access to remote areas; soil erosion and degradation)

### **Regions—**

We have identified four major regions of the world where the environmental issues identified above are most prevalent, and there is opportunity for MSU to take a leadership role in their resolution:

- **Africa** represents a massive and diverse landscape, spanning an area of 12 million square miles and multiple ecosystems (Natural History Museum 2004). A continent as diverse as this has equally diverse environmental problems and MSU hopes to continue to address critical areas where we can affect change. Population growth rates in Africa are the highest of anywhere in the world; its urban population is increasing at a rate of 3% annually, with the rural population increasing at 1.1% (WRI 2004). Such a population increase is leading to increasing food, water and resource scarcity, as well as changing land use including deforestation of valuable forest land cover. MSU is currently involved with research in Africa that focuses on land and water use planning, socio-economic impacts on environmental resources, and wildlife population management. MSU could increase its role in Africa for the future by focusing research and teaching partnerships in this region on the underlying socio-economic drivers of population growth and its impact on the environment. This requires a multidisciplinary approach which, if done in concert with our African Studies Center at MSU, could be a powerful partnership that assists with growth and stability on the African continent for years to come.
- The region we have identified as **Asia** includes China, the countries of southeast Asia (Brunei, Cambodia, East Timor, Indonesia, Laos, Malaysia, Burma,

Philippines, Singapore, Thailand, Vietnam), and India. Many MSU faculty and students are involved in research projects in this region, with projects including such topics as environmental law and toxicology, indigenous populations, forestry, technology exchange and agricultural practices under global climate change. With 12 million reported anglers in China (FAO 2003), 40 million in Cambodia and Vietnam, and 70 % of farm households in Laos (WRI 2004), this region is heavily dependent on the freshwater and marine fisheries that surround them. The protection of these valuable resources for small fishers in Asia from over harvest, invasive species, and water pollution will be critical. Recent MSU research on China has led to a major publication in *Nature* (China's Environment in a Globalizing World – How China and the Rest of the World Affect Each Other). MSU, with its vast resource of knowledge concerning fisheries, water quality and other natural resources, can continue to expand this leadership role by assisting the local communities and world wide community in protecting these valuable resources.

- **North America** rightly needs to be seen in this global context. Much of our national, state, and even local research, teaching, and outreach have global ramifications (e.g. Great Lakes pollution and fisheries, migratory or invasive species). Canada is facing its own unique environmental concerns, and Michigan State University is in a unique position as a Great Lakes state university; international collaboration on freshwater projects with Canada has been continually increasing, and MSU can continue to search for new partnerships there. The MSU Canadian Studies Centre is the oldest Canadian studies program in the US, providing students with internships and research opportunities for students interested in the relationship between the two countries.. Like many industrialized nations, the majority (70%) of Canada's human population is centered in cities. Health-related issues such as urban smog, polluted waters and drinking water concerns are major issues concerning Canadians (Canada's National Report 1991). One of Canada's most serious water quality problems is persistent toxic substances in freshwater ecosystems (Canada's National Report 1991). Canada depends heavily on its abundant freshwater and timber resources and the need for sustainable use of these thus provides opportunities for MSU to contribute and collaborate on environmental issues here. Likewise, opportunities exist for increasing leadership in environmental research in Mexico. Current projects include bioremediation and waste management, environmental reporting, and environmental economics. Drawing from the list of future environmental issues identified above, issues of environmental pollution and harmonization of policies will be crucial areas of collaboration as the economy and natural resources of Mexico become increasingly tied to those of the United States.
- **South America** faces problems of habitat degradation, increased soil erosion, and climate change due to deforestation. They lead the world in forest area lost between 1990 and 2000, with a 4.6% land cover loss (FAO 2001). This rapid land use change and population growth has also contributed to increasing air and water pollution in and near large cities such as Sao Paulo and Rio de Janeiro (World Bank 2004) from vehicles, agricultural runoff, untreated sewage, and

industry. Current research at MSU in South America reflects the emergence of these issues including projects related to pollution, rivers and floodplains, sustainable development, and land use dynamics and deforestation. Helping increase protection of the remaining forest, and the development of the appropriate governmental and social infrastructure to enforce such protection may be ways for MSU to increase its research contribution and leadership in South America.

### **Considerations and Recommendations**

Michigan State University is a leader in international environment research, teaching and outreach/extension. However, past accomplishments are not enough to maintain our status as a leader in the international environmental areas. Below are some suggestions that should be considered if MSU is to maintain and enhance its position as a leader in international environmental research, teaching and outreach (not exhaustive).

- Throughout data gathering for this paper, it became obvious that there was not a central coordination point for international environmental work. For example, while we have mechanisms to track international research projects, little can be found easily about the students who may be participating on these projects? Are the students US residents or nonresidents? Additionally, not all international environment research has been properly identified as such in current databases. A better tracking system that details accomplishments and impacts of these research, teaching and outreach activities is warranted.
- Michigan State University must more obviously embrace the importance of a local to global perspective for all of its faculty and students. Engagement in international activities must be valued as a part of a faculty member's normal assignment expectations. International activities cannot be viewed as "special" or "extra" work; rather it must be transparent expectation of every faculty members assignment.

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