

## AREM: An original joint educational program to improve the sustainability of agricultural natural resources and environmental management

PARADIS Sylvie<sup>a</sup>, DOUGLAS-MANKIN Kyle<sup>b</sup>, HUTCHINSON Stacy<sup>c</sup>  
GAY Michel<sup>d</sup>, SELFA Theresa<sup>e</sup>

<sup>a</sup>University of Toulouse – Ecole d'Ingénieurs de Purpan, Department of Remote sensing and Territorial Management / INRA UMR 1248 équipe "Médiations" ; sylvie.paradis@purpan.fr

<sup>b</sup>Kansas State University, Biol. and Agric. Engineering, Manhattan, KS, USA; krdrm@k-state.com

<sup>c</sup>Kansas State University, Biol. and Agric. Engineering, Manhattan, KS, USA; sllhutch@k-state.edu

<sup>d</sup>University of Toulouse – Ecole d'Ingénieurs de Purpan, Department of Remote sensing and Territorial Management; michel.gay@purpan.fr

<sup>e</sup>Kansas State University, Sociology, Manhattan, KS, USA; tselfa@k-state.edu

**Abstract:** A joint program in Agricultural Resources and Environmental Management (AREM) was developed by faculty at Kansas State University, Manhattan, Kansas (K-State), and Ecole d'Ingénieurs de Purpan (EI Purpan), Toulouse, France. The program addresses a critical need to train students with skills to address AREM issues using knowledge and tools that span economic, sociologic, and agro-ecologic disciplines. The AREM program includes the following critical elements: 1) Exchange of knowledge and experience for both faculty and students, resulting in improved training of our students and a broader global perspective for our faculty; 2) Development and implementation of a new interdisciplinary AREM Certificate Program at K-STATE, and development of a new interdisciplinary environmental management speciality for EI Purpan; 3) Agro-Environmental and landscape problem analysis and solving, including prospective issues and participatory methods, through joint classroom discussion and project team work between US and French students; and 4) Joint teaching of selected courses through distance learning methods.

*Our philosophy is to learn by doing, even by distance! The international composition of faculty and students allows us to confront the agro-environmental impacts of different fundamental concepts of society: the market-oriented North American experience, the regulation-oriented European experience, and the development-oriented Developing Country experience. The AREM has proven to be a laboratory for new teaching methods and learning experiences. Students have learned basic technological AREM topics and methods, developed transversal competences in relation to sustainable development, studied and practiced a systemic approach to environmental impact assessment, and applied their knowledge and skills in team-based interdisciplinary projects.*

**Keywords:** Agro-resources, distance education, international, systemic approach, sustainability.

### Introduction

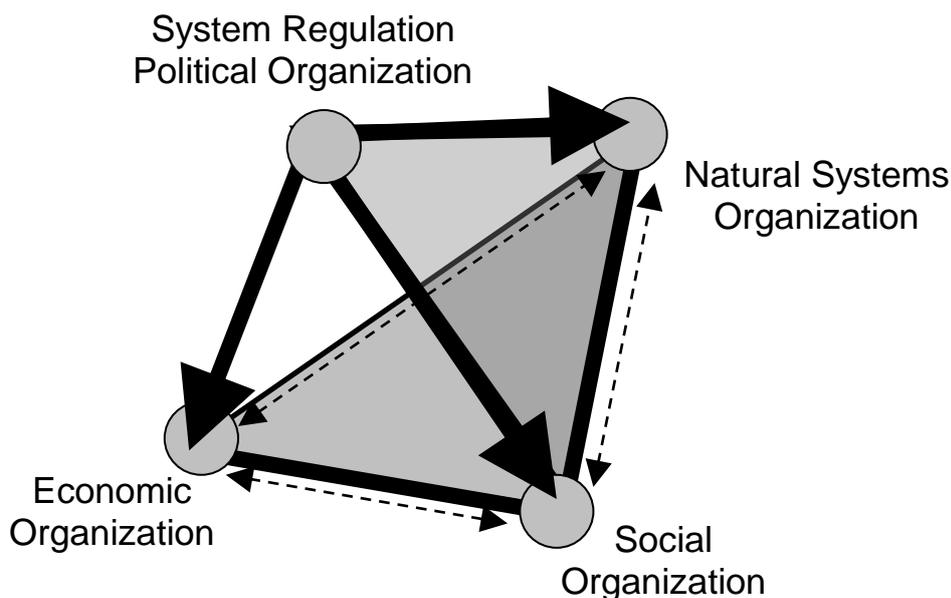
A joint program in Agricultural Resources and Environmental Management (AREM) was developed by faculty at Kansas State University (K-State), Manhattan, Kansas, and Ecole d'Ingénieurs de Purpan (EI Purpan), Toulouse, France<sup>1</sup>. The program is aimed at the Master's degree level and fosters the interaction and exchange of ideas, faculty, and students. The program builds on a longstanding partnership between EI Purpan and K-State. Program development was funded with a 3 year FACE/PUF (French American Cultural Exchange/Partner University Fund) grant from the French Embassy, USA.

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<sup>1</sup> The faculty team is comprised of Michel Gay, Sylvie Paradis, Lionel Aletto, and Françoise Goulard (now with the regional water agency in Toulouse - France) from Purpan (Marie Lummerzheim, Coordinator), and Dan Devlin, Kyle Douglas-Mankin, Jeff Peterson, Chuck Rice, Theresa Selfa, Tim Dalton, Stacy Hutchison, and Bill Hargrove (now with Univ. Texas, El-Paso) from K-State (Don Boggs, Coordinator). We began working on this project in July, 2007.

The critical need identified was to train students to address the myriad of environmental issues encountered in today's professional settings. Our approach was to develop an interdisciplinary team composed of faculty from economics, sociology, and agro-ecology to address agricultural resources and environmental management issues. The AREM program balances study of theoretical principles and practical applications to integrate and develop a new interdisciplinary expertise, aimed at improving land and resource sustainability. The purpose of this program is to enable students to understand and successfully work in areas leading to improved sustainability of agricultural and natural resources and environmental management (figure 1; O'Connor, 2007). Using an anthropocentric approach, we recognize the current extent of human interactions on the environment, and seek solutions that allow humanity to evolve toward a more sustainable relationship with the environment. The AREM program includes the following critical elements:

- 1) Exchange of knowledge and experience for both faculty and students, resulting in improved training of our students and a broader global perspective for our faculty;
- 2) Development and implementation of a new interdisciplinary AREM Certificate Program at K-State, and development of a new interdisciplinary environmental management speciality for El Purpan;
- 3) Agro-Environmental and landscape problem analysis and solving, including prospective issues and participatory methods, through joint classroom discussion and project team work between US and French students; and
- 4) Joint teaching of selected courses through distance learning methods.



**Figure 1.** The tetrahedron for sustainability studies (after O'Connor, 2007).

The international, interdisciplinary program enhances the learning of all participants. The U.S. students gain the benefit of learning about the European environmental policy, societal demands for sustainable development in the European context, and the unique cultural history and appreciation for the food/land/social nexus in France. The French students gain the benefit of learning about market-based approaches to environmental protection; watershed and water use assessment, planning, and management unique to Kansas; and democratic, public participatory processes in development and implementation of water conservation, soil conservation, and water quality restoration and protection strategies. This joint program provides not only a unique opportunity to expose students to critical global

problems, but also provides training in interdisciplinary, collaborative approaches for their solution.

Both French and U.S. students completing the joint educational program will be able to:

- 1) Identify key criteria impacting the sustainability of the natural resource base, with particular emphasis on agricultural resources;
- 2) Understand how ecological, economic, policy, and human dimensions interact, often in complex ways, to impact natural resources and environmental management;
- 3) Have knowledge of the basic policy and regulatory framework of environmental protection in the U.S. and European Union (esp. France); and
- 4) Have tools to address land and water management, rural economic development, watershed assessment and planning, participatory planning and development, economic evaluation of environmental protection, and optimization of landscape/lifescape processes and interactions.

The overall goal is to train students who will have the technical skills and broad understanding to be able to address sustainability and key environmental challenges faced by many sectors of our society. The AREM program will meet the needs of practitioners of natural resources and environmental management in 1) federal, state, regional and local level government agencies; state environmental, planning, and agricultural agencies; and city and county government; and 2) private non-government agencies, such as farm and commodity groups, agriculture and natural resource management consultants, and environmental organizations.

## Methodology

Our philosophy is to learn by doing, even by distance! Students are expected to develop transversal competences in the scientific concepts of agro-economy, agro-ecology and social sciences, including the governance aspects, in relation to sustainable development as applied to rural and suburban landscapes and territories. The different aspects of these core concepts are highlighted by focusing on the strong connection between them, i.e., the systemic approach. The international composition of faculty and students allows us to confront different fundamental concepts of society, for example the market-oriented approach of the North American experience, the regulation approach of the European experience, and the development need approach of the Developing Country experience. Scale change questions (aggregation and disaggregation) are common and permanent elements of AREM program. The AREM program also fosters an adaptive management approach to natural resource management.

The AREM program was built on a similar pedagogical foundation at K-State and El Purpan. Students are expected to enter the AREM program with three-years of educational experience and training in the natural sciences (e.g., agricultural or environmental sciences or engineering) or social sciences (e.g., sociologic or economic sciences). During the AREM program, all the students take 2 interdisciplinary, international courses taught jointly by El Purpan and K-State faculty via real-time videoconference, the Introductory AREM Course (spring semester) and the AREM Capstone Course (fall semester). In addition to these classes, students are required to take complimentary coursework to build breadth and depth in the AREM topic areas. Finally, a study tour has been an important experience in each of the first two years of the AREM Program.

The Introductory AREM Course includes a combination of lectures, guest speakers, assigned readings, class discussion, and a final team project. Our objectives are that students will learn to: (a) Understand the meaning of “sustainability”; (b) Define and describe key sustainability criteria; (c) Describe interdisciplinary perspectives on environmental issues and how they are approached at different scales and cultures; (d) Recognize and understand basic methods in agro-ecological, economic, and social science disciplines; and (e) Apply systems-level approaches and sustainability concepts to important natural resources and

environmental management issues in Kansas, U.S., France, E.U. and the world, including, but not limited to: climate change, water use and quality, and watershed management. The students are required to read The Macroscope, by J. de Rosnay (1979). Originally published in 1979, this book on cybernetics and systems thinking provides the foundation for discussions on using the systematic approach for complex problem analysis and how this approach may change over time. Additionally, the students work on case studies that explore similar US and French problems (e.g., water availability and soil erosion issues) to highlight differences and similarities between the two cultures in relation to sustainable development of agricultural resources.

The primary focus of the capstone course is to provide students with the opportunity to apply AREM concepts to a real-world project. The capstone course is team-taught by both K-State and EI Purpan faculty, and includes an international mix of participants. Students work as part of an interdisciplinary, multicultural team using video conferencing on a realistic topic or problem. Students are expected to use analysis tools such as the SWOT (strengths, weaknesses, opportunities and threats) analysis and the DPSIR (Drivers, Pressure, State, Impacts, and Response) analysis ([www.eea.europa.eu](http://www.eea.europa.eu); Maxim *et al.* 2009). During the analysis process, the students must use both qualitative (e.g. interview based surveys of stakeholders) and quantitative data and information (e.g. hydrologic models and geographic information system analysis of natural resources). Students give a presentation on their analysis and proposed solutions as well as deliver a written report. Examples of problems for students to analyze include: (a) Bioenergy; sustainability of biofuels; food vs. fuels; environmental consequences; (b) Livestock production systems; grass-fed vs. confined feeding for beef production (extensive vs. intensive); environmental impacts; (c) resource competition/urban vs. rural; competition for land and water; potential impact of climate change; environmental consequences; (d) organic agriculture; global food security; environmental consequences.

In each of the first two years of the AREM program, we supported an 8-10 day international study tour to encourage an in-depth analysis and assessment of the multifaceted and integrated ago-ecological, sociologic, and economic factors at work in a particular study topic. K-State students travelled to Toulouse, France in May, 2008 for 10 days. During this time, they were hosted by the EI Purpan students and as a group toured and discussed local French agricultural sites and environmental management practices. In September 2009, EI Purpan students travelled to Kansas for 8 days to gain a better understanding of local Kansas food production and water management issues. In each case, study excursions to the field, where students were able to interact with stakeholders and gain first hand knowledge of local production and governance systems, were coupled with classroom discussion and synthesis of the students' observations and experiences. The study tours culminated in student presentations and reports in which they provided analysis and interpretation of the sustainability impacts of what they observed, and compared and contrasted their observations with related situations in their home country.

In conjunction with these AREM core courses, students build technical depth and breadth in AREM topic areas through additional coursework. At K-State, students select and complete a minimum of three 3-credit-hour courses (US semester credits; 1 US semester credit is equivalent to approximately 3 ECTS) from two subject matter platforms: (a) agro-ecological sciences and engineering, and (b) social sciences, economics, and policy. Courses are selected from a list of eligible graduate-level courses. At this point, these courses were selected from active courses currently taught by faculty in the AREM program. In EI Purpan, coursework in the AREM topic areas is integrated into the last 2 years of a 5-year MSc specialization in AREM, including both prerequisite courses from EI Purpan general core requirements and specific AREM courses of 3 ECTS each : 3 in agro-ecology, 3 in agro-economy and 3 in social sciences. Upon graduation, students receive the EI Purpan diploma plus the AREM specialty MSc.

In the future, we plan to modify existing offer of courses and develop more courses that will be jointly taught by K-State and EI Purpan faculty and offered via videoconference or other distance-education formats. Future enhancements will be consistent with the goals of

increasing exchange of people and ideas between the partner institutions and countries. We also envision increasing the breadth of partner institutions to include a richer diversity in international perspectives, including developing countries.

## Results

Students who have completed the AREM program have developed the capacity to be leaders in the sustainable development of agro-ecosystems. They can address complex, inter-related agro-ecologic, sociologic, agro-economic problems using a systemic approach. They have learned the basic technological AREM topics and methods, and applied their knowledge and skills in a team-based interdisciplinary project. The AREM has proven to be a laboratory for new teaching methods and learning experiences, demonstrating that distance need not be a barrier to effective learning.

In many instances throughout the first year of the AREM program, students and faculty were forced to reconcile core beliefs about agriculture, sustainability, sociology, and economics as they studied these disciplines in a new context (figure 3). One American student was forced to rethink the role of farmer “independence” in adopting sustainable water-resource management, and whether this was a positive or negative attribute. Discussion often centered on the differences between market-based and regulatory approaches to natural resource management. French students wrestled with the apparent lack of concern from their American counterparts about genetically modified organisms (GMOs) in the agricultural system.



**Figure 2. El Purpan and K-State students and faculty interacting during the 2009 study tour to Kansas.**

Throughout the AREM program, lectures from faculty were complimented with presentations from guest lecturers from a variety of organizations (table 1). These guest lectures helped the students take the program beyond the walls of academia and into the working world. Additionally, during each of the study tours, students visited local production systems,

research sites, and governance agencies to further their understanding of agricultural and natural resources management and development in each country (table 2). These interactions with stakeholders enhanced the students' understanding of the complexity of these issues.

**Table 1.** Examples of guest lecturers from government and industry.

| Organization  | Lecturer    | Topic   |
|---|-------------|---|
| CIRAD (Centre de Coopération Internationale en Recherche pour le Développement) | Mathe, S.   | Indicators of Sustainable Development in Aquaculture        |
| Solagro   | Doublet, S. | DIALECTE : Assessment of Environmental Impact at Farm Level |
| United States Environmental Protection Agency                                   | Manale, A.  | The Nitrogen Problem  |
| World Bank  | Mercier, JR | World Bank Environmental and Social Policies                |

**Table 2.** Examples of study tour visits of September 2009 in Kansas and interactions with stakeholders.

| Site/Topic  |
|---|
| <b>Mertz Farm</b> (Abraham Mertz) - diversified family farm with cattle, sheep, irrigated and dryland crops near Manhattan, Kansas                            |
| <b>Kansas Water Office</b> (Earl Lewis) – State water agency, water management issues at state level  |
| <b>Kansas City Center for Urban Agriculture</b> (KCCUA - Katherine Kelly) – non governmental organization, community and training farm & experimentation site |
| <b>Juniper Gardens</b> (Rachel Barner) – non governmental organization (catholic association), training farm for refuges (community gardens) in Kansas City   |

In general, students reported that participation in the AREM program was beneficial and enhanced their educational experience. Looking at a few key assessment questions from the first introductory class (table 3), all students evaluated the course very high (greater than 4 out of 5) with the exception of those questions related to distance learning technology and lectures (Q1 and Q5). For these questions, El Purpan students had much lower scores than the K-State students. This is most likely due to issues with language. All of the lectures were conducted in English, which may have posed some difficulties for the French students. Distance technology may enhance minor language difficulties by restricting the direct interaction with the lecturer and/or problems with actually hearing/seeing the information. In order to minimize these problems, both schools have invested in new video-conferencing equipment, and lecture presentations are provided for the students at least one week in advance. This gives students time to review the material, translate unfamiliar terms, and develop better questions for interaction.

**Table 3.** Student assessment from the Introductory Class. Scale from 1 to 5, with 5 being the best.

| ASSESSMENT QUESTIONS   | K-State |     | Purpan |     |
|--|---------|-----|--------|-----|
|  | ave     | std | ave    | std |
| The distance technology did not hinder my learning in the course.                                      | 4.6     | 0.5 | 3.4    | 0.7 |
| The opportunity to interact with students and teachers from the other institution enhanced my learning | 4.3     | 0.7 | 4.2    | 0.7 |
| The course enhanced my understanding of the perspectives in other countries                            | 4.8     | 0.4 | 4.0    | 1.0 |
| The case study assignment was a valuable exercise  | 4.6     | 0.5 | 4.3    | 0.9 |
| The lectures were easily understood across cultures and disciplines                                    | 4.2     | 0.6 | 3.6    | 1.0 |

## Conclusion

Through the exchange and joint training programs, each institution is benefiting from the other's fundamental approach to agricultural resources and environmental management.

We spent the first year (2007-2008) designing the certificate program, the joint curriculum (including new courses to be offered jointly, like introductory course and capstone course), and the exchange programs. This was accomplished through faculty meetings between EI Purpan and K-State via video-conference and reciprocal visits. The first year tested the pilot program including those new courses and a study tour (for U.S. students in France).

The objectives of the second year (2008-2009) were: 1) improvement of the courses for a new cohort of students; 2) development of communication and marketing plans for the program and 3) organization of a study tour for the French students in Kansas in September 2009.

In the third year, we plan to address the challenge of creating an academic structure for AREM that is sustainable at each university. To be sustainable, the program must be efficient with faculty time and institutional resources, enhance opportunities for student and faculty academic and professional growth, and have a structure that is embedded within each institution's framework so that AREM does not thrive or languish as the faculty team evolves over time.

The structure that will be developed must reinforce and enhance strengths of the current program. For example, the format of real-time interaction of faculty and students through joint courses is essential toward developing a collaborative understanding of the complex AREM topic. Students must develop disciplinary depth in one or more AREM areas as well as the breadth and integrative capacity to address integrated AREM topics using a systemic approach. We also recognize that there exists opportunities to collaborate on teaching courses and topic areas that may currently be duplicative, or in some cases non-existing, at the participating universities. EI Purpan students currently have a well-developed practical-experience internship element to their AREM education, while K-State students typically have a research component to their academic program. Opportunities may exist to develop these experiences into the educational curricula of all AREM students at both universities.

In summary, we feel that the AREM program has the elements to provide students a successful learning experience in the interdisciplinary topics of agro-ecology, sociology, and economics as related to sustainable agricultural resource development. This program has transcended many of the challenges of international collaborative programs through a multi-dimensional experiential approach, including new videoconferencing technologies, interdisciplinary/international team projects, and student and faculty study tour exchanges.

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