Decision Support of Ruminant Livestock Systems in the Gulf Region of Mexico

Project Description

1. Introduction

Rural families in southern Mexico lie at the bottom of a vast and widening development gap. Rural poverty continues unabated in the tropical Gulf States of Yucatán, Campeche, Tabasco and Veracruz. Although the share of rural households living in poverty "improved" to 73% in 2000 from previous years, it was still greater than the level in 1989 (World Bank report No. 23849-ME). A larger share of the rural population (46%) lived in extreme poverty (that is, unable to meet basic food needs) in 2000 compared to 10 years earlier. In 2000, nearly twice as many counties in the Yucatan Peninsula were classified extremely poor compared to 1995 (41 vs. 21 counties). These dire family income circumstances fuel a variety of outcomes undesirable from a public policy standpoint, including rural-to-urban and cross-border migrations. Consequently, the future of southern Mexico, especially the agriculturally-dependent Gulf region, depends on the alleviation of poverty (by increasing food production and food security) and the economic growth to achieve it—two elements of the so-called "critical triangle" of development. Because achieving these goals often conflicts with the factors that sustain, or that may threaten, the environment, attention must also be given to this third element of the triangle—environmental sustainability.

Rapid predicted world growth in demand for animal products in developing countries over the next two decades—the so-called "next food revolution" in animal agriculture—portends complex interactions among people, economic opportunities, and biological and geophysical resources. Greater demand for foods of animal origin

signifies a critical development opportunity for livestock-producing regions. Especially promising are opportunities for Mexican producers, including small-scale farmers (smallholders), in the Gulf region who have comparative advantages in raising ruminant livestock (cattle, sheep and goats). Ruminant livestock are a key component of agricultural systems in the Gulf region, and are owned by many low-income households who employ environmentally sustainable practices. Even households that own few animals benefit from income generated by livestock production and processing. For example, farm managers generate income from three kinds of ruminant livestock systems in Yucatán. Owners of beef cattle systems produce pasture-fed animals, many on old henequen plantations. Smallholder owners of dual-purpose (milk and beef) cattle systems earn livelihoods by producing milk and beef animals with pastures and browse species (trees and shrubs). Owners of small ruminants (hair sheep and goats) also generate income, substantially more so in the last decade, by exploiting multiple species of trees and shrubs on rangelands that also harbor natural flora and fauna.

The case of Yucatán—a thin-soiled, karst topography of "living rock" with limited rainfall and little ground water—illustrates some of the favorable economic potentials from demand growth for products from ruminant livestock. Partly from reduced barriers to shipping cattle from southern Mexico under the North American Free Trade Agreement, more animals from Yucatecan herds (and other Gulf States) are sold and finished in northern feedlots. Smallholder producers also benefit from growth in domestic demand with increased earnings from mutton and kid goat meat (cabrito) sales: increasing numbers of truckloads of hair sheep supply Sunday afternoon *barbacoas* in

Mexico City; and packaged cabrito is finding its way to consumers' plates in northern Mexico.

However, the potential contribution of the livestock sector in the Gulf region to income generation, employment creation, poverty reduction and environmental sustainability can be markedly enhanced through the development and adoption of modified production and marketing practices. Improvements to the current system require additional information on the current potentials and future impacts of alternative production and marketing decisions. As the 2001-06 National Development Plan, USAID, and the World Bank acknowledge, improving Mexico's economic growth and competitiveness requires raising its agricultural productivity and, through higher education, building the human capital portfolio to achieve it. Development of a dynamic decision support capacity in the Mexican Gulf Coast will build on existing comparative advantages—including the region's farmers—to promote a ruminant animal agriculture sector that is more productive, more profitable, that attracts investment and creates jobs, and promotes sustainable resource use.

Therefore, Cornell University and the Universidad Autónoma de Yucatán (UADY), together with other Mexican partners, propose a demand-driven, integrated and interdisciplinary, systems-oriented program of training and decision support of animal industry. This program will facilitate efforts to boost productivity, profitability, and rural incomes in the Gulf region of Mexico. This program is built on Cornell's past experience and leadership in international agricultural and rural development and educational and research programs, including tropical animal agriculture.

2. Development Issues, Objective and Focus

2.1 Justification

The next generation of Mexico's agricultural professionals, and its current cadre, need skills to analyze, integrate and profitably manage resources on the agricultural and environmental nexus. Requirements for sustainable animal agriculture include educational programs with applied research that is focused on decision support for farmers. Livestock performance is sensitive to annual cycles in animal nutrient requirements, feed supply and other inputs. Therefore, management practices and decision frameworks are needed to accurately predict, monitor and manage cyclic changes, and opportunities, to help producers to achieve productivity and profitability goals. Bioeconomic analysis is required to evaluate alternative practices to increase productivity, to anticipate market-level effects and to mitigate environmental risks, including soil-plant-animal nutrient dynamics and nutritional support of herds and flocks. To achieve these educational goals, Cornell's College of Agriculture and Life Sciences (CALS) and the UADY's Faculty of Veterinary and Animal Sciences have designed an innovative and integrative training and problem-solving program of collaboration.

2.2 Development Issues

The main mission of this partnership is to address the challenges and opportunities arising from rapid growth in the global demand for animal products, namely to identify and support agricultural and environmental practices that enhance Mexico's competitiveness in the production of animal-source foods. This program is tailored so that our partners and other Mexican institutions, through innovative

applications of sustainable and profitable technologies, will acquire the additional necessary human capacity to lead animal agricultural development in the Gulf region. This legacy and improved productive efficiencies are expected to enhance competitiveness of ruminant animal-based commodities in a trade-led rural economy and promote investments in animal industry. The program also utilizes radio and telecommunications and information technology in support of environmentally sound animal agriculture in the Gulf region.

2.3 Goals and Objectives

The overall goals of the partnership are to:

- Collaboratively address an array of complex development issues and challenges related to the growth in demand for livestock products and changes in trade policy over the next two decades;
- Strengthen the capacity of Mexican partner institutions and Cornell University (and their broader constituencies) to conduct problem-solving research, instruction, and service, with the aim to identify and address the relevant development issues;
- Contribute to the preparation of a skilled cadre of interdisciplinary, systems-oriented agricultural researchers and extensionists that can address the needs of Mexico's livestock sector in a global marketplace; and
- Promote the broadest possible dissemination of the information generated through the partnership's research and instructional efforts.

Our partnership builds on the strategic priorities of UADY to strengthen two graduate degree programs by focusing on sustainable, productive and profitable ruminant livestock systems in the Gulf region, which can be expected to result in rural development multipliers. These graduate programs are the Master's degree in Tropical Animal Production (which was initiated in 1978) and the Master's degree in Management and Conservation of Tropical Natural Resources (initiated in 1994).

Consequently, our collaborative program integrates multiple learning and knowledge-generating activities on a continuum from problem definition to decision support of producers and the professionals who advise them. It also involves two partner institutions in Veracruz with similar interests—the Faculty of Veterinary Medicine and Animal Science at the Universidad Veracruzana (UV) and the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)-Veracruz. Program activities include 1) short courses, 2) short-term training, 3) faculty exchange, 4) a core curriculum of 4 courses that assures major continuous interactions between UADY and Cornell students and faculty and UV and INIFAP colleagues, and a core research component with 4 Master's students funded by Cornell that focuses on decision support of managers of cattle, sheep or goat enterprises. The target farmer groups and ecosystems are managers of beef cattle systems that depend on pastures and managers of sheep and goat systems, many who are smallholders (e.g., Yucatán), that exploit landscapes with high biodiversity (e.g., multiple species of shrubs and trees). By mutual agreement, most emphasis during the initial project period will be on sustainable cattle systems, especially for beef production, because key decision tools can be calibrated and quickly implemented for this economically important sector. Other students and scientists from UADY, UV and

INIFAP likely will also contribute to the overall problem-solving agenda, thus forming a substantial team of student and faculty collaborators. Our goal is to build a partnership that will endure, and evolve, through achievement on the nexus of complex economic, educational, social and development challenges.

3. Partnership and Program Design

3.1 Strengths of the Principal Partners

Cornell University has been a leader in international agricultural and rural development and in animal science for much of the past century. The International Programs arm of CALS mobilizes academic resources, including faculty and students, to engage in work contributing to sustainable agricultural and rural development. Cornell undertakes to generate new knowledge, often by supporting new initiatives like this one; to develop human resources, frequently by leveraging funding from other sources, as in this proposal; and to strengthen institutions to support this objective, often by facilitating strategic research.

The UADY is a leader in Mexican higher education, including animal agriculture, biological sciences, and natural resource management and conservation. It's highly trained and accomplished Faculty of Veterinary and Animal Sciences is the only college in southern Mexico accredited by the National Council for Veterinary Education (CONEVET), and one of only seven colleges accredited nationally. Besides dynamic professors and students, UADY possesses research laboratories, equipment, facilities, land and livestock, and collaborative relationships with cattle and small ruminant producers to support applied research projects for students from both institutions. As

previously indicated, UADY and Cornell have like-minded interest in improving the efficiency and sustainable productivity contributions of ruminant agriculture to rural development in tropical Latin America.

3.2 Integrated Training and Research Design

The first year of the partnership emphasizes thorough planning of institutional interactions and effective team building. Efforts in the first year initialize the project with a series of short courses that will facilitate problem definition as key partnership inputs, followed by joint teaching and fact-finding exercises, student and faculty exchange, and collaborative research. The fulcrum for the UADY-Cornell program comprises 1) a core set of student research projects (including Mexican Master's students at Cornell and other students at both institutions), 2) a core curriculum of jointly offered courses involving faculty from both institutions and similar enrollments by UADY and Cornell students and is supported by global classroom elements (e.g., video streaming, CD-ROM materials and lectures, web pages) and field laboratories conducted in the Gulf region (also involving Veracruz collaborators), 3) undergraduate student exchange where UADY and Cornell students also participate in core courses and projects, and 4) short-term training of UADY faculty members. An internet platform will be maintained to document multiple activities and distribute information from this project. The UADY will be responsible for the Spanish language dimension of the platform. It will also utilize its radio station to transmit information capsules to listeners in Maya and Spanish languages.

These principal activities initiate our program in year one (see Schedule of Planned Activities in the Appendix for detailed timelines in each year): 1) convene an application process for competitive admission (in years two and three) of 4 Mexican Master degree students at Cornell, 2) announce the reciprocal undergraduate exchange program between UADY and Cornell, 3) conduct a rapid field analysis of constraints on Yucatecan cattle and small ruminant systems as inputs to accurate problem definition and program emphasis, 3) teach a course at UADY on livestock in tropical farming systems for UADY graduate and undergraduate students (R. Blake, instructor), and 4) teach 4 key interrelated short courses at UADY for faculty and selected graduate and undergraduate students from UADY and Veracruz.

Short courses include ruminant nutrition laboratory methods (chemical and kinetic evaluation of forages and feedstuffs; Drs. D. Molina, F. Juarez and E. Canudas, instructors); accurate assessment of nutrient requirements of cattle and sources of nutrients for target scenarios (e.g., body composition) and animal groups using two decision support models developed for these purposes: the Cornell Net Carbohydrate and Protein System (CNCPS) and the Cornell Value Discovery System (CVDS) models (Drs. L. Tedeschi and B. Rueda, instructors); bioeconomic evaluation of the profitability of management options for ruminant systems (e.g., analyses using partial budgeting, linear programming, system dynamics methods; Drs. C. Nicholson, R. Blake and B. Rueda, instructors); and design, application and execution of nuclear breeding schemes for the genetic improvement of ruminants (Dr. P. Oltenacu, instructor). The partnership will be especially underwritten by the extended sabbatical leave at UADY by the Cornell TIES program director (R. W. Blake) from July 2004 to July 2005, who will work closely with

UADY's faculty and students. This partnership element will be supported by Mexico's national PROMEP (Programa para el Mejoramiento del Profesorado) faculty strengthening program (see attached institutional commitment letter from UADY's Rector, Dr. Raúl Godoy, and the Statement of Contributions in the Appendix).

Activities in years two and three center on partnering Cornell and UADY faculty members 1) to deliver, simultaneously and in parallel, a core curriculum of courses to UADY and Cornell students, 2) to collaborate the overall training and research program centered around 4 Mexican students (and their advisors) enrolled in Cornell Master degree programs (and also including other UADY and Cornell student contributions to the overall agenda), 3) to coordinate the reciprocal undergraduate exchange program involving two students each year from UADY and from Cornell who, like Master's students, would matriculate in the core course curriculum, 4) to carry out a research and training faculty exchange component at Cornell for the UADY TIES director (J. Ku), 5) to conduct short-term training at Cornell for two UADY faculty members, and 6) to facilitate two evaluations of the partnership by Lucia Pearson de Vaccaro. [Dr. Vacarro was formerly Professor at the Central University of Venezuela (1981-2002), Chair of the Board of Trustees of the Centro Internacional de Agricultura Tropical (CIAT, 1992-94), Advisory Council member, World Food Prize (1999-2000), and founding member of the Board of Trustees of the International Livestock Research Institute (ILRI; see attached curriculum vita).]

The core curriculum comprises four Cornell courses involving students and faculty from both institutions (participation is also expected from Veracruz institutions). These courses will be adapted and tailored to focus on the various constraints affecting

farming systems in the Gulf region: 1) International Agriculture 402, *Agriculture in Developing Nations I*, would probe agricultural, environmental and development issues in the Gulf region; 2) Animal Science 400, *Livestock in Tropical Farming Systems*, would focus on the analysis of constraints affecting ruminant performance in Yucatecan farming systems, environmental interactions, and problem-solving approaches; 3) Animal Science 640, *TIES Research Seminar*, would focus on student and faculty research projects at UADY and Cornell constituting the partnership research agenda; 4) International Agriculture 602, *Agriculture in Developing Nations II*, would emphasize the analysis of issues and constraints affecting farming systems and sustainable development in the Gulf region on a landscape trajectory from Yucatan to Veracruz. Each course contains a global classroom component using video streaming, CD-ROM and internet technologies to assure exchange of information and viewpoints between concurrent study groups at UADY and Cornell.

Following Cornell's successful past experiences in serving its large body of international students, two core courses will also contain "living laboratory" field trips for motivated students selected to participate. This dynamic learning component brings together students (including those in Master degree and exchange programs) and faculty from Mexico and Cornell to jointly define problems—*on-the-ground*—and to propose potential solutions. Dr. William B. Lacy, Vice-Provost for International Affairs at the University of California-Davis, called this dimension "…. one of the richest learning experiences I have seen in higher education. The dynamic international learning environment is greatly enhanced by bringing together undergraduates and graduates with diverse backgrounds and international experiences with a multidisciplinary,

intergenerational group of faculty, administrators, and extension educators. Each of the participants becomes an active learner and teacher…." (http://www.ansci.cornell.edu/intag/tradition.PDF).

The 9-day field laboratory for Animal Science 400 will involve 10 students and 3 faculty members each from UADY and Cornell. The 13-day field laboratory for International Agriculture 602 will involve 15 students and 3 faculty members each from UADY and Cornell. Students from both institutions form theme groups to examine issues, constraints and development options during the field trips, and propose written term projects to be submitted and orally presented later in the semester at UADY and Cornell. Students from the two institutions, especially members of the same theme groups, are expected to maintain electronic contact to facilitate the development of written projects and oral presentations. Theme groups will share with all UADY and Cornell participants what they learned from these projects and the *living laboratory* in a global classroom setting supported by video streaming.

3.3 Scholarships

Our collaborative agenda of scholarship support, training, student and faculty exchanges, and research is aimed at improving rural incomes and to reduce rural poverty in the Gulf region through decision support and greater productivity of sustainable livestock production. Correspondingly, the Cornell-UADY partnership will provide 8 scholarships for four Mexican students gaining admission to Cornell's Graduate School to pursue Master degree programs. The admission process is a competitive one that requires successful applicants to be academically accomplished, highly qualified

individuals who fully satisfy minimum scores on the Test of English as a Foreign Language (TOEFL). No funds are available for English language training. Cornell's Department of Animal Science will provide 2 scholarships (2 academic years) for each of 3 Master students; two students in years two and three of the project and a third student in years three and four. Financial support for each student and academic year includes a 9-mo stipend, health insurance, and waiver of academic tuition and fees. CALS' International Programs will provide 2 scholarships (2 full years) for one Master student in years two and three. Financial support for this student includes a 12-month stipend, health insurance, and waiver of academic tuition and fees. All students are obliged to support the core course curriculum and other dimensions of our partnership. To help assure effective collaborative research contributions to our partnership, UADY and other Mexican faculty will be appointed *ad hoc* members of advisory committees of Master's students.

A minimum of 20 UADY graduate students are expected to directly benefit from core courses, short courses, or the collaborative research platform. Four UADY faculty members are planned to receive training (or participate in faculty exchange) at Cornell. One faculty member receives short-term training in year one, and three faculty members receive training in year two. These estimates are included in the chart of Proposed Scholarships.

3.4 Partnership Directors

The UADY TIES director, Professor Juan C. Ku Vera, is associate professor and director of the Graduate and Research Program at UADY's Faculty of Veterinary and

Animal Sciences. He is a member of the Mexican Academy of Sciences, a member of the Accreditation Committee of CONEVET, an advisor to the International Foundation for Science, and an accomplished ruminant nutritionist with extensive research experience throughout tropical Mexico.

The Cornell TIES director, Professor Robert W. Blake, is professor of Animal Science and Animal Breeding and director of graduate studies in the field of International Agriculture and Rural Development (http://www.ansci.cornell.edu/faculty/blake.html). He was a member of the First External Program and Management Review panel of the International Livestock Research Institute in 1998-9. His extensive professional, research, and student training experience, especially in Latin America, led to his receiving the 1999 International Dairy Production Award from the American Dairy Science Association.

4. How Activity Accomplishments Relate to Mexico's Competitiveness in the Production of Animal-source Foods

Our plan is to establish a long-lived functional and efficient learning and training partnership that focuses on specific problems of farmers in Yucatán and the Gulf region. This plan is expected to garner additional financial support to achieve realistic long-term development goals. The faculty and graduate and undergraduate student training that is proposed will fortify the cadre of professionals to tackle problems specific to farmers and institutions in the Gulf region of Mexico. Our holistic approach is designed to correctly define problems, constraints and opportunities faced by livestock producers, processors and policy makers and to provide information that will facilitate their response. Their

informed actions are critical for the improved competitiveness of animal agriculture in southern Mexico. Our approach also acknowledges that greater learning and higher education outcomes are derived from teams of the best students and faculty. We recognize, too, that problem-solving skills are strengthened through research and training tailored to local conditions and scenarios and professional interactions, including those with farmers.

A problem-solving approach benefiting all partners, like the one we propose, carries inherent multiplier effects by preparing more effective agricultural development professionals. It also portends significant economic benefits for farmers in the Gulf region with improved productivity and profit potential from sustainably managed ruminant livestock systems. This is especially important in light of the critical development opportunity offered by the global revolution in livestock product demand.

Decision support tools with appropriate bioeconomic analyses help professionals to work effectively with farmers to achieve goals. For example, appropriate decision tools with accurate inputs about local animal, production, weather and feed characteristics can be applied to a range of farm resource scenarios. Farm-specific (and animal group-specific) baseline performance expectations, or targets, and nutritional status of management groups of animals throughout a production cycle would help farmers achieve their goals by avoiding errors in the allocation of feeds and other inputs and by assuring adequate body nutrient reserves for subsequent lactation and timely conception.

5. Institutional Commitment and Sustainability of the Partnership

Each institution within this partnership has a strong commitment to international education activities. Cornell's College of Agriculture and Life Sciences (CALS) is firmly committed to improving its contributions to global higher education by engaging the world outside the US. So too is the Universidad Autonóma de Yucatán. This proposal is a faculty-led demonstration of that commitment in response to collegial interactions and mutual agreement about how best to formulate our partnership. Cost-sharing in excess of one-half million dollars, in cash and in kind from Cornell and UADY, to support a balanced and integrated portfolio of activities clearly demonstrates our resolve to initiate, and to continue, this relationship. Further, the process of developing this proposal has already attracted a Cornell MS/Ph.D. student (from Australia) to seek funding to support thesis research on tropical forage agronomy and management of pasture systems with our partners. This student is planning field visits in June-August 2004 to UADY and UV. We expect substantial leveraging of other financial resources, especially by graduate students at Cornell.

The Department of Animal Science's Kenneth L. Turk Scholarship Fund, bearing the name of the former department chairman and CALS' first director of International Agriculture Programs, is earmarked for the support of international graduate students, especially those from the tropics. It is the source of 6 scholarships and other support for three of the four Master degree students in this proposal. In addition, at least seven Cornell faculty and staff are contributing between 5 and 30 percent of their time to the training and mentorship components of this partnership. Others will become involved as

advisors when Mexican students begin their graduate programs and as faculty in the core course curriculum.

As a center for international higher education, most of CALS' nearly 400 faculty in Cornell's College of Agriculture and Life Sciences have an international dimension to their teaching, research or outreach activities. Over 150 faculty have been affiliated with the overseas agricultural and rural development activities of the Cornell International Institute for Food, Agriculture and Development (CIIFAD). Approximately 45 full time equivalents of CALS' faculty are devoted to international agriculture research, teaching (largely at the graduate level) and extension. More than 50 faculty are appointed International Professors.

The UADY is a keystone member of Mexican higher education through its programs and active participation in the Asociación Nacional de Universidades e Instituciones de Educación Superior (ANUIES). The UADY is also a regional center of excellence that also attracts students from across Latin America. Our long-term partnership plans are to pursue financial support to increase UADY's capacity to lead higher education programs in southern Mexico and Latin America. The goals of both UADY and Cornell are to foster an allied network of educational institutions to promote rural economic growth from the sustainable productivity of animal agriculture; the ultimate legacy for Mexicans, other Latin Americans and the global community.

6. Monitoring and Evaluation

During execution of the project, a battery of surveys of UADY and Cornell faculty and students will be conducted to assess the value of each partnership activity.

Prior to initiating project activities, a pre-test will be developed in conjunction with the project evaluator, Dr. Lucia Vaccaro. It would be self-administered to UADY faculty and selected students to assess baseline viewpoints, constraints to curricula and to farmers in Yucatan and the Gulf region, technology options and mechanisms, and appropriate improvements to graduate and undergraduate curricula and research to better support farmers. Also with the evaluator's counsel, subsequent surveys will be administered in a manner that facilitates unbiased responses (with appropriate timing) about the value of each major training activity—short courses, short-term training, courses in the core curriculum, and research projects. In addition, UADY and Cornell students enrolled in each core course will evaluate it upon completion. We will be interested in assessing additions not only in tools and skills, but also in concept, to the problem-solving framework used by professors and UADY students, and about potential applications (and probable impacts) to real-world problems of farmers.

This survey information will be provided to the evaluator prior to each of her two visits to UADY to facilitate interviews and discussions of issues, challenges and program improvements with faculty and students. Master's degree students and Cornell faculty and students will be contacted by telephone and E-mail if face-to-face contact does not occur.

Each visit by the evaluator will be 8 days in length. An additional 4 days are allotted for writing each report. Results of these evaluations will be used in describing the evolution of the program and included in the annual and final reports stipulated under the reporting requirements of this grant.

Elements of baseline evaluation will include UADY faculty qualifications, publication outputs (scientific quality, practical applicability of results, joint authorships), curriculum design (with some attention to details about subject matter content of key courses), and information facilities and access. The evaluator will emphasize research priority setting (are critical issues targeted?), farmer and/or consumer participation in setting the research/teaching agenda and its implementation, and the interfaces between university and political decision makers. Other evaluation elements include facilitating farmer exposure to farm management options, training, and extension contacts. These qualitative elements will be used rather than numbers of farmers adopting certain practices or specific impacts on income or productivity since we cannot guarantee that farmers will act on the information provided, particularly in the short time frame of this project. Our partnership emphasizes the creation of a sustainable structure that can facilitate positive change over a longer time horizon.

With assistance from Mexican partners and institutions, we will document key economic indicators based on secondary sources (e.g., livestock numbers, production, intra-regional trade, revenues). Our focus is on creating a sustainable partnership that can facilitate improvements in the livestock production and marketing system, and to enhance certain (soil-plant-animal, productivity, profitability) outcomes and increase the adaptability of actors in the system to respond to changes in technology, markets, and trade policy.