CAES Sustainable Agriculture Committee Report. UC Davis, April 2003

In April 2002 Dean Neal Van Alfen of the UCD College of Agricultural and Environmental Sciences appointed a committee to review sustainable agriculture activities in the College. The committee was asked to develop an inventory of all work related to sustainable agriculture at UC Davis, recommend an umbrella organization to coordinate activities and facilitate communication and collaboration, and review and provide recommendations on possible undergraduate and graduate curriculum. The committee members represented 10 departments and three ANR programs with activities on the Davis campus.

Committee Members

Eric Bradford, Professor Emeritus, Animal Science (Chair)
Kent Bradford, Professor, Vegetable Crops
Jenny Broome, Associate Director, SAREP (Sustainable Agriculture Research and Education Program, UC Division of Agriculture and Natural Resources)
Theodore De Jong, Professor, Pomology
R. Ford Denison, Professor, Agronomy and Range Science
John Eadie, Professor, Wildlife, Fish and Conservation Biology
Howard Ferris, Professor, Nematology
William Horwath, Associate Professor, Land, Air and Water Resources
Desmond Jolly, Director, Small Farm Center; Specialist, Agriculture and Resource Economics
Karen Klonsky, Specialist, Agriculture and Resource Economics
Paul Marcotte, Lecturer, Human and Community Development
Robert Norris, Professor Emeritus, Weed Science
Kevin Rice, Professor, Agronomy and Range Science
Roberto Sainz, Associate Professor, Animal Science
Steve Temple, Specialist, Agronomy and Range Science
Mark Van Horn, Director, Plant Science Teaching Center and Student Farm
Chris van Kessel, Professor and Chair, Agronomy and Range Science
Frank Zalom, Specialist, Entomology

Leisa Huyck, Research Manager for the UCD Sustainable Agriculture Farming Systems Program, and **Richard Rominger**, Deputy Secretary of Agriculture, USDA, Washington D. C. 1992-2000, also participated in a number of meetings, and their contributions are gratefully acknowledged.

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Summary

Sustainable agricultural systems are defined as those that serve societal needs in the short and long term, are economically viable and environmentally sound, and promote healthy communities**.** The College is well positioned to develop strong teaching, research and outreach programs related to sustainability, based on breadth of faculty expertise, strength of teaching programs and courses, and existence of ongoing research programs on alternative cropping systems and other relevant areas. The diversity of California's environments and agricultural production systems is also an asset.

We recommend development of an undergraduate curriculum in sustainability of agriculture, with tracks emphasizing the natural sciences and social sciences. No new graduate program is recommended, but information on opportunities for graduate studies related to sustainability through existing graduate programs should be summarized and publicized.

Examples of high priority research topics are listed. Research should build on knowledge from current long-term programs; we support the plan to co-locate the LTRAS and SAFS projects at the Russell Ranch. The availability of additional land at that site provides unique opportunities for a much more comprehensive research program, involving perennial as well as annual crop production systems, animal production systems, biomass production, nutrient recycling and restoration ecology, with particular emphasis on the integration of all these areas. Based on exceptional strengths in both biotechnology and in ecological and environmental sciences, CAES has unique capabilities to assess the long-term impacts of biotechnology on sustainability of agriculture and natural resource systems.

Outreach efforts should involve active dissemination of sound, science-based information to a broad clientele, through UCCE, websites and other communication technologies. Programs should be designed to complement and build on but not duplicate the outreach capabilities of existing College Research and Information Centers as well as ANR programs such as SAREP, IPM, and the Small Farm and Agricultural Issues Centers.

We recommend establishment within CAES of a Center for Agricultural and Natural Resource Sustainability. The Center would facilitate and coordinate the teaching, research and outreach activities described and provide a focus for development efforts to support initiatives in these areas. The Center should have a Director with at least a 50% administrative appointment, staff including expertise in communications and grant preparation, and an Advisory Board comprised of both scientists and external stakeholders. Broad stakeholder input should be sought in setting up the Center and in guiding its continuing evolution.

Development of a coordinated and visible teaching, research and outreach program in sustainability should not only serve CAES clientele more effectively, but also have important benefits to the College. It should significantly increase enrollment in courses emphasizing agriculture and the environment, thus utilizing College faculty teaching expertise more effectively. It would foster greater interdisciplinary collaboration among faculty. By addressing issues of high importance to agricultural and environmental interests, it should increase extramural support from both of these constituencies.

Introduction

Worldwide changes are transforming agriculture into an endeavor focused not only on efficient food and fiber production but also on contributing to improved public health and a sound environment. The production of food and fiber remain essential functions of agriculture, and projected human population growth and changing dietary habits could increase total demand by 50% or more in the next few decades. Additionally, agricultural systems have an increasingly important role in delivering sound stewardship of biological, land, water and atmospheric resources as well as enhanced public health, rural amenities and community well-being. Broad engagement of the natural, social, health and environmental sciences will be essential to meeting the challenges of the changing portfolio of agriculture's products and the changing client base for agriculture.

Concerns about sustainability of agriculture and natural resource use, in California and elsewhere, relate to such diverse issues as increasing salinity of irrigated soils, low agricultural prices due to global competition, diversion of irrigation water to non-agricultural uses, and pollution from livestock operations and agricultural chemicals. Increasing urbanization of the landscape and multiple use of natural resources impact both the management and sustainability of agricultural, range and forest systems. The economic and social wellbeing of rural communities, including both farmers and farm laborers, are also areas of concern. Agricultural producers, land managers and the general public need the scientific knowledge to enable them to address these issues effectively.

The UCD College of Agricultural and Environmental Sciences is exceptionally well positioned to make important contributions to the sustainability of agricultural and natural resource systems. A review of programs at other institutions (see Appendix A) indicates that, while a number of other institutions have strengths related to specific aspects of sustainability, none has the breadth of activities and expertise found at UCD.

This breadth is evidenced by the existence of some 35 campus programs and projects related to sustainability (see Appendix B), and by the names and brief description of expertise/interests of more than 150 College faculty and Cooperative Extension Specialists (see Appendix C; the latter list is expected to be expanded following a survey of all College academic appointees). County CE personnel are not included in this list, but it is recognized that they play an essential role in UC efforts in this area. Of the UCD faculty members belonging to the Ecology Graduate Group, 34 list Agricultural Ecology as their primary or secondary interest. Two of the College's research programs, Long Term Research in Agricultural Systems (LTRAS) and Sustainable Agriculture Farming Systems (SAFS) are recognized nationally and internationally for their contribution to knowledge of long term performance of alternative cropping systems as well as the effect of transitioning from conventional systems.

Biotechnology provides opportunities and approaches with great potential for improving quantity and quality of food and for environmental protection. However, the capacity of biotechnology to create organisms with combinations of genes not found in nature has created much controversy, in the minds of the public and of many scientists. This no doubt reflects a lack of understanding of what is actually involved, and also a lack as yet of adequate knowledge

about the possible long-term impacts of this technology on ecology, food safety, etc. CAES, with very strong programs in animal and plant biotechnology and in ecology and environmental sciences, is in a unique position to assess these impacts on sustainability of agricultural and natural resource systems.

A good example of a multidimensional research issue is the impact of water transfers between regions or between agricultural and nonagricultural uses. If the transfer is not surplus water but reduces the supply available for agriculture, it may reduce agricultural production, employment and incomes, and have environmental and social implications as well. Owens Lake provides an extreme case, as removal of water from the area excluded agriculture from the valley, created a toxic sea of dust, and eliminated a scenic resource and important wildlife habitat. Thus decisions on resource allocation can have multiple impacts, on agriculture, the environment and communities, and need to be assessed from multiple perspectives. A purely reductionist approach may provide incomplete data for decision-making. CAES has the breadth of expertise for the needed multidimensional approach to such issues.

In teaching, the College has highly rated undergraduate and M.S. programs in International Agricultural Development (IAD), with many of the students in those programs interested in sustainability issues. Since 1977 the Student Farm has served UC Davis students and faculty, farmers, gardeners, K-12 school children and many others with a program focusing on sustainable agriculture teaching, research and public service. The Farm's unique resources include a diversity of hands-on, staff-guided experiential learning opportunities and twenty acres of certified organic land and greenhouse space that are used for ecological agriculture research and education, all easily accessible from the campus core. Courses in a number of the College's curricula relate to sustainability. However, to date the College has not developed a curriculum in sustainable agriculture, although clearly there is ample expertise to develop a very strong program in the area.

A coordinated and visible teaching, research and outreach program in the College focused on sustainability issues would not only provide information needed by the College's diverse clientele, but would also have important benefits to the College. For example, an undergraduate curriculum in sustainable agriculture would attract students to courses emphasizing agricultural and environmental sciences, thereby increasing utilization of the teaching skills of a major segment of the College faculty. This could assist in assimilating the shift in I&R/OR splits currently in prospect for College faculty, and in reaching some of the goals being considered, for example, in the Plant Sciences review. In addition, important disciplines required to understand concepts of system and environmental sustainability but with currently low enrollment will benefit from offering a multidimensional undergraduate curriculum. The greater emphasis on agricultural sciences, as it becomes visible, should increase support from agricultural commodity groups, while the greater attention to environmental issues could attract more support from environmental interests and public agencies. Not least, the nature of sustainability issues is expected to contribute to closer collaboration between agricultural and environmental scientists and between these groups and economists and social scientists. Effectively addressing sustainability issues should also lead to clarification of the interrelationships between and common goals for agriculture and the environment.

Vision

To place CAES at the forefront of research, teaching and outreach programs that enhance the sustainability of agricultural and natural resource systems.

Mission

To provide leadership and support for teaching, research and outreach in agricultural and natural resource systems that serve societal needs in the short and long term, are economically viable and environmentally sound, and promote healthy communities.

Goals

- To identify the principles and practices that contribute to sustainability of agricultural and natural resource systems.
- To educate students in those principles and practices, exposing them to a variety of viewpoints on questions that remain controversial
- To disseminate information, developed through research at UCD and elsewhere, that will assist farmers and ranchers in practicing sustainable agriculture and natural resource management.
- To assist California's rural and urban communities and policy makers in understanding and in means of implementing sustainable food and agricultural systems and natural resource management.

Recommendations

1. Sustainability of agriculture and natural resources should be a major thrust of CAES teaching, research and outreach, to be emphasized in the College's strategic planning and in staffing and funding decisions.

2. The College should establish a comprehensive undergraduate curriculum in agricultural and natural resource sustainability, building upon existing resources and programs.

3. Teaching, research and outreach efforts should address issues important to the sustainability of diverse agricultural and natural resource systems of California, encompassing both natural and social sciences.

4. Research should build on the knowledge developed in existing long-term research and outreach programs on annual crops, but needs to be expanded to include perennial crops and livestock components and to deal more comprehensively with nutrient recycling. Moreover, social and economic aspects of sustainability must be more effectively incorporated.

5. Research and outreach activities should be designed to complement the activities of ANR programs such as SAREP, the Small Farm Center and IPM, and to encourage collaboration with these and other relevant programs when appropriate.

6. To focus on these objectives, a **Center for Agricultural and Natural Resource Sustainability** should be established within the College.

Proposed Activities

1. Teaching

    a. Undergraduate

We recommend the establishment of an undergraduate curriculum that brings CAES expertise related to agricultural and natural resource sustainability to students in a comprehensive and organized program.

Assessment of the sustainability of alternative practices and systems must have a strong foundation in the natural sciences. Agricultural/ecological sustainability is also very much influenced by economics and sociology, and training to work as a professional in this field requires substantial knowledge in these areas as well. However, the 180-unit constraint precludes the depth and breadth in both the natural and social sciences that the complexity of the field indicates is needed. We therefore recommend the establishment of two undergraduate curricula: a natural science based curriculum and a socio-economic based curriculum. We suggest that the two should be planned jointly and include common course requirements at both the lower and upper division levels, to take advantage of the more general courses and to bring the two groups of students together. The inclusion of an agricultural education curriculum or track may also be appropriate to provide students an option to specialize in education. We recognize that the organization of the proposed programs may be affected by decisions on other majors currently under review in the College. Possible alternatives as discussed by the curriculum subcommittee are included in Appendix D, for the information of College committees involved in implementation of this proposal.

The natural science-based curriculum will provide students with rigorous training in the basic sciences. Courses in agriculturally related topics are required to connect ecological, agronomic and socioeconomic principles with practical issues that will be important to the development of competitive and sustainable agricultural systems. These courses should include hands-on, in field training. Graduates should find job opportunities in private, government and non-profit organizations in areas of agriculture ranging from production to marketing to social and environmental issues confronting agriculture at local to international levels.

The socioeconomic-based curriculum would expose students to the social, economic and political issues of agricultural systems. In addition, the students would receive a basic level of training in the natural sciences to help in understanding the physical and biological factors controlling agricultural productivity. The training these students receive should provide for job opportunities in similar areas to the science-based curriculum, but with more emphasis on social, economic and consumer issues related to agricultural systems.

The committee focused its efforts on developing in detail the natural science curriculum. The committee also considered the socio-economic curriculum, but it became apparent that development of such a curriculum would require additional expertise and should consider the

future planned for other majors such as IAD (International Agricultural Development) and CRD (Community and Regional Development).

The proposed natural science-based curriculum is outlined in Appendix E. Because of the strength of the course offerings at UC Davis, most of the courses required for the proposed curriculum are already offered. However, we recommend the development of several new courses, four of which would be essential to a strong and viable curriculum. These are:

1) Introductory lower division – Survey of global agricultural systems, agricultural history, production, resource base, ecology, relation to environment, nutrition, consumption, economics, policy (possible GE course).

2) Sustainable Agricultural and the Environment – core course meant for all tracks.

3) Ecology of Agricultural Systems – upper division.

4) Sustainable Food Systems – upper division (sociopolitical, economic, historical perspective) – for all tracks.

The committee also strongly recommends that opportunities for "hands on" experience be made available to students to the fullest extent possible. This could be accomplished by expanding Student Farm activities, involving students more in field experiments such as in the LTRAS and SAFS programs, internships, field trips and other means as appropriate. Another recommendation is the use of guest lecturers: agricultural producers, community leaders, regulators, etc. in selected courses in the sustainability curriculum.

The undergraduate program in sustainable agriculture would be administered through one of the College's Teaching and Advising units. Strong support from the College administration for this interdisciplinary program will be essential to its success.

b. Graduate

We are not recommending a new graduate degree, but note that existing graduate programs such as IAD (International Agricultural Development), Agroecology emphasis in Ecology, and several other graduate groups such as Soil Science, Entomology, Community Development, Horticulture and Agronomy should permit a student to develop a M.S. or Ph. D. program emphasizing sustainability. We recommend that the Center prepare, regularly update and publicize lists of courses from these and other relevant programs as examples of potential graduate study opportunities in this field.

c. Seminars

A regular seminar series should be developed to keep sustainable agriculture activities visible on campus. Freshman seminars in the area are also recommended. A seminar series on this topic is being organized for Spring and Fall 2003 by a subcommittee of the Sustainable

Agriculture Committee, with support from an Innovative Programs grant from the College. Appendix F lists the speakers for Spring 2003.

2. Research

Over the past century, divergent strategies for production of food and fiber have developed in various societies and cultures. At one end of the spectrum are highly mechanized production systems with large external inputs that are designed to maximize productivity and reduce costs. At the other end are production systems centered on smaller farms that are generally less reliant on external inputs. Myriad combinations of philosophy, technology, productivity and economy have arisen. Increasingly, complex issues regarding the sustainability of agro-ecosystems emerge. Many of these issues must be addressed in a multidisciplinary manner. Questions related to nutrient cycling or pest management must be placed in an agronomic, ecological and socio-economic framework. Results from small-plot research need to be validated and studied at the field, farm, community, landscape and even global levels.

Historically, crop and livestock production were closely integrated. More recently, intensive animal production, especially in industrial countries, has shifted to large confinement systems, often spatially separated from feed production. This shift, based on economic benefits, increases the risks of pollution and breaks the cycles of nutrients between the soil, plant tissues and animal wastes. On the other hand, feeding by-products of crop production and food processing to animals, often facilitated by concentration of livestock production, benefits the industries producing these byproducts by reducing the need for waste disposal and providing additional income. Livestock also contribute through managed grazing, providing an alternative to fire and herbicides for vegetation management and reduction of fuel load on range lands. Sustainable production systems must better integrate all aspects of food and fiber production, processing and recycling systems, to complete the organic/inorganic cycles that are fundamental to the long-term sustainable use of natural resources. Research on the integration of production, societal, economic and environmental components will be required to accomplish these goals.

One example of a multidisciplinary project at UC Davis has been SAFS (Sustainable Agriculture Farming Systems). The program has been quite successful, but lack of consistent institutional support required constant pursuit of funding to sustain momentum. That led to frequent turnover in staff personnel, resulting in less than optimum data management and some loss of archived samples. Another important example is the LTRAS (Long-term Research on Agricultural Systems) project, which has enjoyed institutional support, consistent staffing and a long-term focus which have facilitated efficient data handling and sample archiving. To date, however, that project has not enlisted as many long-term committed researchers as needed for most effective utilization of the resource.

Both SAFS and LTRAS deal primarily with the productivity and consequences of annual cropping systems, including organic and conventional systems. They include local, but not landscape, environmental issues, and do not integrate perennial crop, animal, or human components. Clearly, there is opportunity to conceive and initiate projects of larger vision and scope. Personnel at UC Davis possess expertise that would allow research on issues of

sustainability in profound depth and enormous breadth covering the physical, biological and socio-economic aspects of agro-ecosystems.

The UC Davis Russell Ranch is an important research facility for sustainability research in the College. Currently, approximately 40 ha are used for the LTRAS experiment. The consolidation of LTRAS and SAFS at one location will provide for a major teaching, research and outreach focus for the Center. There is space available to expand into perennial crop and livestock production systems. The Animal Science Department maintains facilities for all of the common livestock species; some of these facilities may need to be moved from central campus in the near future. The Center could foster collaboration among diverse campus departments to design facilities and integrate research programs with the goal of minimizing risks of pollution and improving recycling of plant nutrients. Facilities and research activities at the Russell Ranch will develop around issues of restoration ecology, perennial as well as annual crop production systems, biomass and animal production systems, with particular emphasis on the integration of all these areas. It is also recommended that opportunities for collaborative projects with producers in such areas be explored, to expand the range of production systems and environments studied and thus to broaden the applicability of results. Such studies can complement but not replace the long-term assessments of alternative practices under controlled conditions.

In addition, UC Davis has a unique opportunity to apply biotechnology to address sustainability issues. In some areas, crops developed using biotechnology facilitate conservation tillage practices with fewer external inputs and off-farm losses. In California, there are opportunities for more environmentally-compatible pest management systems, for increased tolerance of salinity and drought, and for nutritional and quality enhancement of agricultural products. A UC Davis Center for Sustainability could provide leadership in this area by focusing research programs to assess the potential impacts, both positive and negative, of biotechnology on agricultural, environmental and economic sustainability. The multidisciplinary systems approach of the Center would be ideal for investigations of the ecological, economic and social impacts of products derived through biotechnology, both prior to and after their commercialization.

Other potential high priority research areas for the CAES program in sustainability include:

- Increasing efficiency of use of irrigation water, necessitated by the combination of increased demand for food, finite fresh water supplies, and diversion of irrigation water to urban and industrial uses.
- Development and comparison of strategies for dealing with soil salinity, including development of salt-tolerant crops and of production practices that reduce or prevent soil salinity build-up.
- Breeding crops and livestock for genetic resistance to diseases and pests.
- Impacts of globalization and concentration in the food system on sustainability.
- Maintaining agriculture and reducing land use and other conflicts at the rural-urban interface.

- Environmental and economic tradeoffs between high yield agriculture and more wildlife-friendly, less intensive agriculture.
- Mitigation of effects of crop and livestock production on water and air quality
- Impacts of alternative production and marketing systems on sustainability of agricultural productivity and of rural communities.

3. Outreach

The goals of outreach in sustainable agriculture and natural resources are to facilitate interaction between campus-based academics and UCCE farm advisors, and to provide access to information from UCD for all interested stakeholders including the agricultural industry, the general public, students, media, etc. Several different UC Davis programs as well as statewide special programs and projects of the UC Division of Agriculture and Natural Resources (ANR) based at the Davis campus currently facilitate outreach in various aspects of sustainable agriculture. There is a need to link the outreach efforts of ANR and campus programs into a coordinated source of information on sustainability issues. The coordination effort should build on existing resources but not duplicate them.

Recommended outreach activities include:

1. Development and maintenance of a website with a dedicated webmaster, to provide:
    - Links to existing research and information centers (RICs)
    - Links to expertise by area in the college, and on the UCD campus
    - Links to relevant programs at the UC statewide level (e.g. SAREP, Small Farms and Agricultural Issues Centers, UCIPM)
    - Links to LTRAS, SAFS, Student Farm websites
    - Calendar of events
    - Recent publications
    - Grant opportunities
    - Student opportunities (employment and internships, curriculum link)
    - Answers to frequently asked questions about sustainable agriculture

2. Organization of an annual or biennial sustainable agriculture continuing or coordinating conference. Such a conference could have specific themes, such as weed management, tillage, sustainability indicators, environmental impacts of agriculture, etc. Currently there are several ANR workgroups that conduct annual meetings similar to the above coordinating conference (Organic Farming Research, Biologically Integrated Farming Systems, Pest Management, Small Farm Center, Agro and Eco Tourism, Sustainability Indicators, Conservation Tillage etc.) Appropriate workgroups should be included in planning such an event.

3. Organization of a formal UC Davis seminar series in conjunction with the teaching program.

4. Provision for an informal seminar series, such as in-house, multidisciplinary discussion groups within the college (e.g. brown-bag sessions), for a forum for discussions with outside speakers such as farmers, policymakers, government agency representatives, as well as for interaction with UCD academics outside of the college, e.g. the College of Engineering, Division of Biological Sciences, School of Veterinary Medicine.

5. Working with SAREP, UC IPM and SFC to coordinate access to information on organic agriculture through links to appropriate websites and providing a section on answers to frequently asked questions.

6. Working with existing programs to jointly produce a newsletter or newsnotes on an appropriate timing.

7. Archiving relevant Power Point presentations and photographs in a searchable library suitable for downloading.

Memoranda of Understanding (MOU) could be developed that would outline how the UC Davis program could work with existing programs and build on and cooperate with these programs in the area of sustainable agriculture and natural resource management. For example, UC SAREP has a 3-times-a-year newsletter that goes out to over 3500 subscribers interested in sustainable agriculture and it could dedicate a set number of pages of the newsletter to UC Davis based information outreach activities.

CAES Center for Agriculture and Natural Resource Sustainability

The teaching, research and outreach activities described above have the potential to place the UCD College of Agricultural and Environmental Sciences at the forefront, nationally and internationally, of the field of agricultural and natural resource sustainability.

To achieve the stated goals, the CAES Sustainable Agriculture Committee recommends the establishment within the College of a Center to coordinate and support these activities.

In establishment of the Center, broad stakeholder input should be sought on the needs of the various clienteles and their recommendations on how the University can contribute to meeting those needs; e.g., for research information and for trained graduates.

The following provides some suggestions from the committee on organization of the Center, for discussions within the College and with stakeholders in planning for implementation of the program:

The Center should provide for:

Strong administrative support for an interdisciplinary, interdepartmental curriculum

A continuing effort to attract external funding, both grants and major gifts, to support its programs

Increased collaboration among agricultural, environmental and social scientists within CAES, and between CAES and ANR programs related to sustainability

Broad stakeholder input on a continuing basis

It is suggested that this will require appointment of a Director to lead program development and fund raising, and an appropriate Advisory Board to ensure broad-based input from both scientists and stakeholders. The Director should have at least a 50% time administrative appointment. Ideally, this position would be an endowed chair, analogous to the Mott Chair at Michigan State or similar positions elsewhere.

While the teaching program recommended may be administered through an existing unit responsible for instructional programs, we recommend that the Director and Advisory Board maintain an active interest in the teaching program, with the objective of helping ensure its continued relevance to needs of students and prospective employers of graduates.

With regard to research, within CA&ES, and at UC Davis as a whole, there is extensive previous and current research on components of the sustainability of various agro-ecosystems (see Appendices B and C listing programs and faculty involved in research on sustainability). However, there are few examples of integrated, multidisciplinary projects that attempt to examine all aspects of the sustainability of agricultural systems. None, for example, has addressed such potentially important factors as global climate change, which could be critical to economic sustainability. Key factors in the development of such integrated projects include:

- Coordination and leadership
- Participant buy-in and commitment
- Necessary infrastructure and institutional support
- Agreement on ownership or sharing of data and access to resources
- Visibility and outreach
- Sufficient consistency over decades to document long-term trends
- Reward systems that encourage interdisciplinary and collaborative research

An important role of a Center in support of research on the sustainability of agricultural systems is to address and facilitate the key factors listed above. The first three are especially critical. How might groups of researchers with similar vision, excitement and commitment be identified and fostered? To a large extent, such groups must self-identify and self-select their participants. The Center will facilitate and accelerate these processes by:

- Identifying issues in sustainability
- Identifying funding sources
- Facilitating brainstorming sessions among key personnel
- Facilitating assembly of grant proposals
- Managing facilities and institutional support
- Scheduling and accommodating visitors

- Assisting with outreach activities such as websites, field days, seminars, newsletters, etc.

In outreach, the recommendations stress building on existing programs. The expertise of UCCE Farm Advisors related to sustainability and their key role in disseminating such information makes it particularly important that this arm of the University not be unduly compromised by the current state budget shortfall.

The Center is envisioned as having only a small staff initially. In addition to the Director, there should be a webmaster, and, if possible, a person to assist individuals and particularly teams of researchers with grant proposals. As collaborative activities increase and more funds are brought in, there may be need for research and outreach coordinators, but initially these activities would be responsibilities of the Director.

The physical home for the Center should be chosen to facilitate the linkages desired and to promote the stated objective of complementing but not duplicating existing programs. One suggestion is that the office be located at the Plant Sciences Teaching Center and Student Farm. This is close to central campus and could strengthen connections between teaching and research. It is recommended that outreach activities be closely coordinated with those of SAREP, since outreach is a major focus of that program and they have a well-developed infrastructure in this area.

We believe that public interest in agricultural and natural resource sustainability is such that there are good possibilities for major gifts to support the proposed Center. Since a large physical facility is not envisioned, such gifts could be used to establish an endowment for the Center. Given the importance of long term projects to answer some of the key questions related to sustainability, the continuing support provided by an endowment would be an invaluable asset to the program. The Center could be named in recognition of an appropriate gift.

Appendices

A. Programs in Sustainable Agriculture, Ecological Agriculture, Agroecology, or Organic Agriculture – California, USA, and Other Countries

(Summary of report of subcommittee on other programs: J. Broome, Chair; L. Huyck; D. Jolly. Complete report available from: jcbroome@ucdavis.edu)

Organization of the document:

We have arranged this listing into three major sections; 1). California university based programs (excluding UC Davis & its ANR-based programs as they will be covered in another document), 2). USA programs; and, 3). Foreign country programs. We have then attempted to include 5 sections for each college/university deemed of interest:

Undergraduate Degree programs (B.S. or B.A. noted)
Graduate Degree programs
Research & Extension Centers
Research & Demonstration Farms/lands
International Programs

All of the above are important elements of a comprehensive research-education-extension program in sustainable agriculture. Most of the programs profiled herein contain excellent examples of one or more elements, but few or none have all of them. In each section, we have listed the programs in the order of what we felt to be the most interesting and relevant to the committee's mission.

Because we tried to cover 5 major areas (graduate, undergraduate, Centers, Farms, and International) we did not go into great detail for any one area although more effort was put into finding degree programs and Centers than into international programs or demonstration farms. The web sites are provided for those who wish greater details.

General comments on programs found:

Within the US, there are extension centers that have existed for up to 10-15 years that have focused resources and developed and extended grower and industry focused educational programs in sustainable agriculture. There are far fewer undergraduate or graduate degree programs; however that is changing and often being driven by increasing student demand.

Degree programs

Iowa State has a graduate degree program worth looking at for graduate programs but has not created an undergraduate program. Most other universities offer undergraduate and graduate minors or specializations in sustainable agriculture like University of Minnesota, Washington State University etc., often within the Crop and Soil Science departments. Several universities

are looking into offering degree programs (undergraduate and graduate) in the near future (e.g. North Carolina, Illinois). Washington State University is in the planning stages with a curriculum for a B.S. in Organic Agriculture. The Common European Ecological Agriculture program takes an interesting approach in using faculty at several different universities who work in organic farming systems research to form the core teachers for a transnational program for undergraduate education complete with summer courses. We could consider whether UC as a whole might create something along these lines. There are currently summer courses taught at UC Davis and Santa Cruz that draw a large number of domestic and foreign students and we have faculty currently teaching and interested in different aspects of the food and agricultural system at Davis, Berkeley, Santa Cruz, and Riverside as well as Santa Barbara.

Smaller colleges like University of Maine or Slippery Rock in Pennsylvania have many fewer course offerings and disciplines but the kinds of programs and linkages they often have can be quite interesting. Maine has offered a BS in Sustainable Agriculture and a Masters in conjunction with several departments for quite a few years now. Slippery Rock offers a Masters in Sustainable Systems. Cal Poly Pomona has a live-in community combined with a demonstration farm where students get practical hands on experience to better inform the theory they are learning elsewhere. These approaches may be valuable to consider whether they have relevance to UCD undergrad curriculum.

Some institutions like Cornell (David Smith) and Michigan (Richard Harwood) when contacted about having specific degree programs in Sustainable Agriculture or Agroecology have answered that there has been "a very purposeful concentration on inclusion of these directions into the formal degree programs of the basic disciplines." (Pers. comm. R. Harwood). The cited programs, as an example, were Ecology & Evolutionary Biology and the Center for Microbial Ecology at Michigan.

In terms of undergraduate or graduate degree programs that focus on international development, UC Davis and Cornell still are the main educational institutions that offer undergraduate and Masters level degrees in international ag development. Other institutions also have programs that have been created more recently, undergraduate mostly, but we did not describe these programs as UCD already has experience in this area and an existing successful program.

According to Dr. Lorna Butler, Rural Sociologist, who is now the Director of the Iowa State Sustainable Agriculture graduate degree program, land grant universities have not seen the importance or the value of teaching and research in the social sciences in agroecology or sustainable agriculture degree programs. Yet technological approaches alone are often not successful in changing farming or food system practices or in increasing the adoption rate of a desired practice. Agriculture affects and is profoundly affected by human societies and behaviors. Generally, enlarging the role of and better integrating social science into agricultural research will enhance the effectiveness of future public policies by grounding policies in knowledge about what matters to people and guides their behavior. More consistently incorporating social science research into such multi-disciplinary efforts will help focus the natural science research on the truly pressing problems and consequently ensure that research results are directly integrated into near-term applications. Because interdisciplinary work brings

together knowledge and methods from different fields, it has been suggested that it involves fewer simplifying assumptions and can yield more robust results to complex problems. Ecological approaches to pest management are felt to require a level of collaboration among agronomists, weed and insect ecologists, plant pathologists, meteorologists, and social scientists (NRC, 2000b). Today's environmental problems and opportunities are rarely addressable by scientists from only one or two disciplines, especially when solutions require understanding the larger systems to ensure that solutions in one part of the enterprise do not create problems in others. A land grant university like UCD can draw from an incredible diversity of faculty and disciplines to further improve and strengthen interdisciplinary or transdisiplinary research and teaching. UC Berkeley has recently hired an extension specialist in Natural Resource-Dependent Workers and Communities, Dr. Christine Getz.

While this committee to date has focused more on the agricultural system, food system analysis has received much greater attention nationally and internationally. Typically it has involved social scientists such as geographers and sociologists as well as natural scientists like nutritionists. By most definitions it is a crucial part of sustainable agriculture, where understanding the food system is as important as understanding the production system. Greater community food security (i.e. sufficient, culturally appropriate food for all community members) is held up as the goal of social and natural science research that produces a fuller understanding of the food system. UC Davis does not have someone on faculty who works in this area, yet it is through the food system that most citizens experience anything to do with agriculture. And it is through consumption that citizens develop a relationship with the agricultural system that may be critical in sustaining agriculture in this country. Tufts University has a well-known Nutrition program and has built on that to develop a research and educational program in food systems. UC Davis could develop the linkages between nutritional science and food systems analysis to a greater extent due to its leadership in nutrition.

Research & Extension Centers

Within the US, there are a fair number of extension centers that have existed for up to 10-15 years that have focused resources and developed and extended grower and industry focused educational programs in sustainable agriculture. UC SAREP was the first one founded by State legislation in 1986. These centers are often fairly disconnected to the curriculum work at the main campus as their mandate has been to work more in research and extension and focus on agricultural clientele.

Research & Extension Farms/Lands

North Carolina appears to have a very nice physical infrastructure that supports farming systems research. Other university farms were developed more through students interested in hands on experience, such as Iowa State, and have been supported through student fees as well as by college funds.

International Programs

One of the most interesting foreign agricultural programs, with an international focus, that we investigated was the Common European Specialization in Ecological Agriculture, in which several European universities collaborate in offering similar Bachelor's degrees in Ecological Agriculture. At least one semester is taken abroad at one of the other participating universities, and a common summer intensive course is required of all students. The location of the summer course varies by year. The SAFS Project here at UC Davis has close ties with faculty in this program in both the Netherlands and Italy.

A common theme in most of the international programs, from Europe to Australia, is a perceived need to change the way agriculture is designed and practiced, by changing the ways in which students learn as well as the ways research is conducted and extended. Some of the specific changes that are recommended involve teaching that agriculture is part of a larger ecosystem with many functions, only some of which involve providing food, feed, and fiber. Quality of life for farmers, consumers, and society as a whole is seen as an essential aim, and this quality of life includes the existence of meaningful work, aesthetic considerations such as the visual quality of the landscape, and other aspects. Research is conceived of as a co-learning process in which the intended audience participates in the design and implementation of the project. Undergraduate and graduate students at all of these universities are expected to learn by doing; in other words, they are expected to work on farms, participate in ongoing research and demonstration projects designed by others, and finally, design and implement their own projects on real farms with participation of farmers and other researchers.

B. Programs Related to Sustainable Agriculture at UC Davis

1. College of Agricultural and Environmental Sciences CAES)

- Agricultural History Center
- California Institute for Food and Agricultural Research (CIFAR)
- Center for Aquatic Biology and Aquaculture
- Center for Biosystematics
- Center for Consumer Research
- Center for Environmental and Agricultural Informatics
- Dairy Research and Information Center (DRINC)
- Foodsafe Program
- Fruit and Nut Research and Information Center
- Long Term Research in Agricultural Systems (LTRAS)
- Office of Pesticide Information and Cooperation
- Parsons Seed Biotech Center
- Plant Science Teaching Center and Student Farm
- Sustainable Agriculture Farming Systems (SAFS)
- Vegetable Research and Information Center
- Weed Research and Information Center

2. UC Division of Agriculture and Natural Resources (ANR) Programs at UCD

- Agricultural Issues Center
- Center for Cooperatives
- Genetic Resources Conservation Program (GRCP)
- Integrated Pest Management (IPM)
- Small Farm Center
- Sustainable Agriculture Research and Education Center (SAREP)
- Research and Extension Centers, 11 statewide; many used by UCD researchers

3. Other Campus Programs

- Biotechnology Program
- Center for History, Society and Culture
- John Muir Institute – Center for Ecological Health Research
  – Center for Integrated Watershed Sciences and Management
  – Center for Natural Resource Policy Analysis
  – Information Center for the Environment

4. Regional and National Programs at UCD

- Global Livestock CRSP (USAID)
- USDA/ARS Exotic Pests and Diseases
- USDA/ARS National Germplasm Repository

- Western Center for Agricultural Health and Safety
- Western Human Nutrition Research Center
- Western Region and California Pest Management Center
- Western Region Center: National Institute for Global Environmental

C. UCD Sustainable Agriculture Expertise List

Please note: The list below has been developed by the Sustainable Agriculture Committee, and is not based on a comprehensive survey. Thus it is no doubt incomplete. We recommend that the list be circulated to all academic appointees in the College, to provide an opportunity for individuals to add (or delete, if they wish) their names. The suggested criteria for inclusion are: "individuals devoting a significant amount of time to teaching, research or outreach activities related to agricultural and natural resource sustainability".

Agricultural and Resource Economics:

Blank, Steve. CE Specialist. Financial management, decision making under risk, risk management, methods and tools.

Cook, Roberta. Lecturer. Fruit and Vegetable marketing, food distribution, international competition and trade, food safety, and consumer demand.

Farzin, Hossein. Assoc. Professor. Natural resource, environmental, development and international economics, and resource allocation.

Goodhue, Rachel. Asst. Professor. Agricultural marketing & organization, environmental, natural resource, Ag policy & regulation, & pesticide regulation.

Hardesty, Shermain. CE Specialist. Director, Center for Cooperatives. Energy issues in California agriculture, organic production and marketing systems.

Jolly, Desmond. CE Specialist. Consumer demand for products of alternative regimes & policy alternatives to support a diverse structure of agricultural production.

Klonsky, Karen. CE Specialist. Farm business management, decision-making at the farm level, pest management, comparative farming methods, and organic agriculture.

Sumner, Daniel. Professor. National and international agriculture policy, agriculture supply and demand, and labor economics.

Agronomy and Range Science:

Denison, Ford. Professor. Sustainable agriculture stress physiology of legume root nodules and evolution of mutualism.

Demment, Tag. Professor. Feeding, ecology and nutrition of domestic and wild herbivores and sustainability issues in global livestock production.

Dubcovsky, Jorge. Assoc. Professor. Development of wheat varieties to minimize the use of pesticides and make more efficient use of nitrogen.

Geng, Shu. Professor. Agricultural systems, modeling and simulation of environmental impact on agricultural production and food systems.

Gepts, Paul. Professor. Crop evolution, genetic conservation, molecular evolution, and genetics of agronomic crops.

George, Mel. CE Specialist. Range and pasture improvement, grazing management, rangeland water quality and rangeland management practices.

Goyal, Sham. Specialist in AES. Regulation of nitrogen usage efficiency, physiology of abiotic stress and tolerance and site-specific tillage for reduced energy input.

Foin, Ted. Professor. Computer simulation and experimental analysis of semi aquatic systems and simulation of rice-weed interactions in rice cropping systems.

Hill, Jim. CE Specialist. Research and education programs in rice-based cropping systems and effect of production practices on environmental quality.

Jackson, Lee. CE Specialist. Genetics of host/parasite interaction, integrated pest management, integrated crop management and agricultural systems.

Kaffka, Steve. CE Specialist. Improving efficiency and reducing environmental impact of crop production, water quality and salinity management.

Laca, Emilio. Assoc. Professor. Foraging behavior, range management, spatial heterogeneity and geostatistical applications.

Phillips, Don. Professor. Crop physiology, soil microbiology, plant-microbe interactions, biochemistry, nitrogen fixation and metabolism.

Plant, Richard. Professor. Systems analysis of crop resource management, database management and mathematical modeling.

Putnam, Dan. CE Specialist. Alfalfa and forage crops systems, alternative field crops and crop ecology.

Rains, Bill. Professor. Effect of salinity on nutrition and metabolism of plant genotypes varying in salt tolerance and nitrogen use efficiency of crop plants

Rice, Kevin. Professor. Plant population ecology, conservation biology, restoration ecology, and ecological genetics.

Sundstrom, Chip. Adjunct Professor. Member of USDA accredited organic certification body.

Tate, Ken. CE Specialist. Rangeland hydrology, water quality, nonpoint source pollution, and grazing management.

Temple, Steve. CE Specialist. Host plant resistance breeding of grain legumes, cover crops and sustainable farming systems research.

Teuber, Larry. Professor. Genetics and biology of floral characters influencing alfalfa pollination by honey bees and resistance to lygus bugs and whiteflies.

Travis, Bob. Professor. The physiology of N metabolism and N use efficiency in crops.

Van Kessel, Chris. Professor. Soil fertility and nutrient cycling in agro-ecosystems.

Animal Science:

Bradley, Francine. CE Specialist. Niche poultry production and conservation of poultry genetic resources.

Conklin, Douglas. Assoc. Professor. Environmental effects of fish cage culture in the tropics and recirculating systems.

Conte, Fred. CE Specialist. Environmental regulations affecting aquaculture production.

Delany, Mary. Assoc. Professor. Genetic assessment and conservation of U.S. poultry genetic resources.

May, Bernie. Adjunct Professor. Assessing genetic health and genetic integrity of natural populations of aquatic species.

Mench, Joy. Professor. Animal welfare regulations and guidelines affecting livestock and poultry production.

Meyer, Deanne. Assoc. CE Specialist. Animal waste management and nutrient recycling.

Mittloehner, Frank. Assistant CE Specialist. Air emission mitigation for livestock operations.

Oltjen, James. CE Specialist. Allocation and utilization of resources for livestock production and water use.

Pittroff, Wolfgang. Assistant Professor. Range ecology and range management systems for reducing fuel load.

Sainz, Roberto. Assoc. Professor. Sustainable grazing and feedlot livestock production systems in temperate and tropical environments.

Wilson, Barry. Professor. Avian and aquatic toxicology, IPM and Ecotoxicology especially runoff and toxicity of pesticides.

Biological and Agricultural Engineering:

Giles, Ken. Professor. Pest control and plant protection and handling and distribution of biological pest control agents.

Jenkins, Bryan. Professor. Energy systems in agriculture biomass fuel production and environmental impacts.

Miles, John. Professor. Minimizing environmental impacts of forest operations and the harvesting of tree fruit.

Piedrahita, Raul. Professor. Aqua cultural engineering with emphasis on water quality in pond and tank systems, water quality monitoring equipment and techniques.

Rumsey, James. Senior Lecturer. Sustainable agricultural practices related to row and tree crop production.

Vandergheynst, Jean. Assoc. Professor. Bioprocess engineering for the remediation of agricultural waste products and the production of food and energy resources.

Zhang, Ruihong. Assoc. Professor. Treatment of agricultural and food wastes for pollution prevention.

Division of Environmental Studies:

Johnston, Robert. Professor. Models of urban development, impacts of development on environmental quality and land energy use.

Entomology:

Ehler, Lester. Professor. Biological control, ecology and management of insects and mites in natural, agricultural and urban environments.

Godfrey, Larry. Assoc. CE Specialist. Integrated pest management of field and vegetable crops.

Mussen, Eric. CE Specialist. Agriculture, minimizing pest damage to pollinator populations.

Parrella, Michael. Professor. Integrated pest management for ornamental plants and biological control.

Zalom, Frank. CE Specialist. Integrated pest management.

Environmental Design:

Harrison, Patricia. Assoc. Professor. Design for the low-income community including farm workers, immigrant families, elderly, and mentally disabled.

Environmental Science and Policy:

Goldman, Charles. Professor. Watershed and wetland ecology and management.

Harrison, Susan. Professor. Community structure, conservation biology and conservation ecology.

Johnston, Robert. Professor. Land use policy, land use planning, and resource management.

Quinn, James. Professor. Conservation biology and design of nature reserves.

Sabatier, Paul. Professor. Environmental policy, water quality, water marketing, and environmental ethics.

Environmental Toxicology:

Charles, Judith. Assist. Professor. Agriculture and Human Health.

Cherr, Gary. Professor. Aquatic toxicology and impacts of pollution and natural pressures on reproductive and developmental biology.

Craigmill, Arthur. CE Specialist. Environmental Toxicology: pesticide biodegradation & pharmacokinetics of chemical residues in livestock.

Food Science and Technology:

Barrett, Diane. CE Specialist. Factors affecting fruit and vegetable quality and organic foods.

Mitchell, Alyson. Assist. Professor. Food chemistry and toxicology, impact of dietary exposures on metabolism.

Winter, Carl. CE Specialist & Director of Food Safe Program. Pesticide residues in food, risk assessment, regulation and public policy.

Human and Community Development:

Brush, Stephan. Professor. Social anthropology, cultural ecology, environmental issues in agriculture development, technology adoption and impact.

Campbell, David. Director of California Communities Program. Intersection between public policy and community development processes at the local level.

Grieshop, James. CE Specialist. Communication and community development.

Hirtz, Frank. Assoc. Professor. Rural sociology, food and agrarian policies.

Marcotte, Paul. Lecturer. Rural society, farming systems, organizational management, and education/training in sustainable agriculture.

Momsen, Janet. Professor. Gender and development issues in rural areas, especially in relation to tourism and agriculture.

Sokolow, Alvin. CE Specialist. Local government organization, land use policies, especially farmland protection policy.

Wells, Miriam. Professor. Economic development, anthropology/sociology of work, social movements and social organization of agriculture.

Land, Air and Water Resources:

Bahre, Conrad. Professor. Land use and human impact on vegetation change.

Bledsoe, Caroline. Professor. Soil microbial ecology.

Claasen, Vic. Assist. Research Soil Scientist. Soil fertility in wildland systems, revegetation, and soil organic matter.

Dahlgren, Randy. Professor. Biological, hydrological and geochemical processes in natural and managed environments.

Flocchini, Robert. Professor. Energy balance of the planet and air pollution meteorology.

Fogg, Graham. Professor. Ground water hydrology and subsurface contaminant transport.

Grattan, Stephan. CE Specialist. Irrigation water management, crop-water management, and salinity effects on plants.

Grismer, Mark. Professor. Chemical transport in soils, relationships between irrigation-drainage system and soil salinity; environmental ethics.

Harter, Thomas. Assoc. CE Specialist. Assessment and remediation of groundwater contamination.

Hopmans, Jan. Professor. Soil physics, soil and water management of water resources.

Horwath, William. Assoc. Professor. Soil organic matter dynamics, soil fertility, and water quality.

Hsiao, Ted. Professor. Crop growth and yield as related to water use efficacy.

Lauchli, Andre. Professor. Responses of plants to environmental stresses.

Marino, Miguel. Professor. Groundwater hydrology, pollution and management and water resource systems.

Meyer, Roland. CE Specialist. Efficiency of fertilizer use, pollution from waste products and fertilizers, and water quality evaluation.

O'Green, Anthony. CE Specialist. Soil resource specialist.

Pasternack, Gregory. Assoc. Professor. Watershed processes and habitat restoration.

Pettygrove, Stuart. CE Specialist. Soil fertility, land application of water and wastewater and precision agriculture.

Richards, James. Professor. Plant physiological ecology, root ecology, mechanisms of competition for nutrients and water.

Rolston, David. Professor. Soil physics and containment transport processes in soils.

Scow, Kate. Professor. Biodegradation of organic pollutants and nutrient cycling in agro-ecosystems.

Silk, Wendy. Professor. Water-plant environment interactions.

Singer, Michael. Professor. Land use and resource development, soil erosion and conservation.

Southard, Randy. Professor. Pedology and non-point sources of dust.

Snyder, Richard. CE Specialist. Biometeorology, plant-climate mapping and climatic risk analysis.

Ustin, Susan. Professor. Remote sensing and land use.

Wallender, Wesley. Professor. Water quality and irrigation science.

Zasowski, Robert. Professor. Soil chemistry and fire effects on soils.

Nematology:

Caswell-Chen, Edward. Professor. Selection effects of host-plant resistance on biotypes of plant-feeding nematodes.

Ferris, Howard. Professor. Ecology and management of sustainable production systems, bioindicators of soil condition, structure and function of the soil food web.

Jaffee, Bruce. Professor. Biological antagonists of nematodes and top-down control of pest species.

Kaya, Harry. Professor. Biological management of soil insects.

Westerdahl, Becky. Assoc. Professor. Applied integrated management of plant-feeding nematodes in cropping systems.

Plant Pathology:

Epstein, Lynn. Assoc. Professor. Biochemical ecology of phytopathogenic fungi, fungal development; fungal mutants.

Rizzo, David. Assoc. Professor. Mycology, fungal diseases of woody plants, fungal ecology and forest pathology.

Pomology:

Blumwald, Eduardo. Professor. Soil reclamation through the development of salt tolerant crops.

Brown, Patrick. Professor. Precision agriculture and sustainable orchard management. Nutrition, pollution, resource management, and information systems.

Dandekar, Abhaya. Professor. Transgenic approaches to manipulating quality and productivity traits in the tree fruit and nut crops.

DeJong, Ted. Professor. Development and evaluation of Prunus rootstocks for disease resistance/tolerance and sustainable management practices for stone fruit.

Gradziel, Tom. Professor. Development and evaluation of almond and peach varieties for disease and insect resistance and uniform productivity.

Johnson, Scott. CE Specialist. Optimizing use of inputs (water, nutrients, labor) in stone fruit production systems.

Larson, Kirk. CE Specialist. Breeding and management strategies to reduce chemical use in strawberry production.

Mitcham, Beth. CE Specialist. Developing non-chemical methods for control of post harvest **diseases**, insects and physiological disorders.

Polito, Vito. Professor. Managing walnut production to minimize pollen-induced pistillate flower abortion and pollen-transmitted black line disease.

Potter, Dan. Assoc. Professor. Investigation of genetic diversity and phylogenetic relationships of horticultural crop plant species and their wild relatives.

Shackel, Ken. Professor. Reducing irrigation by direct monitoring of plant water status and effects of irrigation practice on fruit quality and economic performance.

Southwick, Steve. CE Specialist. Evaluation and implementation of labor saving technologies and effects on economics of orchard systems.

Weinbaum, Steve. Professor. Increasing the efficiency of fertilizer nitrogen usage to reduce nitrate contamination of groundwater on orchard crops.

Vegetable Crops:

DiTomaso, Joe. CE Specialist. Weed science and biological control of weeds in non-cultivated lands.

Fennimore, Steve. CE Specialist. Alternatives to methyl bromide and weed seed management to reduce dependency on herbicides.

Fischer, Albert. Professor. Modifying the physiology and morphology of rice to make it more competitive with weeds.

Hartz, Tim. CE Specialist. Management of fertilization practices to reduce off-farm pollution.

Jackson, Louise. CE Specialist & Professor. Nutrient cycling in undisturbed and cultivated soils as affected by cover cropping and fertilization.

Lanini, Tom. CE Specialist. Low input and non-herbicide methods of weed control.

Mitchell, Jeff. CE Specialist. Soil conservation and soil building practices such as cover crops and biologically integrated farming systems.

Norris, Robert. Professor. Integrated pest management.

Voss, Ronald. CE Specialist. Small farm and rural-urban interface issues and education methodologies to enhance sustainable agriculture.

Wildlife, Fish and Conservation Biology:

Anderson, Daniel. Professor. Avian ecology, and minimizing effects of toxicants on non-target species.

Botsford, Louis. Professor. Sustainable fisheries in California.

Caro, Tim. Professor. Wildlife conservation in human impacted landscapes.

Cech, Joseph. Professor. Conservation of California native fishes and reducing impacts of structures such as fish screens associated with irrigation water supplies.

Dewees, Christopher. CE Specialist. Marine fisheries and human dimensions of fisheries management.

Eadie, John. Professor. Wetland and wildlife conservation in the agricultural landscape an agronomic, benefits of wildlife-friendly farming, waterfowl and rice farming.

Elliot-Fisk, Deborah. Professor. Sustainable viticulture, forest sustainability and ecosystem restoration of wildlands.

Fitzhugh, Lee. CE Specialist. Tulare Lake Basin water and wildlife relationships, ranching sustainability through income recreational activities on private land.

Kelt, Douglas. Assoc. Professor. Sustainable extraction of forest resources from Sierra Nevada forests.

Moyle, Peter. Professor. Conservation of freshwater, anadromous, and estuarine fishes in California.

Salmon, Terrell. CE Specialist. Wildlife/Human conflicts especially as the relate to agriculture.

Thompson, Lisa. Assist. CE Specialist. Sustainable fisheries, impact of dams and other water diversions on aquatic ecosystems and terrestrial-aquatic linkages in watersheds.

Van Vuren, Dirk. Professor. Ecological management of vertebrate pests in agricultural systems.

Whisson, Desley. Assoc. CE Specialist. Wildlife damage problems, integrated approaches to vertebrae pest management.

Woodroffe, Rosemary. Assist. Professor. Animal conservation, animal husbandry and sustainable natural systems.

ANR – SAREP:

Broome, Janet "Jenny". Assoc. Director. Biologically Integrated Farming Systems, ecological based pest management and alternatives to methyl bromide.

Bugg, Robert. Farming Systems Analyst. Agroecclogy, cover crops, entomology, conservation biology, and restoration ecology.

Chaney, David. Education Coordinator. Outreach and educational programs, website, publications, shortcources in sustainable agriculture.

Feenstra, Gail. Food System Analyst. Community food security, direct and institutional marketing, community gardens, and nutrition.

Swezey, Sean. CE Specialist. Director, SAREP and Specialist at the Center for Agroecology and Sustainable Food Systems, UCSC. Organic farming, entomology, pest management, biological control, apples, cotton, artichokes, and strawberries.

USDA:

Baumgartner, Kendra. Plant Pathologist. Sustainable viticulture, weed ecology

D. Report of the Curriculum Subcommittee

(W. Horwath, Chair; S. Brush; F. Denison; J. Eadie; P. Marcotte; M.Van Horn).

The sustainable agriculture curriculum subcommittee was formed to consider organization and programs related to sustainable agriculture in the College of Agriculture and Environmental Sciences. A subcommittee on curriculum was formed and given the task to develop a proposal for a new major, with a strong natural science base. There was a general recognition by the sustainable agriculture committee that agricultural/ecological sustainability is very much influenced by economics and sociology, and that training to work as a professional in this field requires substantial knowledge in these areas as well as in more technical subjects. With this in mind the curriculum subcommittee was also given the task to develop a companion major to the science-based major that focused on the socioeconomic issues of sustainable agriculture. In addition, the subcommittee decided that the inclusion of an agriculture education major or track maybe appropriate. The intent of this process is to both reassess current curriculum offerings at UC Davis and to provide graduates with the necessary training to address problems and provide direction for California agriculture.

The science-based curriculum is intended to provide student a rigorous training in the basic sciences. Secondly, courses in agriculturally related topics are required to develop an understanding of the ecology, agronomic and socioeconomic issues of agricultural systems that are important to the development of competitive and sustainable agricultural systems. It is envisioned that these students will find job opportunities in private, government and non-profit organizations that are involved in agriculture areas ranging from production to marketing to social and environmental issues confronting agriculture at the local and international level.

The socioeconomic-based curriculum is intended to expose students to the social, economic and political issues of changing and emerging agricultural systems. In addition, the students will receive a lower level of science-based training to insure understanding of factors controlling the physical and biological factors controlling agricultural productivity. The training these students receive will provide for job opportunities in similar areas to the science-based curriculum with an emphasis on post-production relating more to infrastructure and consumer issues surrounding agricultural systems.

The subcommittee developed a proposal for the natural science undergraduate curriculum (Appendix D) and made initial progress on the socio-economic curriculum. However, the subcommittee did not develop a proposal for this socio-economic curriculum because the development of such a curriculum is logically linked to a number of interrelated issues that were beyond the scope of the subcommittee. For example, while the committee considered developing a single major that would include a natural science track and a socio-economic track, it may be more appropriate for the socio-economic track to be part of a different major, such as Community and Regional Development (CRD). In addition, the relationship of curriculum in sustainable agriculture to International Agriculture Development IAD undergraduate major (which currently includes both natural science-focused and socio-economic focused tracks) was discussed, as was the inclusion of an agricultural education track in a “single major” model.

Some of the issues, which were raised within these discussions can be summarized as follows:

1. Tracks all in one major or in different majors:
   –Social science curriculum may be very similar to CRD major; should it be housed in CRD?
   – "All in one major" could facilitate cross-discipline learning by different groups (tracks)

2. Relationship to IAD
   –Similarities to IAD; should IAD and the "Sustainable Agriculture" major be merged?
   –Future of IAD major unclear as faculty retire
   –Maintaining IAD identity within merged curriculum/major(s) would be a challenge

The subcommittee believes that a curriculum focusing on the socio-economic aspects of sustainable agriculture is essential to a comprehensive educational program in sustainable agriculture and is a realistic goal for the College. The subcommittee recommends that the CAES courses and curricula related to socio-economic aspects of sustainable agriculture and agricultural education be reviewed and a plan developed to address the issues and needs outlined above.

One of the tasks of the subcommittee was to conduct a survey of existing student feelings on both the subject of sustainable agriculture and creation of a new major. The survey was given to students in Soil Science 100 and distributed to all students in majors within the College of Agriculture and Environmental Sciences. Soil Science 100 is a large class containing approximately 100 students and is required by a number of plant science and environmentally structured majors. The at-large undergraduate student population responded very poorly to the survey. Approximately 2 % of the students responded in total. The survey to the at-large population was conducted using email toward the end of the fall 2002 quarter and may explain the low response. In addition, the majority of students in the college are located in animal science (many preveterinary students), agricultural and resource economics and nutrition, who may not be interested in a major that addresses production, infrastructure and environmental issues of agricultural systems. This is most likely the reason for the poor response of the at-large student population. On the other hand, students in Soil Science 100 would have a genuine interest in agriculture and environmental issues. There was little difference in the response from the at-large student population and the response from students in Soil Science 100. The survey is included as Attachment I.

The results of the survey indicate a strong interest in sustainability and a positive interest in a sustainable agriculture major. The survey indicated a strong interest in a major containing an emphasis on environmental issues. There was less but positive interest in a major that focused on social and production issues in sustainable agriculture. Most students felt that a sustainable agriculture major could adequately prepare them for jobs in private industry and government, education and non-profit organizations. When given the choice of names for the major, students were equally divided between "Sustainable Agriculture" and "Agricultural Ecology and Sustainability". Slightly more students favored the name containing the term ecology. Most students that responded were seniors.

As the subcommittee deliberated on the above issues it became clear the curriculum development objectives could be achieved by a number of different models. The simplest model would involve simply replacing and reducing existing majors (Figure 1). However, the low enrollment in production agriculture majors would not justify the creation of a new major unless the topic of sustainable agriculture attracted a significant number of students from other majors within the college and new students interested in the proposed major. The subcommittee realizes that some consolidation of majors will inevitably occur in the future, however the simple model in Figure 1 does not adequately address all the separate disciplines, such as plant science and soil science, required to maintain a knowledge base suitable to maintain agricultural productivity in California and elsewhere.

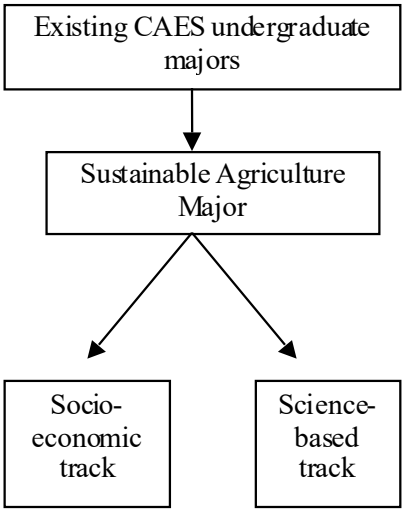

Figure 1. Model that considers reducing and or consolidating some production and environmentally structured majors into new sustainable agriculture majors.

An example of the science-based curriculum is included as Appendix E. An example for the Socioeconomic-based track was not agreed upon. The science-based track relies heavily on existing courses. A number of new courses are suggested and include an introductory survey class on agricultural systems, sustainable agriculture and environment, ecology of sustainable agricultural systems and a sustainable food systems class. The sustainable agriculture and environment and sustainable food systems would be lower and upper division core classes for the major. The other new classes would be expected to draw students from a number of different majors. The science-based major contains a rigorous list of natural and physical science, math and economic based courses that are prerequisites for classes in the specialized areas of the major. The requirements would suit students well for science-based graduate studies

The second model involves introducing a structured group of majors that share an introductory core course requirement before students would choose a specialization in different areas of sustainable agriculture (Figure 2). In this model, an effort would be made to expose students to the diverse areas of sustainable agriculture with an introductory set of core courses

supplemented with practicum courses. After taking these initial core course requirements, students would then decide to specialize in one of three tracks including Agricultural Education, Socioeconomic and Politics or Science-based sustainable agriculture areas of emphasis. An example curriculum for Agricultural Education was not considered.

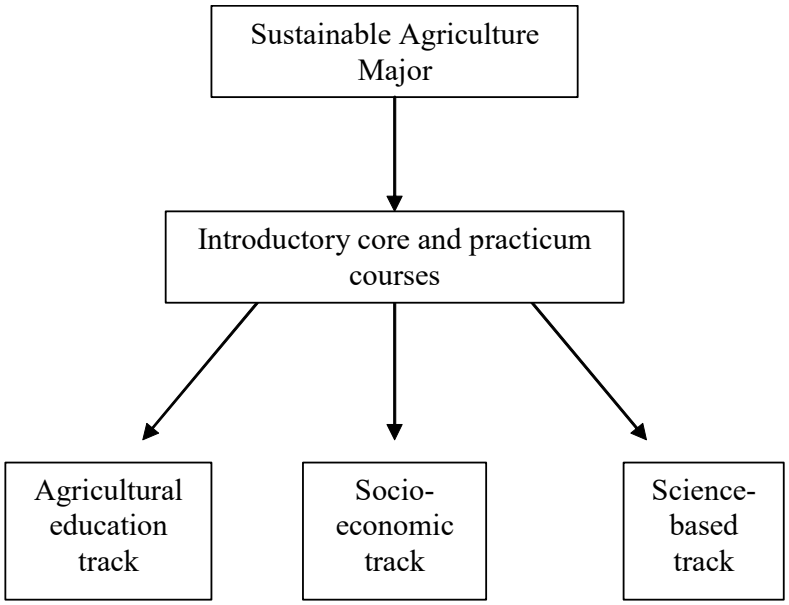

Figure 2. Model that introduces students to an introductory core class requirement before specializing in one of three areas of emphasis in Sustainable Agriculture.

The subcommittee realized that the consolidation of socioeconomic and science-based areas of emphasis would not be easily achieved within the existing divisional structure of the College of Agriculture and Environmental Sciences. For example, the current International Agricultural Development major has many characteristics, both a science-based and socioeconomic track, being proposed in Model 2 (Figure 2). It was felt that the socioeconomic track would better fit in the Division of Human Sciences. Therefore a third model was proposed that relies on the divisional structure of the college to implement the tracks of the proposed sustainable agricultural major (Figure 3). Inherent in Models 2 and 3 is the inclusion of the Agricultural Education major. In addition, a distinction in the science-based track was made that included creating an area of emphasis in plant production and the environment. Both of these areas of emphasis would share the science-based prerequisites core courses to satisfy individual track requirements.

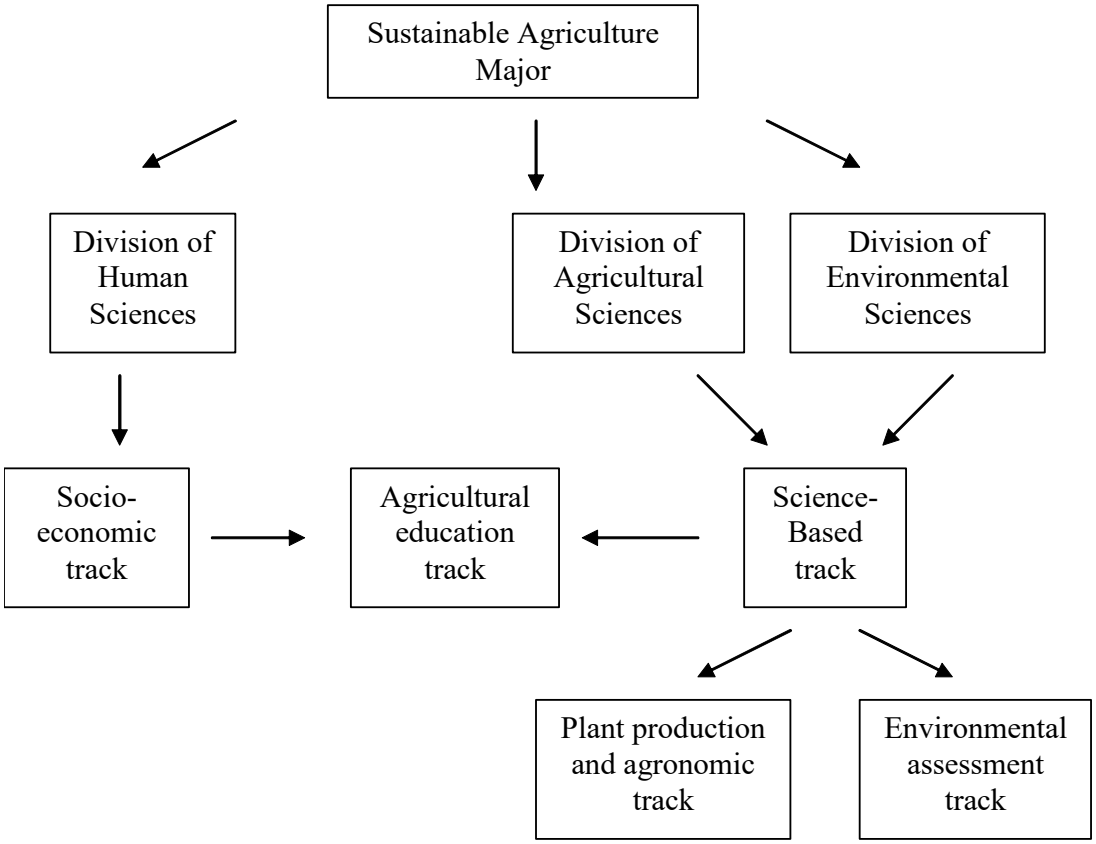

Figure 3. Model that supports the theme of sustainable agriculture but the tracks are divided among the divisions of the college. The Agricultural Education major would cut across divisions and students would be expected to specialize in a science (plant production or environmental emphasis) or social based education major.

The subcommittee realizes that proposing these three models is beyond the scope of the original objectives of the committee. Yet the implementation of these new majors will probably require a reassessment of existing majors to streamline and design majors that will provide students with the necessary tools to confront changing and evolving agricultural problems and systems of the future.

Conclusions and Recommendations of Undergraduate Education Subcommittee

We think there are significant numbers of students interested in agriculture/ environment issues and/or in more sustainable approaches to farming.

These potential undergrads are unlikely to be attracted by the names of our current majors: Crop Science and Management (production-oriented and new hint of alternative approaches), Agricultural Management and Range Science, Environmental and Resources Sciences or Environmental Biology and Management, although IAD may appeal to the subset of these students interested specifically in less industrialized countries.

The **Agricultural Ecology and Sustainability** major should probably have at least two tracks emphasizing natural sciences (ecology, soil science, plant science, etc.) and social sciences (assuming there's enough demand for a social science track in a science-intensive major).

The subcommittee recommends the inclusion of an education major or track that would parallel tracks emphasizing natural sciences (ecology, soil science, plant science, etc.) and social sciences.

The **Agricultural Ecology and Sustainability** major would be appropriate for students interested in graduate study or for jobs with government agencies, nongovernmental organizations, private industry or educational institutions requiring considerable expertise in both the science of crop production, environmental and social issues in agriculture.

Students who are certain that they want to farm should be encouraged to major in Crop Science and Management, which might need an organic farming track.

All students in the major should take a common core of courses in the natural and social sciences and in crop production practices, sufficient to communicate effectively with ecologists, agricultural policy folks, and farmers.

Most of the courses needed to implement this major and tracks are already offered.

ATTACHMENT I. Student Survey Results on Program Names

1. Do you feel sustainability is an important issue in our society?

1. not important	2. somewhat important	3. important	4. very important
2	0	9	57

2. Would you be interested in a major that focused on sustainable agriculture?

1 no interest	2. somewhat interested	3. interested	4. very interested
9	13	14	32

If your answer to Question # 2 was a 2, 3 or 4, please fill out the following two tables:

3. What is your level of interest in a major in sustainable agriculture that focused on:

	No Interest	Some Interest	Interest	Strong Interest
Environmental Issues	0	3	13	43
Social Issues	3	10	21	25
Production Issues and Training	0	11	18	30

4. The importance of a major related to Sustainable Agriculture to prepare students for careers in the following areas would have the following importance:

	Not Important	Somewhat Important	Important	Very Important
Production/Industry	0	3	23	34
Government	1	8	26	25
Education	0	7	23	30
Non-Profit	3	11	23	21

5. What do you think an attractive name for a sustainable agriculture major should be?

1. Sustainable Agriculture (27)
2. Agriculture Ecology and Sustainability (31)
3. Other:
   - Sustainable Agriculture and Ecological Systems
   - Sustainable Agriculture and Development
   - Agriculture in Sustainable Systems
   - Sustainable Agriculture and Ecology
   - Agriculture and Resource Sustainability
   - Agroecology and Sustainable Food Systems

6. Are you a:

1. freshman (0) 2. sophomore (3) 3. junior (17) 4 senior (39)
5. graduate student (6)

E. Proposed Undergraduate Major in Sustainable Agriculture

Major Title: Agricultural Ecology and Sustainability

The Major Program

The major is designed for students who are interested in understanding the sustainability of food and fiber production systems, including aspects of management and relationship to the environment and society. The curriculum provides an interdisciplinary background to expose students to natural science, environment and natural resource science and social science. Students will acquire a core understanding of sustainable food and fiber production systems as managed ecosystems that interact with the natural environment and their integration with human society and social change.

The Program. Specialization in Sustainable Systems covers food and agriculture production, agroecology, pest ecology and management, soil science, environmental resource science and economic and social impacts of agricultural production systems. Students will develop expertise depending on their elected coursework in plant and animal production systems, environmental and natural resource protection, sustainable resource utilization and social aspects of agricultural practices. All students gain practical experience through a combination of internships and practica. Students may also pursue an Honors thesis in their senior year.

Career Alternatives. Graduates from this program are prepared to pursue a wide range of careers, including various technical and management positions in agricultural and business enterprises; farming; consulting; private, state and federal agencies concerned with agriculture and natural resource management; Cooperative Extension; international development; teaching; agricultural and environmental journalism, information and communication services. Graduates are qualified to pursue graduate studies in the natural and social sciences, such as agroecology, environmental studies, soil science, pest ecology and management, education, and business management.

New *Required* Courses

Introductory lower division – Survey of global agricultural systems, agricultural history, production, resource base, ecology, relation to environment, nutrition, consumption, economics, policy (possible GE course).

Principles of Sustainable Agricultural and the Environment – core course meant for all tracks.

Ecology of Agricultural Systems – upper division (e.g. new or modified PLB 142).

Sustainable Food Systems – upper division (sociopolitical, economic, historical perspective).

Other New Courses to Consider Adding to Major

Organic/Ecological Crop Production – upper division. (e.g. AMR 110E or new course) focuses on ecologically based practices of soil/nutrient and pest management.

AnSci course on limited resource and/or alternative production.

Capstone problem solving course (e.g. Compare to AMR 101).

Biological pest management.

BS Major Requirements:

	UNITS
Written/Oral Expression	8
ENL 1	4
CMN 1	4
Preparatory Subject Matter	46-48
Chemistry 2A and 2B, Biological Science 1A, 1B and 1C, Physics 1A and 1B or 7A and 7B, Math 16A, 16B, Statistics (AMR 120 or STA 100), Economics 1A	
Breadth/General Education	24
See general education requirement	
Unrestricted electives	20-30
Sustainable Agriculture (Core courses)	14
Survey of Global Agricultural Systems (new)	4
Sustainable Agricultural and Natural Resources Practicum	6
Choose two: AMR 49, AMR 92, ABT 49, AnSci 49, IAD 162, AMR 192, AMR 192-S, ABT 142, ABT 145, AMR 137, SSC 105, ERS 192	
Principles of Sustainable Agriculture and Environment 100??	4
Sustainable Crop & Animal Production Systems	**12-14**
AMR 150 (Consider name change)	4
Choose two:	
AMR 107,AMR 110A, B, C, AMR 118, VEN 111	8-10
SSC 118	4
ANS 1, 2, 41; ANS (new course on limited resource)	
AMR 130, new course in Organic/Biological Sustainable Production	
Ecology & Environment	12
Choose one: ESP 100, EVE 101 (16C)	4
Agricultural Ecology course (new or modified PLB 142)	4
Choose one: PLB 117, ENH 160, WFC 154, AMR 101; ERS 60, SSC 112, ANS 129	4
Soil and Water Science	13-14
SSC 100, SSC 109	10
Choose one: SSC 111, SSC 118, ERS 121, HYD 110, HYD 124	3-4
Genetics/Genetic Resources…(consider new course crops and animals)	3–4
Choose one: BIS 101, PLB 152, PLB 143, EH 150	3-4

F. Spring 2003 Sustainable Agriculture Seminar Series

Spring 2003 Topics and Speakers include:

April 4	The Science of Sustainable Agriculture in a Context of Disciplinary and Private Knowledge, William B. Lacy, Vice Provost, University Outreach and International Programs, and Professor, Department of Human and Community Development, University of California Davis.
April 11	Intensive Cereal Production Systems for Global Food Security and Protection of Natural Resources, Kenneth G. Cassman, Professor and Chair, Department of Agronomy and Horticulture, University of Nebraska Lincoln.
April 18	Globalization and Its Impact on California Agriculture, William Friedland, Professor Emeritus, Department of Environmental Studies, University of California Santa Cruz.
April 25	NO SPEAKER THIS WEEK
May 2	Strategies for Sustainability in Agriculture: A European Perspective, Floor Brouwer, Agricultural Economics Research Institute (LEI), The Hague, Netherlands.
May 9	Measuring Sustainability: Learning by Doing, Simon Bell, Senior Lecturer in Information Systems, Center for Complexity and Change, Technology Faculty, The Open University, United Kingdom.
May 16	Civic Agriculture and Food Citizenship: Sustaining Local Food Systems in a Globalizing Environment, Thomas A. Lyson, Liberty Hyde Bailey Professor, Department of Rural Sociology, Cornell University.
May 23	Agricultural Production and Climate Changes, Cynthia Rosenzweig, Research Scientist, National Aeronautic and Space Administration, Goddard Institute for Space Studies.
May 30	Economic Policies to Encourage Sustainable Agriculture - Some Examples from Irrigated Crop Production, Richard E. Howitt, Professor, Department of Agricultural and Resource Economics, University of California Davis.
June 6	Feeding the World: Social and Economic Constraints, Glenn Davis Stone, Associate Professor, Department of Anthropology, Washington University, St. Louis.