

STRATEGIC DIRECTIONS

DIVISION OF AGRICULTURE AND NATURAL RESOURCES

The Executive Council has considered, in some detail, potential strategic directions for the Division of Agriculture and Natural Resources (ANR). The Executive Council concluded that there are at least three critical long-term strategic program areas for the Division. The criteria used to judge the importance of different strategic directions included: 1) importance to the State of California; 2) the existence of a significant comparative advantage for ANR in addressing the challenges in question; 3) the capacity of ANR to add value in solving the range of problems subsumed in each of the strategic areas; and 4) strategic programmatic areas are expected to remain important over the long term (more than 10 years). The Executive Council noted that in each of the strategic areas there are immediate problems or activities that require attention. These are identified in the description of each strategic area that follows:

GENOMICS RESEARCH AND EDUCATION: During the last half of the 20th century, there has been an explosion in the amount of information available to people. Access to that information has been critical in driving an unprecedented economic expansion both in California and nationally. The information explosion has been accompanied by a transformation of the U.S. economy and culture from one that was primarily agrarian and industrial to one that is increasingly dependent on knowledge. Innovation has always depended on the acquisition of new knowledge, and today we are faced with critical decisions regarding appropriate directions to follow in seeking to acquire new knowledge. Among other things, it seems clear that significant resources will need to be invested in acquiring the knowledge that will be the cornerstone of a major transformation in the biological sciences and in educating the public broadly about the benefits and risks of agricultural biotechnology.

Clearly, research in plant, animal, and nutritional genomics will drive productivity gains and economic development in agricultural, natural, and human resources throughout the 21st century. Mendel's discoveries were the beginning of a revolution in classical genetics that allowed innovations in plant and animal breeding to contribute to unprecedented increases in agricultural productivity. Our ability to sustain and enhance those gains over the next 25-30 years, and perhaps beyond, is dependent upon the prudent investment of resources in developing the new technologies that are open to us via genomics research. Only by investing in and contributing to the development of genomic data and its utilization will we be able to maintain the preeminence in agricultural and biotechnology productivity that has been the hallmark of California and the United States. Indeed, the future prosperity of the nation can remain secure only if we maintain the capacity to feed, clothe and house our citizens.

As the population of California and the nation continues to grow, new and intensifying demands will be placed on our natural resources and the environment. The resulting

pressures are likely to constrain and threaten the productivity of agriculture. Counter efforts to develop strategies to enhance productivity and create innovative products will depend upon obtaining the information contained in the genomes of species that we have depended upon historically as well as others that we could come to depend upon in the future. This information will inform new strategies to address the pathologies of plants, animals and humans and to guide the use of environmentally sound technologies and techniques for managing land and water and producing food. This information will also guide in developing foods and diets that are nutritionally healthy and have the potential to improve the health of individuals and populations. There is no aspect of human, natural and agricultural resources that will be unaffected by investing in genomic research.

The productivity and payoff of research in agricultural genomics and the promise of agricultural biotechnology will depend importantly on the support of a *well-informed* public. Some of the current skepticism about the benefits of genomics research is fueled by misunderstandings about the prospects and possibilities of agricultural biotechnology and its potential side effects. There is a compelling need to familiarize the public-at-large with the facts about agricultural biotechnology, about the potential benefits of employing such biotechnology and about potential unwanted side effects and how they can be managed. ANR should use its considerable outreach capabilities to mount effective and informative programs of public education in the general area of plant, animal and human genomics. That program should be informed by research on agricultural genomics. The development of the agricultural genomics research agenda should give appropriate weight to research that will help inform the education program.

For the immediate future, the Executive Council will give high priority to the development of a new Center for Science and Innovation, which will be provisionally called, "The Institute for Plant, Animal and Nutritional Genomics." The Center will involve faculty from the College of Natural Resources (Berkeley), the College of Agricultural and Environmental Sciences (Davis), the School of Veterinary Medicine (Davis) and the College of Natural and Agricultural Sciences (Riverside). The Center will involve faculty from other schools, colleges and campuses as appropriate. The structure and operation of the Center will entail appropriate collaborative relationships with the private sectors as well as appropriate state and federal research institutions.

MANAGEMENT OF INVASIVE SPECIES: A new exotic pest enters California every 60 days. This rate is likely to accelerate as market opportunities increase and the pace of international trade, tourism, and human immigration from the semitropical and tropical regions of the world accelerate. Today, exotic pests are estimated to cost California agriculture \$3 billion annually. They also threaten the biological integrity of California's wild and natural ecosystems. The magnitude of this damage, together with control expenditures, will grow as the number and frequency of new invasions grows. Consequently, over the long term, ANR will need to be positioned to respond to the need to develop and devise control and/or eradication strategies for individual pests. Simultaneously, however, more fundamental work in basic and applied science will be

needed to build the foundations for managing and controlling exotic pests on something more than an episodic basis.

The biology of invasions by plants and animals is an emerging science. The nature of invasive processes, the factors, which determine integration and spread and the characteristics of the successful invader, are all incompletely understood. The need to develop multiple strategies of intervention, including prevention, eradication and control will require both a broader and more detailed understanding of invasion biology. Successful development of excellence in invasion biology will require broad multi-disciplinary participation from ANR faculty as well as biology faculty found elsewhere throughout the University.

For the immediate future, the Division will need to give very high priority to the development of methods of controlling and combating Pierce's Disease bacterium. Transmission of Pierce's Disease by the Glassy Winged Sharpshooter poses a clear and dangerous threat to California's grape industry. Grapes represent the second largest crop (in terms of cash receipts) in California. Ultimately, other diseases caused by the Pierce's Disease bacterium may threaten other permanent crops in California so that the potential devastation is not limited to grapes. To-date, no strategies or actions to eliminate the disease or avert its adverse effects in the short to medium run have been identified. Ultimately, resistant stocks can be bred, but the disease may have run its course by the time this occurs. Thus, there is an urgent need for ANR research and outreach personnel to devote intensive efforts to the discovery and dissemination of knowledge related to the management and ultimate eradication or control of the disease. ANR should make a high profile commitment to finding ways of eliminating the damages caused by this disease.

WASTE MANAGEMENT: During the first two decades of the 21st century, California's population is expected to grow by 15 million, an increase of almost 50 percent. This population growth is likely to be accompanied by significant rates of economic growth, both of which will intensify pressures on the environment. Population and economic growth will cause increases in the quantities of waste byproducts, which will have to be managed to preserve environmental quality. Intensifying human pressures on landscapes will require careful management if the capacity of California landscapes to provide environmental services and amenities is to be maintained and enhanced. As competition for scarce water supplies intensifies, as the trend of air quality degradation grows, and as the problem of finding and managing landfills become more and more difficult, agricultural and natural resource producers will have to find new methods of production, recycling and waste treatment which will minimize the impact of agricultural and natural resource impacts on the environment.

The need for land disposal of sludge from wastewater treatment plants arises directly from national water quality protection regulations. It is also important to recognize that any activity on waterscapes or landscapes is influenced by the prevailing environmental conditions that are, in turn, influenced (and changed) by the activity in question. The

ease with which crops can be cultured depends upon the environmental conditions in the field and surrounding area. The growing of crops, in turn, affects the environmental conditions in the field and surrounding area.

For the future, ANR needs to cast its environmental research in an integrated, ecosystem-based fashion. Only in this way can the implications of different schemes of environmental and waste management be understood with a reasonable degree of thoroughness. The failure to do this results in piecemeal policies that do not account for the complex interrelatedness of environmental systems. The piecemeal nature of environmental regulations and the failure of state and national legislation to envision environmental management in a holistic and integrated way has led to sub optimal practices of environmental and waste management. For example, most pollution control laws and regulations focus on a single sink – land, air or water – and prescribe standards and practices for protecting and enhancing the quality of one sink without recognizing that an inevitable response is to move waste products to another sink. Thus, it is imperative that research, education and outreach activities on waste management be conducted in a holistic fashion that acknowledges and recognizes the interrelatedness of environmental systems.

For the immediate future, the Division should accord high priority to the development of new, innovative and integrated ways of managing dairy animal waste. California is the leading producer of dairy products in the nation, and these products (milk and cream) contribute \$3.6 billion to the California agricultural economy. Dairy is the largest agricultural activity in terms of cash receipts. The trend in the dairy industry is toward large intensively managed operations with herd sizes exceeding 1,000 animals. These large concentrations of cattle result in the generation of enormous volumes of waste, including manure, wash water and aerosols on relatively small parcels of land. These wastes have the potential to degrade seriously both the quality of water and air resources.

In rapidly urbanizing areas such as the Chino-Corona basin in southern California, pressure to relocate dairies is increasing. Throughout California, land use regulations are becoming more stringent, and this places new and significant constraints on the location and operation of existing as well as new dairies. There is a clear need to find new and effective ways to manage the wastes created by dairy operations and to get this information into the hands of dairy operators. ANR should make a visible commitment to finding effective ways to manage these wastes to minimize environmental degradation while maintaining the safety and high quality of California produced dairy products.

(added 2/03)

FOOD SAFETY: Each year, one in four Americans suffers from potentially serious food borne illness that causes suffering and pain and may result in losses in workforce contributions, increased societal costs of medical care and incalculable emotional costs from unnecessary deaths. The incidence of food borne illness among Californians is higher than the national average. There are many factors that contribute to high rates of incidence including relatively recent changes in food production, processing, selection, and preparation methods, as well as the globalization of food supply systems which is associated with failures in the detection of human health threats at critical points along the production/consumption continuum. Increasingly, consumers depend upon others to produce and prepare their food as the world becomes urbanized. While California leads the nation in identifying the causes of food borne illness, the causative agents are identified and preventive measures are available in only about half the cases.

Improving food safety is difficult because of: 1) the complexity of domestic and foreign food systems; 2) rapid changes with these systems; 3) the multiple causes of food borne illnesses; 4) emergence of new pathogens and chemical toxicants; and 5) the increased mobility of the globalized society that stimulates demands for ethnic and cultural food products which are produced by different production systems. The traditional "farm-to-table" framework for managing food safety is inadequate if food safety is to be addressed in a comprehensive and systematic fashion. The framework needs to be expanded to include the environment in which food is produced, processed and distributed. In addition, natural resources associated with food production such as land, water, air, forage and wildlife must also be considered. Individual consumer response to food will also be important. In short, the new food safety framework must represent a continuum from environment-to-consumer.

While chemical residues have received significant attention in the last decade, the majority of current food-borne illnesses are caused by microbial pathogens including bacteria, viruses and parasites. New data and analyses suggest that concomitant infections from viruses, bacteria or protozoa can be synergistic, resulting in more serious disease when present together. The roles of nutrition and genetics in determining the relative susceptibility or resistance to infections also require further research. In recent months, new challenges associated with bioterrorism, which include threats to food safety, have emerged and must be addressed in California as well as in the nation-at-large. One-third of the 16 confirmed cases of bioterrorism and 31 confirmed individual biocrimes committed in the U.S. involved food or other agricultural products. California's food animals are extremely vulnerable to acts of bioterrorism which employ any of more than a dozen infectious diseases, some of which are equally infectious for animals and humans.

Perishable crops, many of which are high valued crops, are at special risk from the impacts of associated food borne illness and illustrate the economic harm associated with

public health concerns. Sales plummet, and while many, but not all, consumers eventually return to purchase the commodity in question, the short term loss in crop value cannot be recouped because most crops are perishable. And, contamination of food in global markets may lead to prolonged economic losses.

There is much uncertainty about the safety of the nation's food supply. Less than 2% of imported foods are inspected, for example. The origins of food products are often difficult to ascertain. The food system lacks trace-back capacity and there are few adequate systems of accountability. The dynamics of foreign agricultural practices and changing domestic practices, influence food safety in ways that are frequently unknown. Science-based surveillance systems need to be developed that can identify emerging problems in a cost-effective manner. Control and response systems need to be developed to address outbreaks effectively.

New scientific knowledge, innovations in technology, improved methods of risk assessment and diagnostics as well as better consumer education will be required across the entire continuum of food production if the causes of low dose, sporadic and geographically dispersed outbreaks of food borne illness are to be identified and addressed. The development of interventions that can be used to prevent hazards at each step of the production system, from environment to consumer, will be critical elements in the protection of public health and economic vitality.

NEW! (added 6/05)

SUSTAINABILITY OF AGRICULTURE AND NATURAL RESOURCES:

Sustainability of agriculture and natural resources balances environmental stewardship, economic development, and community vitality. This is an increasing focus for today's land-grant institutions and the world. There is growing recognition of human activities and their connection to environmental degradation through processes such as soil erosion, deforestation and surface and ground water contamination.

Compounding this situation, about 90 million people are added to the global population every year--mostly in developing countries--with the U.S. population increasing by 3 million each year. Within the next 40 years, the world's population is anticipated to reach 9 billion. California is the most populous state in the nation; adding more than 500,000 new residents each year since the 2000 census, further contributing to growing pressures on the state's agricultural and natural resources. By 2020, California is projected to grow to greater than 42 million people. As population increases in California and knowledge and technology continue to change in relation to agriculture and natural resources industries and constituencies, the interrelationships among people, the economy and the land grow increasingly vital. ANR plays a key role providing science-based information at these interfaces.

The significant issue facing California in this area is guiding the development and application of management approaches and policies that result in the sustainability of diverse ecosystems that provide food and fiber, human recreation, and the survival of plant and animal species in the face of the increasing human population of the state and increased demands on our environment. This is an area that ANR has both the capacity and mission to address.

ANR's research and extension programs in agriculture and natural resources address these issues through the development and delivery of new knowledge to help support and sustain California's agricultural and natural resources communities. ANR is a world leader in developing technologies and reduced input systems that contribute to long term sustainability. ANR is also a world leader in technology transfer. ANR continues to offer farmers access to un-biased research results driven by long term goals.

ANR will emphasize development and evaluation of strategies to ensure the ecological sustainability of California agriculture and natural resources. ANR research and extension programs in this area will focus on opportunities and challenges associated with the transition to organic production techniques, the development of new crops and breeds, the use of biotechnology, and developing effective management and marketing systems to ensure the economic viability of California's diverse agricultural system. Agriculture is a large and highly-valued component of California's economy. The profitability of California farms, however, has been diminished by sharply rising production costs, the depressed value of some crops due to overproduction and global competition, increased diversity and availability of imported crops, and trade restrictions that limit export markets. Organic production of plants and animals is a rapidly increasing sector of agriculture with a need to determine potential implications in terms of food safety/quality and human nutrition and health.

In addition, emphasis will be given to the development and evaluation of the effectiveness of management practices that promote ecological sustainability and discover the effects of management practices that promote economic opportunity in sustainable natural resource production. Sustainable use of natural resources incorporates management approaches that maintain critical ecosystem conditions on a landscape scale and over the long term while maintaining the economic viability of resource dependent industries and communities.

From an ecological point of view, sustainability means use of resources that will allow for long-term survival of ecosystems and their associated plants and animals. Implicit in the persistence of ecosystems is the concept that species will not be driven to extinction, the balance of individual populations will be maintained, and natural resources will be managed so they will not be exhausted.