# 2005-2006 Plan of Work Update

## Montana State University

## College of Agriculture
## Montana Agricultural Experiment Station

## April 1, 2004

**Executive Summary**

Montana State University is currently searching for a permanent Dean of the College of Agriculture (COA) and Director of the Montana Agricultural Experiment Station (MAES). It is anticipated that this position will be filled by mid-2004. The tenure of the Dean and Director has been a challenge for at least the last 12 years, with six individuals filling this role during this period. The Associate Dean for Resident Instruction and seven Department Heads serve as the administrative team for COA/MAES that develops and implements a plan of work, and constantly seeks external stakeholder input. We have seven departments in the College, lead by Department Heads, three of which have less than one year of experience. In addition, Montana State University has recently hired a new Director of the Extension Service (ES). Hopefully, we are entering a period of administrative stability that will enhance our planning, execution, and impact evaluation activities in the COA, MAES, and ES. This would be done with a time sensitive planning horizon, where appropriate. With split appointments being the norm of faculty (75%) in the COA, administrative stability is critical for future success. With flat salary budgets over the past several years, we are beginning to see a migration of faculty to other institutions, which has impacted key programs and short- through long-term goals. Although budgets are not optimum, the stability of faculty is the most critical aspect of our program, despite the administrative turnover.

Montana is a semi-arid state with plant and animal systems that provide roughly a 50:50 mix of cash receipts totaling $2 billion annually which makes agriculture the number one basic industry. Agricultural enterprises range from low to high intensity plant and animal systems. We are world-renown for our wheat quality and beef cattle seedstock industry and proven genetics. These plant and animal systems utilize water and soil resources ranging from forested lands to rangelands across the state. Programs in the COA span the basic to the applied, with management applications, economic viability, and environmental stewardship playing key roles in the decision-making processes of stakeholders, land managers and users, conservationists, policy makers, and other decision makers. Most, if not all, programs have impact; the "term" (e.g. short- to long-term) is difficult to consistently identify relative to USDA requests. Our portfolio contains research conducted in conjunction with and often on ranches and farms. Short-term, there are progress reports, and refereed papers produced. Long-term, there are more popular electronic and popular press products that supplement in-state meetings that impact behavior, conservation activities, economic returns and, consequently, economic development. We have no resources to conduct direct impact surveys of changes. Our economic statements are general, so a general literature review is provided. We have prepared a broader statement of economic impacts under the Program Review section.

The 2005-2006 Plan of Work continues to address 10 Research Programs within five federal Goals. It is our intent to: 1) give more in-depth information over fewer sub-subjects, 2) give definitive impacts of research programs, 3) integrate, where appropriate, with ES and other states, 4) expand the stakeholder input process, and 5) expand partnerships with other Montana institutions, 1994 Institutions, and state and federal agencies. Funding is from state and federal sources, which amounted to over $20 M in grant expenditures in 2002 over and above the state (COA/MAES) portion of $14 M, with a federal base of $2 M. This investment is a 7:1 ratio of state to federal base funds.

**Vision**
To create environments where people excel through innovative learning and discovery.

**Mission**
As a Land Grant Institution, Montana State University-Bozeman provides instruction and research programs to meet the ever-changing needs of Montana and its people. In keeping with this mission, the COA/MAES provides science-based education, new knowledge, and leadership on agricultural and natural resources issues.

## MAES PLANNED PROGRAMS AND KEY THEMES

### Goal 1. An Agricultural System that is Highly Competitive in the Global Economy

Montana's agricultural systems are wheat/barley and forages with plant systems and predominantly, beef livestock with animal systems. Our plant improvement programs are an on-going effort supported by the Montana Wheat and Barley Committee with breeding and genetics programs focused on insect and disease resistance issues. The wheat stem sawfly is a major pest that has culminated in efforts in multiple programs with plant, insect, pathology, soil, weed, and cereal sciences focusing some of the efforts on the use of plant improvement techniques to be the first defense against pests in dryland and irrigated systems. Improved management techniques and the reintegration of crop rotations (new alternative crops and cropping systems) will potentially increase net returns and provide more flexibility in crop-based systems. We are actively exploring alternative pest control tactics to combat plant pests including: pesticides, biocontrol, cultural, biological, and integrative techniques.

Improving feed efficiency, cost-effective feed supplements, feed alternatives that can be grown in Montana, managing stress particularly during the winter period, lowering production costs, beef genetic improvement for improved carcass yield and quality, matching optimal breed combinations for maternal ability in stressful environments, and the effects of mineral supplements on ovulation rate in beef heifers will continue to be a primary focus in our animal programs. Research impacting the sheep industry will focus on factors impacting lamb mortality, wool quality, use of sheep as an invasive species control technique, feeding behavior and supplement delivery methods, and breeding programs with ewes.

### Goal 2. A Safe and Secure Food and Fiber System

Montana continues to be a leader in the tracking of beef cattle throughout the production cycle. We are well-positioned to become a pilot project with animal ID procedures necessitated by the BSE and subsequent actions and impacts in the United States, North America, and international trading customers. Currently, 63,000 Montana calves will be tracked from the ranch to the packing plant. In addition, we are actively working with the University of Nebraska to evaluate the opportunities that exist at the ranch level to decrease the risk of food-borne pathogens, particularly reducing the incidence of E. coli.

Biological risk assessments are essential if we are to honestly evaluate and make informed decisions on use of genetically modified organisms to combat pests in comparison to traditional use of herbicides, and the comparative threat of West Nile Virus compared to preventative spraying of insecticides. Risk assessments are a relatively new methodology that enables scientists to evaluate the relative risk of a

particular action or practice as compared to an alternative approach. These are two issues that are routinely discussed with the public, legislature, local governments, and the scientific community. These two examples of very contentious, emotional issues will provide good templates for the public and policymakers to evaluate reasonable alternatives.

**Goal 3. A Healthy, Well Nourished Population**

Montana produces some of the highest quality plant and animal products in the world. Our reputation is directly related to the production systems that maintain the quality of the raw commodities. In certain areas we are actively studying the mechanisms of disease transfer from wildlife to livestock (e.g., prion infected cervids and sheep) in order to determine the route(s) of chronic wasting disease and scrapie agent transmission. The development of novel vaccines will also add to a safe and secure food system. We are also investigating the use of crop products, such as mint oil, as an additive to ensure beef product quality.

In addition, through our breeding efforts, we will research the potential development of low carbohydrate wheats (high amylase content) and will continue expansion of testing new crops for the celiac market. An Amazing Grains Cooperative has been formed and is looking to expand into new niche markets. Our mainstream winter and spring wheat breeding programs will continue to develop world class wheats in terms of yield and, most importantly, milling, baking and brewing capability. We are continually in contact with international representatives who provide direct feedback on the quality of our wheat, and various other end-use properties such as noodle production. Lastly, we conduct foreign explorations to identify potential biocontrol agents and on endophytic plants that may contain compounds that have value in agricultural, industrial and pharmaceutical applications that help to ensure food quality.

**Goal 4. An Agricultural System which Protects Natural Resources and Environment**

Many of our plant and animal based research efforts have a significant component addressing environmental stewardship. Fertilizer inputs, legume rotational crops (add N), precision ag practices, manure management, and the pesticide use are all decision points for land managers which can improve or degrade the soil, plant, water, and air environment, if the latest tools are not optimally utilized in particular cropping enterprises. Our agronomic studies continue to have an environmental component to them such as: modeling the fate and transport of compounds and chemicals, residual soil nitrate-N testing, phosphorus loading and transport off site, use of biocontrol agents as one alternative to traditional pest control techniques, residue management, and efficient of crop utilization of inputs.

Our research will also look at livestock grazing patterns on the landscape and determine the trends of certain breeds to partition their grazing activities on portions of the upland, mid-section or toe slope of a range. Through the tracking of grazing patterns, use of water, supplements and certain breeds, livestock activity may be more intensively managed to optimize use of the forage resources and minimize the impact on potentially sensitive areas. Sheep grazing is being used to reduce the impact of invasive weeds.

**Goal 5. Enhanced Economic Opportunity and Quality of Life for Americans**

Innovation has been a hallmark of agriculturalists throughout the country and Montana is no exception. We have been in the mode of producing high quality plant and animal raw products for decades. Presently and into the future, Montanans and particularly rural Montanans must creatively develop value-added opportunities for wheat, barley, forage, beef cattle, sheep, and other commonly produced commodities that will add new dollars to the state and provide for enhanced small business opportunities in rural communities. We are integrating our research efforts with economic development and technology transfer initiatives to enable Montana to actively participate in biobased enterprises. These biobased products have the potential to add net returns and partially replace imported petroleum-derived products which will directly support farmers/ranchers and their communities, reduce foreign energy dependence, and be readily biodegradable. This will also empower our stakeholders to directly participate in the FSRIA of 2002 that promotes the use of biobased products by federal agencies.

**STAKEHOLDER INPUT**

The COA/MAES will work with the ES to obtain stakeholder input. We have the primary grower groups present at some of the information gathering sessions. The Directors will work with local County Extension Agents and Department of Research Center faculty to identify key stakeholders and non-traditional stakeholders to assist in the evaluation of Montana needs in research and extension. We will advertise on the radio and in print resources to encourage broad participation in these listening sessions. Given the number of 1994 Land Grants in Montana, we will make a concerted effort to include their input into the process and build capacity with the Reservation Extension Agents.

The new Dean and Director will look and evaluate all of the existing advisory committees at the local and state level. Modifications will be made to increase the diversity of perspectives and potential audiences that have been or might be impacted (knowingly or not) by current and future MAES programs. As new programs are initiated with new or existing faculty, these program elements will be added to reflect Montana, regional, national, and international needs. We will initially participate in the State Technical Committee of NRCS/FSA and from those issues addressed, and the 70 plus representatives, pick leaders from a broader cross section of Montana. Individuals who have interest in our programs with dynamic perspectives, and have the resources to participate will be invited to serve on a new Stakeholder Committee for COA/MAES. Input will be categorized by Goal and sub-program, and then sent to the appropriate department for inclusion in activities. Resources must then be redirected or provided to support this new/modified program.

**PROGRAM REVIEW**

MAES Projects continue to have a comprehensive and rigorous review process associated with their implementation, productivity, and evaluation. All MAES project reviews require a self assessment by the principal investigator. We will electronically publish on the COA website, the seminar schedule for faculty participating in the MAES project review process. This will allow for additional external comments and review from a wide array of the public. Projects will continue to be set for three years for new projects and up to five years for existing projects. Wherever possible, we will try to incorporate an Extension Service faculty member for appropriate projects to help ensure that the

technology transfer and educational programs are in place to facilitate the adoption of new research findings. Other than the above noted minor modifications, the Program Review process will remain as previously described in the 2000-2004 POW.

**Economic Impacts**

Although farmers and ranchers have experimented with different techniques for over 10,000 years, organized agricultural research is a fairly recent phenomenon. Conventional wisdom is that investments in agricultural research have yielded sustained returns for society. Immense growth in agricultural productivity enables today's farmers to outpace the extraordinary increase in food demand caused by continued growth in world incomes and human population. For example, the world used about 3.5 billion acres of land for crops in 1961, but needed only 3.7 billion acres in 1998 to double world production of grains and oilseeds (Pardey and Beintema 2001). Prices for food products are at their lowest levels ever, and food variety and quality are steadily increasing, benefiting consumers who are able to eat better and spend less of their income on food. While these descriptive facts justify past investments, and support increased funding, private and public agricultural research investments have fallen in recent years (Gopinath and Roe 2000)[1].

Many research administrators cite annual rates of return in the range of 40 to 60%. A survey by Alston et al. (2000) on all available evidence on investment returns in agricultural research and development since 1953 found over a 100% rate of return estimate and yielded mean rate of return estimate of 100% per year for research, 85% for extension, 48% for studies that estimated the returns to research and extension jointly, and 81% for all studies combined (Table 1). These averages were widely dispersed, ranging from -7 to 5,645%. Therefore, the mode (the most frequent observation) and the median (the middle observation) were also reported.

Table 1. Ranges of rates of return (Alston et al. , 2000)

| | Mean (%) | Mode (%) | Median (%) | Minimum (%) | Maximum (%) |
|---|---|---|---|---|---|
| Research | 100 | 46 | 48 | -7 | 5,645 |
| Extension | 85 | 47 | 62 | 0 | 636 |
| Research and Extension | 48 | 28 | 37 | -100 | 430 |
| All studies | 81 | 40 | 44 | -100 | 5,645 |

In a comparison across countries, mainly focusing on the European Union and the United States, Schimmelpfennig and Thirtle (1999) found that differences in productivity in agriculture can be explained by public sector research and development, education, land quality, and private sector research.[2] They estimate a public research rate of return of 60%. Allowing for international spillovers[3] between countries, this estimate falls to 10 to 12%. The problem of spillovers is also addressed by Gopinath and Roe (2000). They emphasize the importance of public investment due to the difference in private and social rates of return and potential market failure and discouragement of private investment. Their estimates for private rates of return range from an average of 22% per annum for farm machinery to 43% for food processing. In contrast, the direct rate of return to public

[1] The decline is research investment is not unique to agriculture, but follows a general trend in total industrial research and development spending in the U.S. economy.

[2] Other studies (e.g., Evenson et al. 1987) also confirm that changes in agricultural productivity can be explained by means of variables such as research, extension and farmer education.

[3] Spillovers denote additional returns to investment in agricultural research in other industry sectors or across states and countries.

research in primary agriculture was estimated at 88%. Accounting for spillover effects across sectors yielded a social rate of return to investments in agricultural research and development of over 80%. While Gopinath and Roe (2000) also point out that a decline in investments in agricultural research in recent years coincides with a stagnation and even decline in productivity growth in agricultural sectors, several studies focus on the fact that not all of the research efforts are intended to raise agricultural productivity levels. Significant research investments, 35% to 70% of U.S. research alone, are needed to maintain current levels of productivity and previous research gains (e.g. Adusei and Norton 1990).

**These findings confirm the likelihood of relatively high rates of return to investment in agricultural research and the importance of these research investments due to large potential social gains.**

**MULTISTATE RESEARCH**

The Multistate Research Program meets the multi-institution, -state, and -discipline federal requirements. We believe that this is part of the future, regional uniqueness, where expertise is garnered from other institutions in the region or United States. We are not in a position to fund programs outside of the COA. Aacross other MSU Colleges, numerous grant efforts span across college and university boundaries that do not include SAES funding. In the 2000-2004 Plan of Work, we had 43 multi-projects. During the current reporting period 14 of those were dropped and 11 were added spanning Goals 1 and 3-5. The success of these multi-state activities will be judged on their productivity and continued faculty interest toward the group goals imbedded in the projects. The five-year program review process is an excellent evaluation tool. Faculty that do not want to participate in these projects due to its poor productivity, will be respected, and is also an excellent indicator of success and the need to continue these particular multi-state programs.

Program elements include: family well being, agricultural literacy, rangeland ecology, bioactive compounds for biocontrol agents, renovation/revegetation of deteriorated lands, biobased products, controlled environments, beef cattle evaluation, and soybean/bean improvements through genetics.

**INTEGRATED RESEARCH AND EXTENSION ACTIVITIES**

Approximately 75% of COA faculty have joint appointments with MAES, MES or Instructional funding. All COA faculty are required to conduct research and outreach programs irrespective of the source of funds utilized to pay their salary and other aspects of their program. Faculty that do not have a formal extension appointment frequently participate in outreach activities to a large degree, but this is counted or credited at the College of Agriculture level. This is a cultural commitment to the Land Grant Institution. We have participated in the Four State Ruminant Nutrition Program (MT, WY, ND, SD) for the past two years and anticipate that this will continue through this planning period. We will continue to fund and participate in Montana Ag Live a live PBS television program that provides research and extension faculty to the entire state (estimated 300,000 viewers). Faculty with MAES and MES appointments naturally have integrated research and extension programs with time allocated to each based on their appointment. Montana, Utah, and Wyoming have a long-standing tradition of publishing a regional herbicide guide based on research and extension activities from all states. This effort will continue. Nine percent of the FTE will be devoted to integrated research and extension

activities, although this may fluctuate with state and federal budget recisions. More effort will be allocated to integrated staffing of programs with the new Director of the Montana Extension Service and the new Director of the Montana Agricultural Experiment Station.

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