Increasing Profitability by Improving Efficiency of Montana's Farm and Ranch Lands

A proposal developed by 24 scientists from Montana State University, the University of Montana and three private industry partners.

Production agriculture is the single biggest sector of the Montana economy with~ 27,800 farms and ranches and >$4.2 billion annual sales. This proposal focuses on optimizing dryland agriculture that encompasses> 6 million acres of Montana cropland and will provide an estimated $15 to $25 million increase in the net return in the 18 month project period.

A. Wheat/Crop System:

Our intent is to replace much of Montana's 4.6 million fallow acres with income producing crops that fit the predominant wheat/fallow/crop ecosystem, this project's primary objective is to address the barriers farmers & ranchers across the state face when moving from a wheat-fallow to a wheat-crop system, including:

1. Reducing risk from herbicide residues that can affect either wheat or pulse crops,
2. Maintaining water availability for winter or spring wheat crops,
3. Development and identification of adapted pulse crop varieties,
4. Development of crop water availability models (soil water + precipitation – crop water use) that will assist in cropping system planning,
5. Determination of pulse crop-microbe produced nitrogen availability to wheat crop and corresponding effect on wheat protein content under varying climatic conditions.

B. Cover Crop and Pulse Crops:

By increasing the utilization of pulse and cover crop mixes to across Montana, farmers and ranchers could see these benefits:

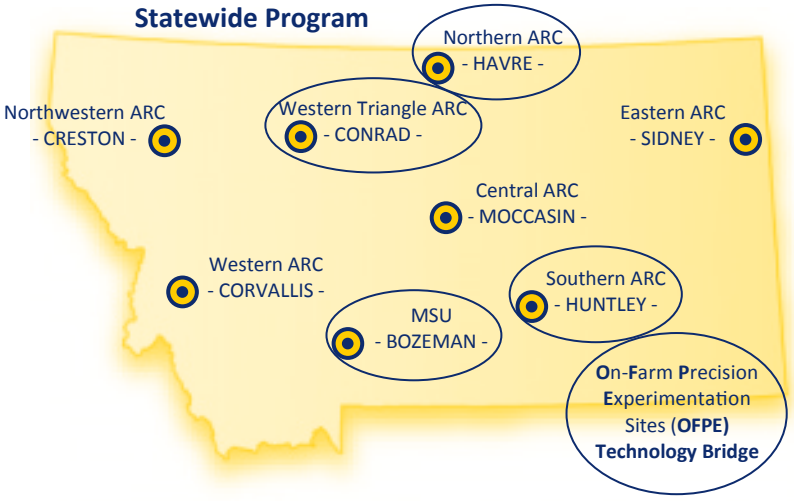
1. An increase in the organic matter in soils
2. Greater water holding potential
3. Assistance in the reduction of soil-borne plant pathogens
4. Increased wheat yields and a decrease in wheat pest losses where rotations to non-cereal crops are used
5. Nectar from pulse and cover crop mix flowers support wheat stem sawfly parasite, thus decreasing the damage from the sawfly, which costs Montana more than $100 million per year
6. Increased revenue from the food processing industry's demand for non-GMO, high quality pea protein
7. Improved microbial inoculants that fix atmospheric N for pulse and other crops, or to help reduce nitrate toxicity to livestock from grazing cover crops

C. New Products/Crops:

Montana growers currently raise durum wheat developed for ND and Canada and pulse crops bred for ND, WA and Canada. Experience with winter and spring wheat suggests we can expect a 5% yield increase by growing Montana adapted pulse and durum varieties. New product development includes, environmental sensors, optically controlled spray nozzle controllers, predictive climate/crop water availability models, and microbial inoculants for crops and livestock.

Optical sensor based sprayers allow for spraying only where weeds are

Weed map



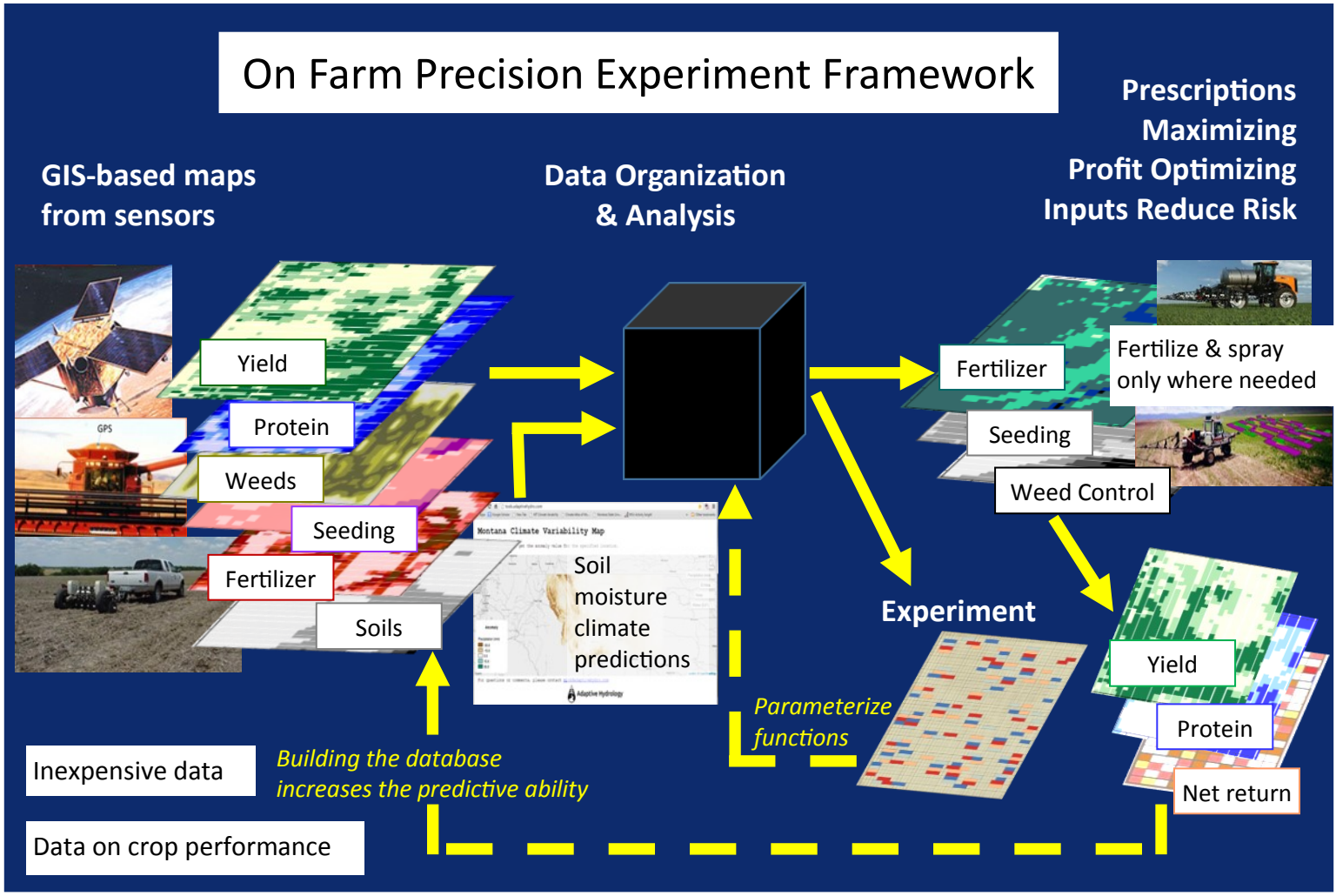
Research Goals

Improve farmer ability to manage risk and uncertainty with a precision agriculture based decision support framework.

- Demonstrate **O**n-**F**arm **P**recision **E**xperimentation (**OFPE**) to improve input management
- Automate OFPE to improve adoption
- Develop new crop analyzing sensors and climate prediction technologies
- Use farmer/industry based participatory research network to identify and address barriers to adoption

Innovative approaches and new ideas

1. Put the unprecedented flow of field/crop specific data to work for Montana farmers.
2. Our OFPE based framework for understanding uncertainty promises increased farm resilience.
3. OFPE is a unique approach to translating site-specific data into field specific, prescriptive management
4. OFPE creates a need for increased sensor technology development and small business opportunities.



The **OFPE** framework provides a farmer the ability to assess all uncertainties of production in one optimization routine. Site-specific data from sensor technologies coupled with experimental treatments placed in fields with rate control technologies allow analysis of variability in crop response to inputs across a field and over different years. Crop yield and protein predictive models, coupled with climate prediction models parameterized with OFPE date, will provide the profit maximizing prescription for each input. Preliminary results indicate a $10-$20/acre increase in net returns with precision management of weeds and nitrogen fertilizer alone. Automating and demonstrating the OFPE process will increase adoption.

Feasibility of obtaining expected outcomes:

1. We will demonstrate application of OFPE on six fields in Montana. Savings in weed control costs and improved fertilizer net returns in 2015 and 2016 will be demonstrated.
2. The OFPE-based framework development represents a significant new approach to agricultural research that will fuel further research (grant activity) and create jobs in the private sector, including:
   a. Crop consultants
   b. Crop sensor technology businesses
   c. Data management businesses
   d. Software businesses

Return on Investment

This project should return **$15-25 million** directly to the Montana economy by the end of the 18-month project. **Five to 10 year returns are likely to be in the $100s of millions.** New jobs will be created – many in the "high tech sector" but also for crop consultants, providing rural, as well as urban, Montana benefits. The precision approach to agriculture promises to return more young Montanans to the farm. Because agricultural property taxes are based on productivity, tax receipts to state and local governments will increase and increased incomes, in turn, increase income tax receipts. Increased economic activity will mean improves vitality for all Montana, but particularly rural communities.