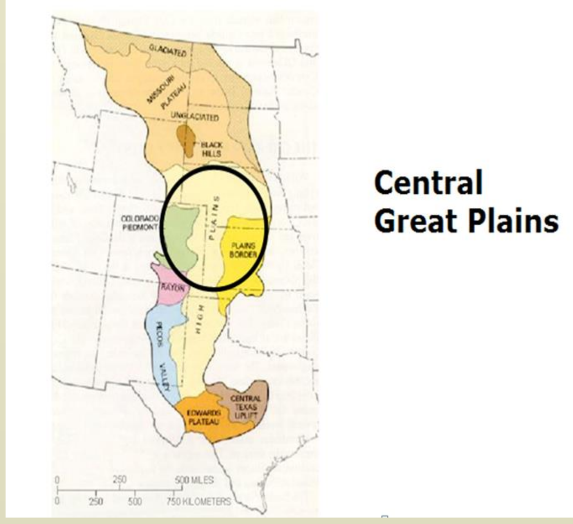
# Systems Approach Critical to Agroecosystems Management

L.A. Sherrod[1], Laj Ahuja[1], M.E. Schipanski[2] G.A. Peterson[2] PA-ARS-USDA[1] Colorado State University[2]

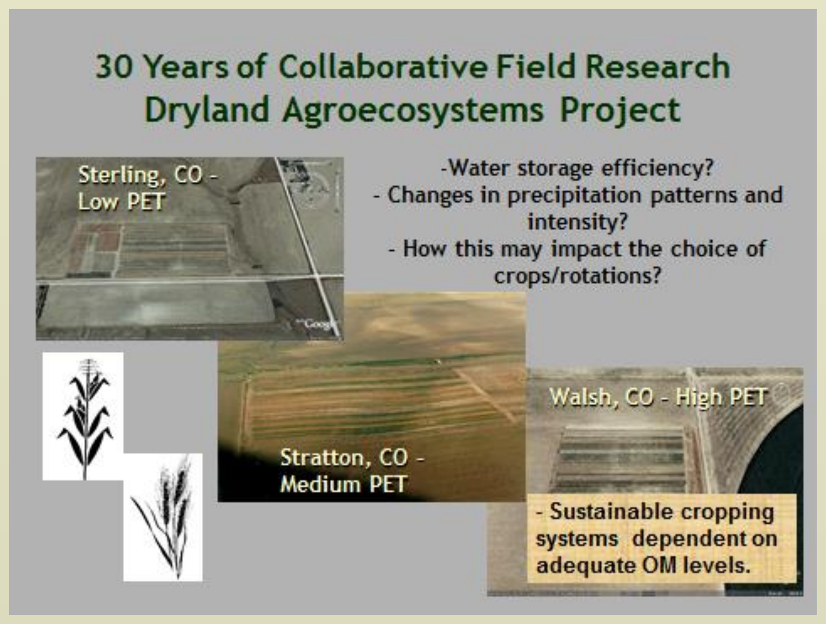
**ABSTRACT:** Sustainable dryland agriculture in the semi-arid Great Plains of the US depends on achieving economic yields while maintaining soil resources. The traditional system of conventional tillage wheat-fallow was vulnerable to excessive soil erosion which resulted in excessive organic matter losses. No-till has allowed for increased cropping and less fallow. Optimizing the cropping system depends on environmental factors such as mean annual precipitation (MAP) and potential ET (PET) along with soil types working in concert with robust systems management. A long term cropping systems experiment was established in 1985 to identify systems that maximize the use of precipitation by collecting data across gradients of 1) PET sites, 2) soils (across landscapes) and 3) cropping intensities. The 4th variable is time whereby the minimum length of the study is derived by the longest rotation in the study. Each phase of each cropping system is represented each year. Since the maximum rotation length is 4 years all systems are back to their starting phase in year 12 and 24, (1997, 2009) which permitted a comprehensive evaluation of the annualized production for each of the cropping systems. Systems can be compared within a PET site and soil or pooled over soils within each location or over all locations and soils. This study has been designed to 1) determine if cropping system sequences with fewer summer fallow periods are feasible; 2) quantify the relationships among climate, soil type, and cropping sequences; 3) quantify the long-term effects of no-till on soil structural stability, microbial populations, and nutrient cycling along with organic C and N; 4) identify cropping systems that will minimize soil erosion; and 5) develop a data base across climatic zones that will allow the economic assessment of the different management systems and provide a long-term data source to improve soil and crop models.

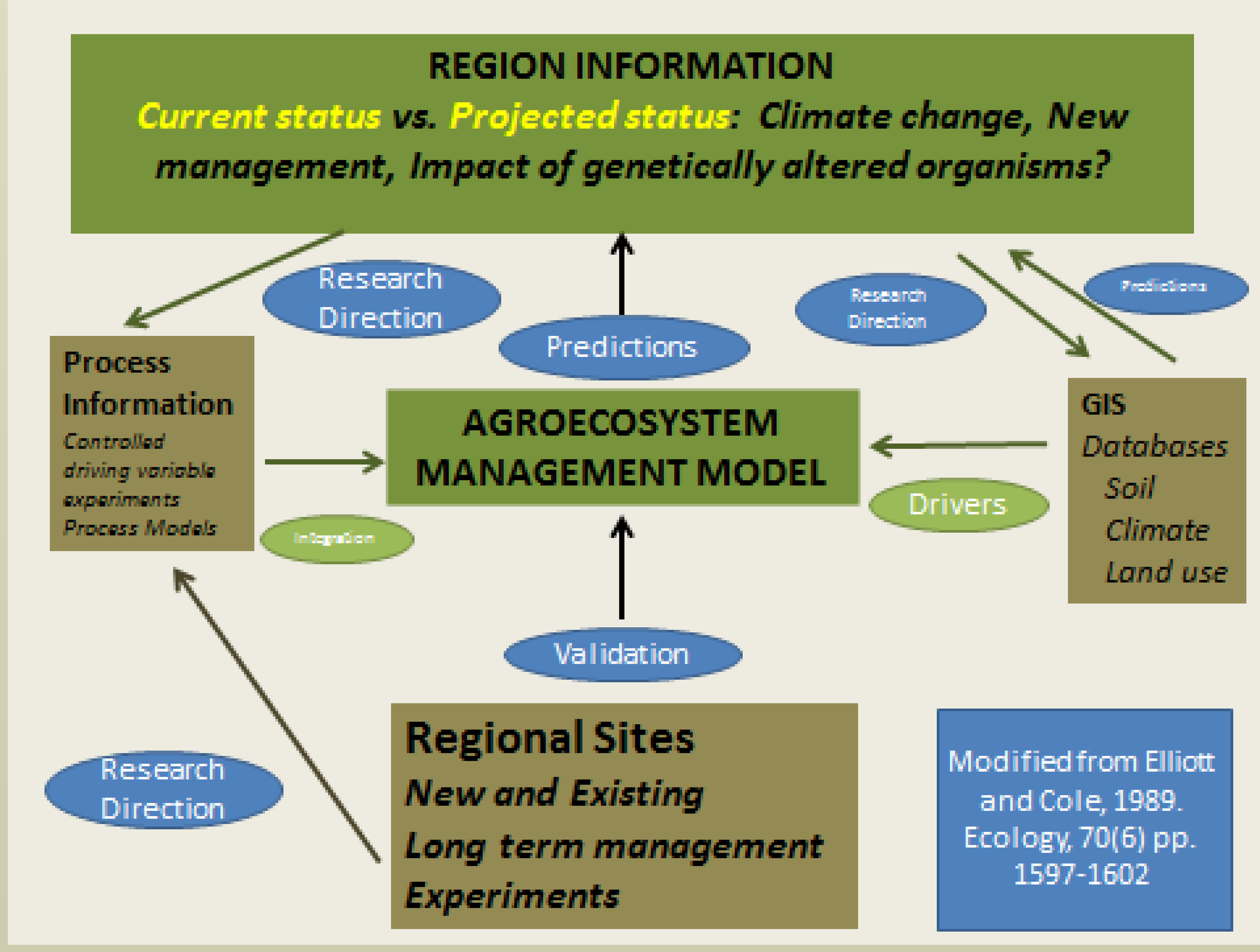
AGROECOSYSTEM: "An interactive group of biotic and abiotic components, some of which are under human control, that forms a unified whole (ecosystem) for the purpose of producing food or fiber."
Elliott and Cole. 1989 Ecology, Vol. 70, No.6

CURRENT ROTATIONS:
1) Grain based only (WF, WCF)
2) Biomass based (Sorghum forage-Soybean forage)
3) Mixed system of Grain and Biomass
4) WF – using cover crops in the fallow phase.

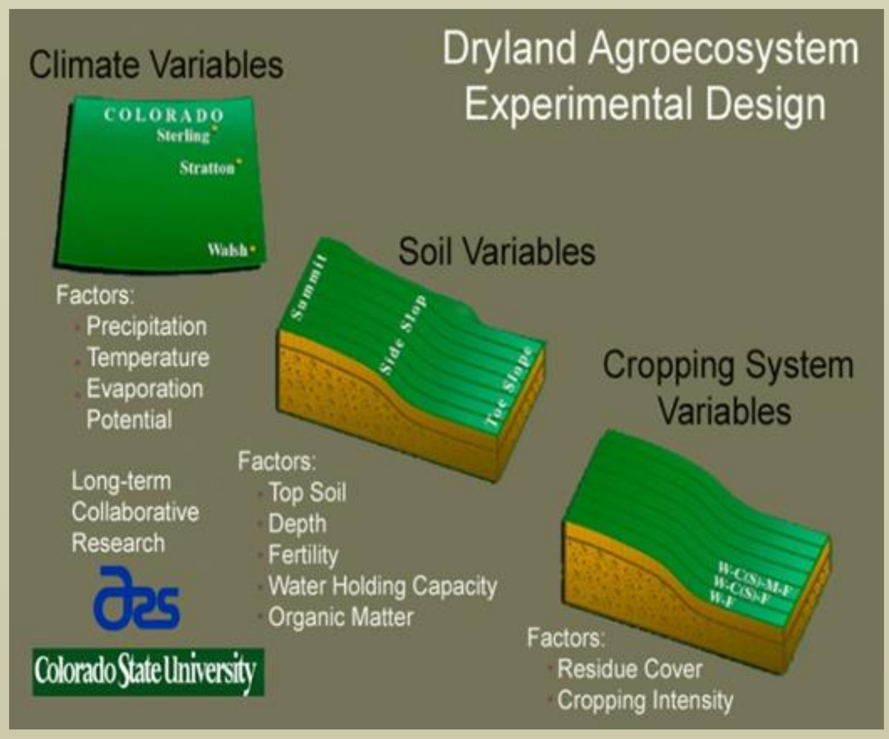



- 55 Papers in Peer Reviewed Journals.
- 9 Book Chapters
- 25 Technical bulletins and reports.
- 76 Published Abstracts.

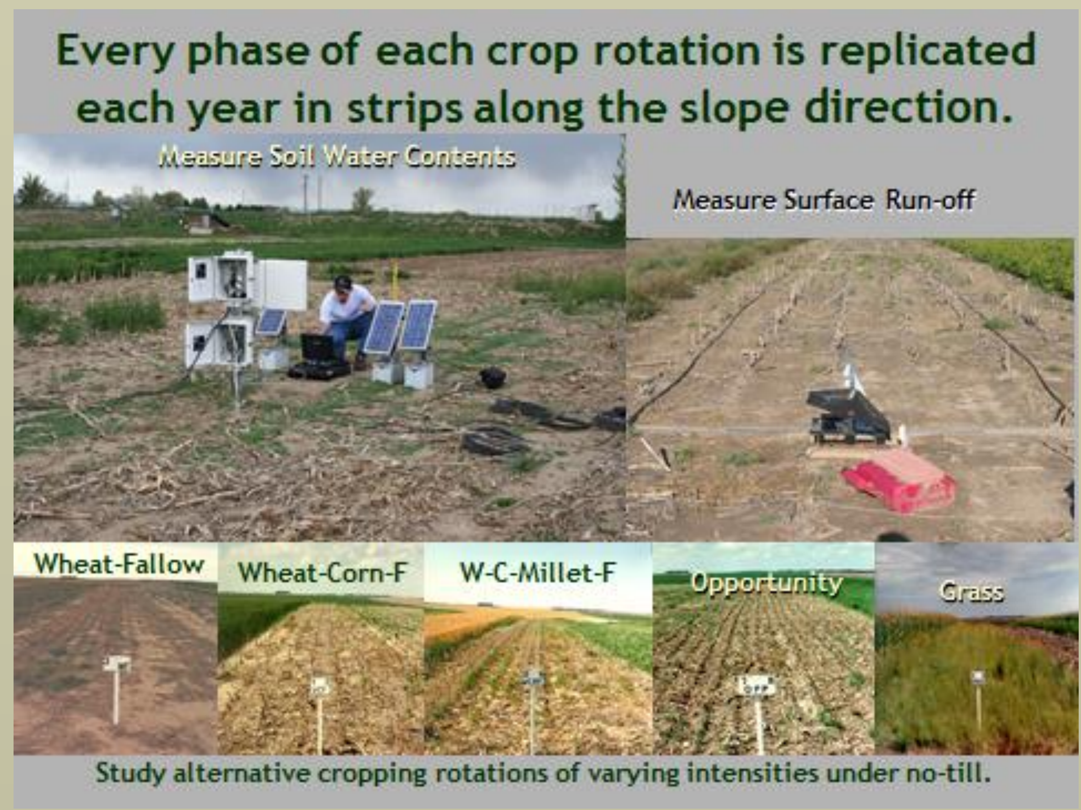


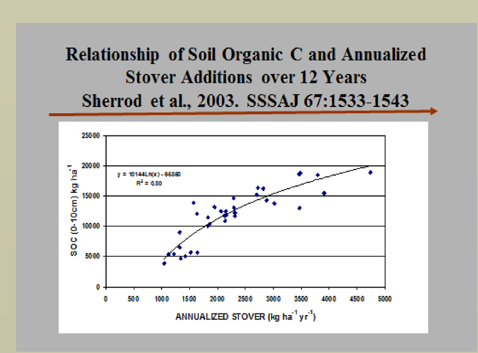

"There are numerous interactions and feedbacks that will vary as climate and management changes, which makes prediction difficult without models." Elliott and Cole 1989.

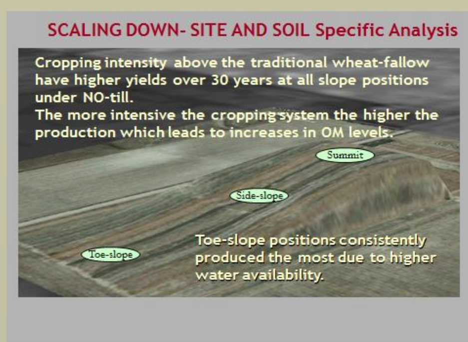


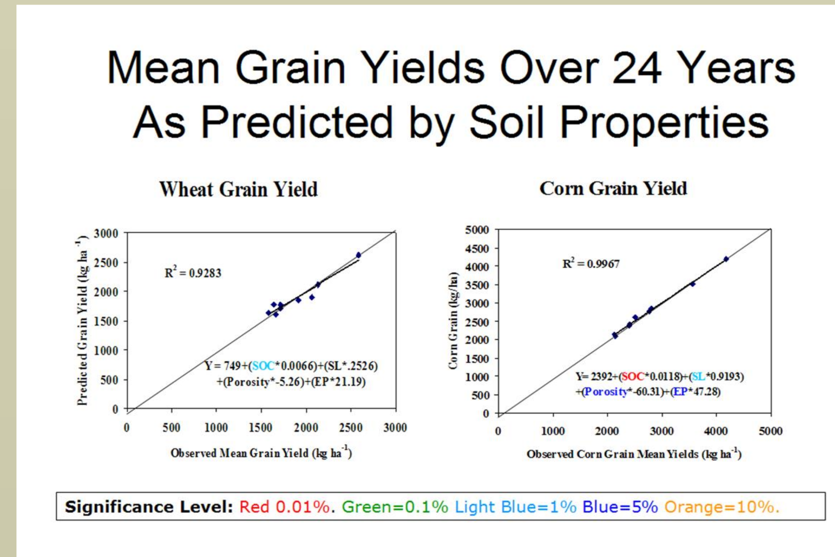

"Goals of ecologist and agricultural scientists are converging within agroecosystem science. This integration will help provide insight for solution of the production and environmental problems we are currently facing." Elliott & Cole 1989




Scaling up to Regional Levels

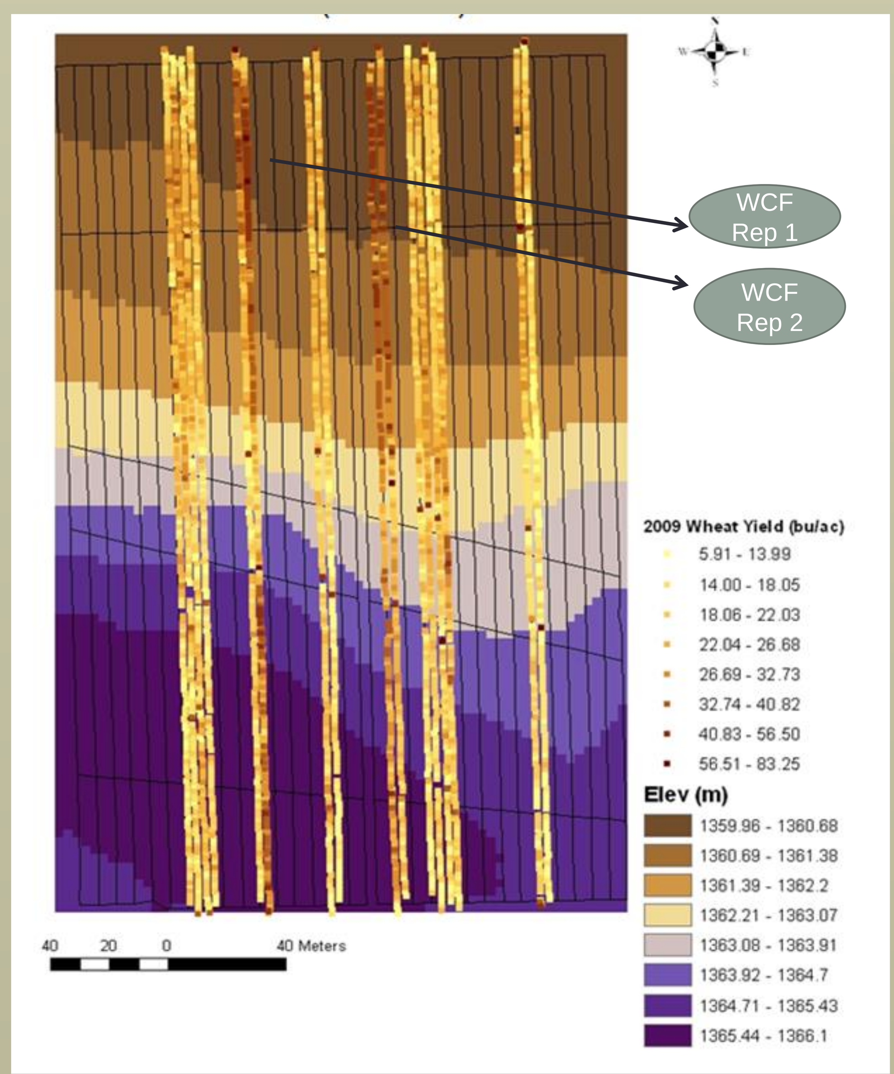


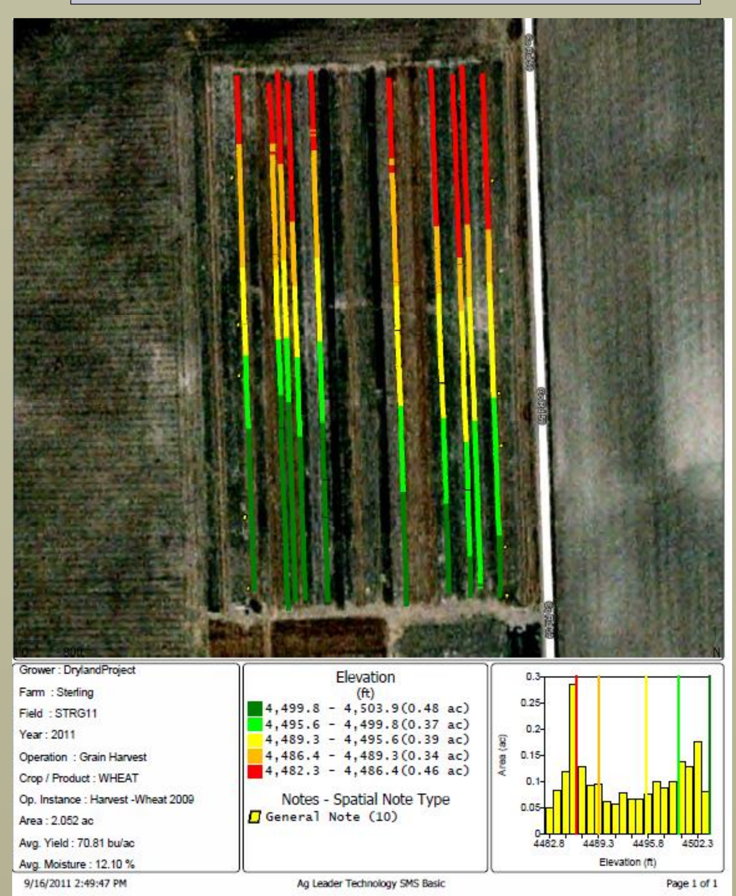

"The critical issue is that experimental sites represent points in a continuum and data gathered at these points can then be quantitatively related."
Peterson, Westfall and Cole 1993.

"Because of periodic and chronic disturbances inherent in agricultural management, agroecosystems are some of the fastest changing landscapes of any ecosystem type." Elliott & Cole 1989.

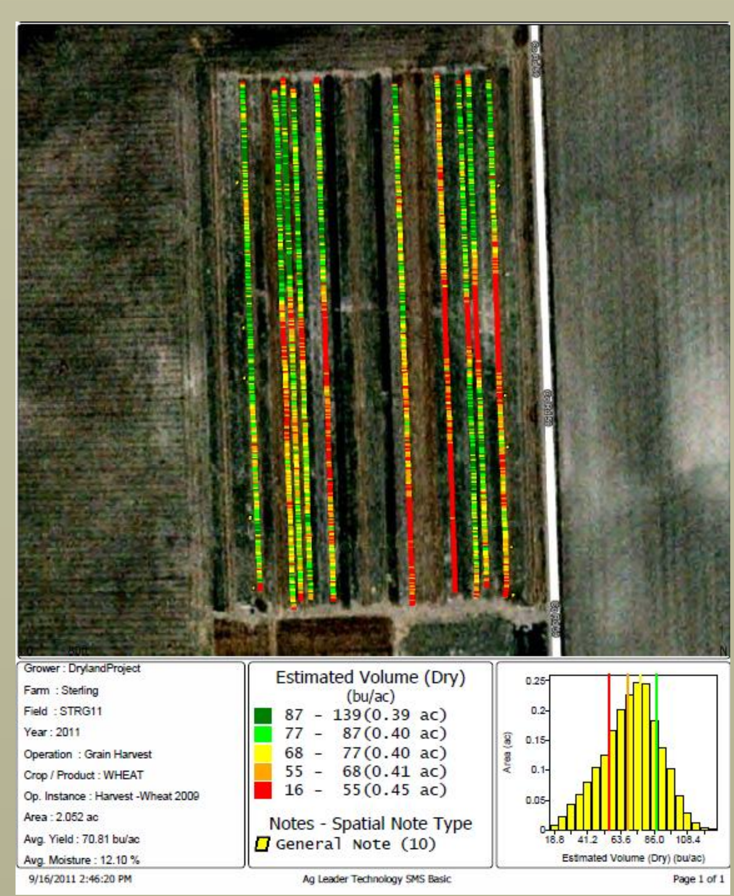



In 2009 the Low PET site had a slope by cropping system interaction with the WCF system providing higher yields on the toeslope soil. During the dry years (98-09) only 1 fallow system was in place (WCF).

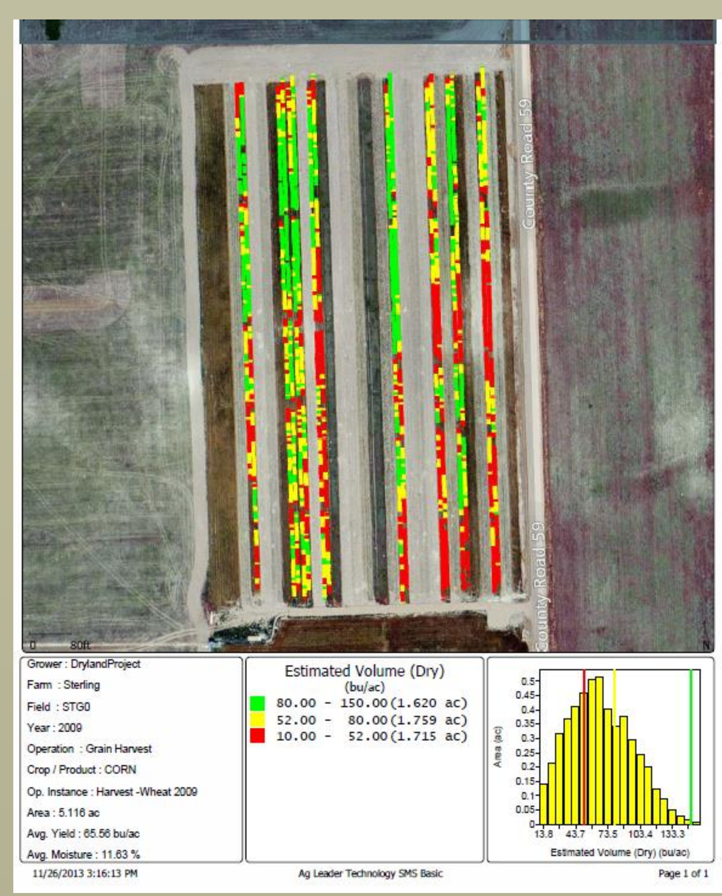
ELEVATION MAP



WHEAT YIELD MAP



CORN YIELD MAP



## References

*Elliott, E.T. , and C.V. Cole. 1989. A perspective on agroecosystem science. Ecology 70:1957-1602.*

*Peterson G.A., D.G. Westfall, and C.V. Cole. 1993. Agroecosystem approach to soil and crop management research. Soil Sci. Soc. Am. J. 57:1354-1360.*