Diversity in Dryland Winter Wheat Cropping Systems

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Considerations for Developing Novel Cropping System

- Designing a cropping system for any given environment requires a complex planning of various elements that entails biology, climate, management, and socioeconomic factors (Figure 1)
- Most limiting factors of the system play critical role in the decision making process. For example, water is one of the most limiting factors of semi-arid and arid climate that play important role in deciding the composition of cropping system
- Maintaining the crop diversity in a given cropping system under water limited environment can be challenging but possible with careful considerations of resource management and utilization potential
- Economics are key drivers of decision process but It is also critical to consider the long term sustainability while devising the cropping system plan
- Maintaining crop diversity in a cropping system would enhance soil health, management, economic and market flexibility and diversity

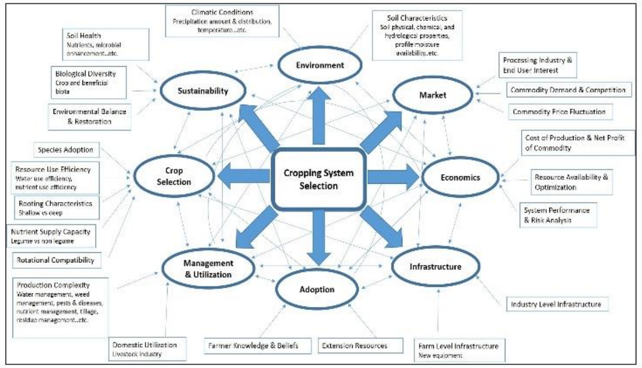

Figure 1: Elements of cropping system selection and decision planning

Case Study: Cropping Systems Study in Eastern New Mexico

Introduction:

Under dryland conditions of Southern Great Plains, the production capacity of traditional winter wheat (*Triticum aestivum L.*) cropping systems is stagnated over decades. The scope of crop intensification in the rotation to improve the overall productivity of dryland cropping systems is extremely limited by the availability of soil moisture in the growing season. Considering the unpredictable weather and erratic precipitation patterns, supplementing nitrogen and other inputs under rain-fed conditions is often risky and non-profitable management decision for most of the existing winter wheat cropping systems. In addition, during peak summer, the fallow period in the traditional winter wheat cropping system allows considerable amount of nutrient loss from the top soil due to lack of cover. Keeping the disadvantages of existing cropping system in view, devising a new strategy is necessary for efficient utilization of stored soil moisture and to conserve finite resources of soil while maintaining the production sustainability.

Rationale:

In reality, the replacement of fallow period in wheat-fallow rotation with any alternate crop will affect the soil water content and yields of the following cash crop. At the same time, leaving fallow in the rotation will inevitably result in the non-productive evaporation losses of soil moisture, making the system more vulnerable and inefficient. Introducing an alternate crop that reduce the length of fallow period will have several advantages in terms of productivity per each drop of water, soil quality, and sustainability. Optimizing the crop rotation benefits in the traditional winter wheat systems by introducing diversity is necessary for sustainable crop production in semi-arid environments. In addition, with the introduction of new crops, especially legumes and other forage crops, feed problems of integrated live-stock can be resolved. However, the effects of alternate crops in the rotation sequence in terms of productivity, water availability, and nutrient use efficiency should be evaluated before making any practical recommendations to the producers.

In the dryland winter wheat cropping system of Southern Great Plains, growing a legume crop in rotation would compromise some winter wheat yield in the following season. However, in the situation where live-stock is an integral component of agricultural system, there may be some economic benefits of growing legume crop that may offset the economics of lost yield. It can be in terms of water, nutrients, soil quality, or yield. Looking at overall cropping system in a long run is more logical in this case.

Aim and Objectives:

Main aim of this project is to evaluate the input and production efficiency of various winter wheat cropping systems by introducing crop diversity under dryland/limited irrigation conditions.

Step 1:

1) to evaluate the water and nutrient use dynamics and soil quality of 16 diverse crops to be integrated into various winter wheat cropping systems
2) to evaluate the yield potential (both forage and grain) for different crops and their possible impact on subsequent winter wheat yield
3) to evaluate the production and input use (especially water and nutrients) economics of these crops

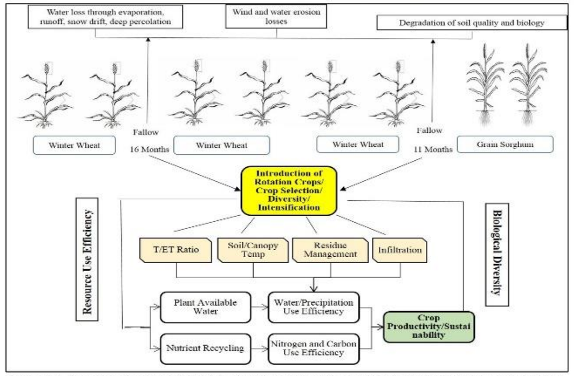

Figure 2. Schematic representation of winter wheat based crop rotations at Agricultural Experiment Station, Tucumcari, NM

Methodology:

RCBD with 11 summer and 5 winter crop crops with 4 replications at Tucumcari, NM

- Winter crops- winter canola, Austrian winter pea, berseem clover, hairy vetch, and red clover
- Summer crops: pearl millet, proso millet, German millet, lima beans, pole beans, spring canola, sesbania, cowpea, chickpea, lablab, and pearl millet+cowpea.
- Measurements: Water use efficiency (WUE), nutrient dynamics (NUE), Seed yield and biomass, soil physical characteristics (soil bulk density, infiltration), residue management, forage and grain quality
- Production and input use economics of these crops
- Potential for crop modeling (DSSAT)

Step 2:

- Once the resource efficient crops are identified, crop intensification efforts will be made to replace the fallow in the winter wheat cropping systems. In this step, system efficiency will be evaluated based on the overall resource use efficiency, productivity, and profitability

Potential Limitations:

- Biggest challenge is developing domestic market for some of these commodities
- Processing and infrastructure capabilities