ARS's Kernza Initiative - can Kernza promote the sustainable intensification of US agroecosystems by perennializing crop production and promoting the integration of resource cycles?

USDA's Agricultural Research Service (ARS) is initiating coordinated national research on Kernza® as a transformational grain crop that can support the sustainable intensification of US agroecosystems, enhance economic and societal health, and improve the well-being of the nation's citizens. Kernza, a product of The Land Institute's breeding of intermediate wheatgrass (*Thinopyrum intermedium*), is a perennial crop with "dual use" flexibility. Kernza can be harvested for both grain and forage within a single growing season, potentially expanding options for producers. Kernza's perennial nature offers the potential to minimize farm inputs and field disturbance associated with annual cropping, while its deep roots hold the promise of more fully utilizing available nutrient and water resources while conserving and building healthy soils.

The potential to integrate Kernza into livestock production systems is seen as a means of promoting better resource cycling within the nation's agroecosystems, as well as the perennialization of landscapes. Through ARS's Dairy Agroecosystem Working Group (DAWG), ARS's Kernza research evaluates the potential for Kernza to serve as both a new source of cash receipts (grain sales) as well as an alternative source of cattle nutrition (forage and processed grain). ARS research sites are exploring grazing and conserved forage opportunities for dairy and beef, as well as the value of feeding Kernza byproducts from end uses such as brewing. At each participating site, ARS is using the Integrated Farming Systems Model (IFSM) to quantify key sustainability outcomes following the adoption of Kernza by different farming systems.

ARS's Kernza research involves coordinated field trials and system-level analysis to support regional and national conclusions around this novel crop. This collaborative work seeks to develop best practices for agronomic management of Kernza, and to rapidly channel feedback to Kernza breeders to inform breeding targets. Powerful leveraging of stakeholder partnerships will permit systematic exploration of how Kernza can contribute to sustainable outcomes for farms and regional communities in nine states (Arkansas, Colorado, Idaho, Minnesota, Pennsylvania, Utah, Washington, Wisconsin, and Wyoming). In particular, ARS is partnered with the USDA-funded Kernza CAP network, led by the University of Minnesota and The Land Institute, as well as with a variety of public and private sector stakeholders who have interest in Kernza's potential to advance the sustainability of US production systems.

Overarchingly, ARS's national field trials will offer detailed empirical results to support the development of best practices for Kernza production. A common set of measurements will be collected from field trials at all sites to support regionally specific recommendations while permitting robust cross-site comparisons. All trials include a minimum common core set of soil and plant analyses intended to offer insight into Kernza's grain and forage yields, nutrient management needs, water requirements, and potential for increasing carbon sequestration and building soil health. ARS sites located in the arid west where water supplies are diminishing are prioritizing understanding how Kernza can help agriculture adapt to a future with less water and promote water conservation, either as a perennial entry in dryland cropping systems, or under limited irrigation scenarios. Data from these trials will be combined in a common database to support broader analysis and enterprise modeling aimed at quantifying Kernza's effect on farm productivity, environmental outcomes, and local markets.

ARS's coordinated Kernza trials also include complimentary analyses to aid in understanding how and where Kernza fits into new, innovative, emerging forage and grain markets focused on sustainability and nutritional quality. While intermediate wheatgrass has been utilized for decades

as a perennial forage, detailed multi-location data on forage nutritive value remains sparse. All sites will analyze forage yield and nutritive value as a function of stand longevity and variety, and couple this with data on soil fertility and growing environment, rapidly expanding the knowledge base for livestock nutrition. The use of Kernza as a grain crop for human consumption is new and emerging. While early production data indicates that Kernza can be used in a variety of food products (e.g., flour, pasta, crackers), early quantification of nutritional qualities such as protein concentration and mineral nutrient density will provide valuable data to aid in connecting growers with millers, bakers, and other agricultural markets. Kernza grain from all ARS trial locations will be analyzed for protein and mineral micro- and macronutrients to give insight into how Kernza nutritional characteristics vary based on yields, soil, location, climate, and variety. Finally, the brewing and distilling industry has the potential to serve as a high-value market for Kernza, driving interest and awareness of its contribution to sustainable production systems. ARS's coordinated research seeks to characterize Kernza's brewing and distilling properties along the supply chain, working with industry stakeholders to understand Kernza's characteristics for these end uses as well as the characteristics of spent grains as a source of nutrition for cattle.

