Building Resilience to Climate and Non-Climate Drivers of Change through Systems Diversification with Maize: Scope and Implications in the Western and Eastern IGP

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Northwestern India, especially the states of Haryana and Punjab, have long-standing concerns about declining water tables and soil quality degradation. This prompted renewed calls for investments from the Government of India, to diversify the *Kharif*-season staple crop production by replacing rice with crops like maize. Despite the emphasis on diversification, there are several 'unknowns' about potential markets, higher-economic risks for producers associated with crops that are not generally publically procured, as well as uncertainties about underlying hydrology processes and associated-resource-quality considerations – including the need to manage irrigation in ways that reduce the probability of secondary salinization in salt-affected soils. There are also significant feedback interactions between these factors that necessitate an integrative approach that unites socio-economic, bio-hysical, and policy dimensions in order to best estimate the implications of diversification at both the household- and regional levels.

In the comparatively warmer Northeastern Indo Gangetic plains (NE IGP) and especially eastern Uttar Pradesh and Bihar, there is a growing imperative to look for alternatives to the *Rabi*-season wheat as the thermal window for production is already sub-optimal and expected to be further- reduced and increasingly variable from year-to-year with progressive climate change. The most promising staple alternative in the NE is maize which can be tremendously high-yielding in the winter months and is not as vulnerable to the threat of terminal heat during the spring grain-filling period. Nevertheless, some of the same considerations regarding market dynamics must also be explored in the NE along with risks to individual producers from price perturbations caused by factors such as bird flu. Substituting maize for wheat in the NE IGP establishes a scenario where the relatively small-land-holding- and impoverished- farmers would shift from a lower-input 'food security' crop with higher-bio-physical risk of failure to a higher-input commodity crop with significant market-based risks and investment requirements for fertilizer, irrigation, and energy. Understanding the risk-bearing and investment capacity of different groups of farmers is an essential consideration for shaping progressive policies that would facilitate diversification for meeting food and livelihoods objectives in the NE IGP with acceptable levels of risk.

Assessing the potential role of innovative technologies such as conservation agriculture (CA) is essential since risk, profitability, and environmental quality outcomes can be significantly conditioned not simply by crop choice, but also by the specific production practices employed by farmers, including planting of adapted varieties and hybrids. Quantitative analysis is required to determine the value of these practices at nested-spatial scales from the farm to the landscape.

It is important to note that climate and market-based risks are dynamic and in the case of climate change, evolving with time. Determining the temporal aspects of diversification and addressing the issue of *when* it makes sense for policy makers, value chain actors such as feed mills, and individual farmers to invest are also salient concerns.

This paper explores the prospects and implications of cereal systems diversification in the NE (maize for wheat) and Northwest (NW) (maize for rice) IGP in order to determine the plausible impacts on food security, livelihoods, and environmental quality.