Extended Abstract
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Paper/Poster Title	The roles of knowledge in farmers' adoption decision of integrated digital technology: evidence from North China

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Abstract	***200 words max***
The adoption of integrated digital farming technologies (IDFTs) among Chinese farmers is at low rate, despite the potential benefits these technologies offer in enhancing agricultural productivity and sustainability. With the complexity of IDFTs, farmers' knowledge constraints may serve as a potential barrier for farmers' adoption decisions. However, the role of farmers' knowledge in their adoption decisions in the context of IDFTs has not been extensively explored. We use a data from 878 maize farmers in Inner Mongolia, North China, to estimate the effect of farmers' general agricultural knowledge and specific knowledge of integrated water-fertilizer irrigation technology (IWFIT) on their decision-making processes. This includes farmers' willingness to pay (WTP) for IWFIT attributes and their adoption behaviours. Our results suggest that two dimensions of farmers' knowledge directly influence their adoption of IWFIT. However, the study did not find evidence indicating a causal relationship between knowledge and farmers' WTP for specific attributes of IWFIT. Furthermore, little evidence was found to support the direct effects of WTP for specific attributes of IWFIT on farmers' adoption of the technology. These findings underscore the crucial need to address farmers' knowledge constraints as a means to promote the widespread adoption of IWFIT among farmers.	

Keywords	Knowledge; technology adoption; decision-making process; integrated digital farming technology
JEL Code	Micro-Based Behavioural Economics D9 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***
Digital farming technologies have been widely recognized for increasing agricultural productivity and enhancing agricultural sustainability. Despite this potential, the adoption of IDFTs among Chinese farmers is limited. By integrating and improving fragmental technologies and knowledge into a cohesive system, IDFTs are developed with the nature of knowledge-intensity and complexity, i.e., integrated water-fertilizer irrigation technology (IWFIT). Given these characteristics, knowledge constraints emerge as potential barriers hindering farmers from making informed adoption decisions. The process of farmers' decision-making on adopting IDFTs is a psychological journey involving knowledge acquisition, attitude generation, and decision stages. The level of knowledge in this process can induce changes in perception, attitude, and subsequent adoption decisions. While previous researches have explored technology adoption decisions, the focus on IDFTs, and specifically the	

role of farmers' knowledge in this context, remains limited. To address this gap, we investigate the influence of farmers' knowledge on their decision-making process concerning IDFTs. This exploration is crucial in understanding the underlying reasons for farmers' low adoption behaviour and provides meaningful insights for researchers and agricultural extension agents aiming to promote the widespread adoption of IDFTs. In this study, we use IWFIT as an example of IDFTs. By examining the role of farmers' two types of knowledge (general agricultural knowledge and specific knowledge of IWFIT), we aim to unravel the complexities of their willingness to pay and adoption behaviours.

Methodology	***100 – 250 words***

We conducted face-to-face interviews with 878 maize farmers in Inner Mongolia, North China in 2022 following a IWFIT training program, which was implemented as a randomized experiment for IWFIT extension. Considering the potential heterogeneity in farmers' knowledge influencing their WTP and adoption behaviour, we employed two-stage instrumental variable models by instrumenting the variable of actual intervention participation through randomized assignments in the IWFIT training program to address our research questions. Farmers' knowledge was measured in two dimensions: (1) General agricultural knowledge related to basic water and fertilizer knowledge and maize planting skills, was assessed with nine short questions. The resulting agricultural knowledge score ranged from zero to nine. (2) Knowledge of IWFIT included nine IWFIT-related questions covering knowledge about devices, rationale, and functions of IWFIT. Farmers' WTP for IWFIT attributes was measured through a discrete choice experiment. Adoption behaviour was gauged based on three levels of IWFIT, considering the uptake of digital applications, automatic devices, and the number of digital devices. By identifying our variables, we investigate whether farmers' knowledge act as a limiting factor for WTP and the adoption of IWFIT. Additionally, we explore whether changes in WTP serve as an intermediary factor influencing the adoption of IWFIT.

Results	***100 – 250 words***

By estimating the data, our results indicate that two dimensions of farmers' knowledge significantly influence their adoption of IWFIT. Specifically, farmers' general agricultural knowledge emerges as a pivotal factor in the adoption process, underscoring the substantial impact of prior knowledge and experience on the uptake of IWFIT. Additionally, an increase in IWFIT-specific knowledge contributes positively to the adoption of this technology. However, our analysis did not yield substantial evidence suggesting a causal effect of knowledge (both general agricultural knowledge and IWFIT knowledge) on farmers' WTP for specific attributes of IWFIT. Despite the importance of knowledge in the adoption phase, it does not necessarily translate into a direct impact on WTP for specific IWFIT attributes. In addition, we found limited evidence supporting the direct effects of WTP for specific attributes of IWFIT on farmers' adoption of the technology. While WTP plays a role in the decision-making process, its impact on the broader adoption behaviour of IWFIT appears to be less pronounced.

Discussion and Conclusion	***100 – 250 words***

In conclusion, the findings emphasize the critical need to address knowledge constraints as a key driver for promoting the adoption of IDFTs among farmers. Farmers' with more general agricultural experience and specific technology knowledge contribute to their uptakes of new innovations, especially for knowledge-intensive and

complex practices. Moreover, the decision-making process for farmers is not a linear path involving continuous consideration of knowledge, WTP, and adoption decisions. Instead, farmers may navigate between these processes, highlighting the dynamic and multifaceted nature of their decision-making process. The policy implications for extension systems could be to provide specific knowledge intervention to farmers. Further research should delve deeper into these dynamics to inform targeted interventions aimed at fostering a more widespread adoption of IDFTs.