Extended Abstract
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Paper/Poster Title	**The intention to adopt spot spraying for sustainable weed control – an extended theory of planned behaviour approach.**

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Abstract	***200 words max***
Smart farming technologies could make modern arable farming more sustainable and economically more viable, e.g., via plant-specific application of agrochemicals. However, due to the early stage of technological development and limited commercial availability, little is known about farmers' behavioural adoption determinants. We extend the Theory of Planned Behaviour (TPB) and conduct a preregistered survey with 453 German arable farmers to investigate drivers of their intention to adopt spot spraying, a smart weeding technology (SWT) that allows for substantially reduced herbicides application and delivers benefits to farmers, the environment and, thus, society at large. Besides confirming the established relationships of the TPB, we find that the intention to adopt spot spraying is influenced directly and indirectly (via the attitude towards the SWT) by moral norms. Furthermore, subjective norms and pro-environmental attitude have high explanatory value for farmers' moral norms. Our findings underline the direct and indirect relevance of farmers' perceived social pressures in forming their attitude and intention to use spot spraying for sustainable weeding practices. Implications arise for future dissemination strategies and related policy instruments if SWT become commercially available.	

Keywords	Sustainable intensification, smart farming technology, partial least squares structural equation modelling, Theory of Planned Behaviour, crop farming
JEL Code	Q16, Q24, D91

Introduction	***100 – 250 words***
Smart farming technologies (SFT), equipped with smart sensors and artificial intelligence, can take account of the heterogeneity of fields and conduct (semi-) autonomous managerial actions in a plant-specific manner. This may help farmers to minimize cost for agrochemical inputs and manual labour while society would benefit from reduced negative environmental impacts of agriculture. However, SFT are still in an early stage of technological development. They come with new technology attributes, such as data sharing requirements, and initially high investment cost and limited proof of technology functioning may lead to low adoption rates. Anticipating how these factors affect farmers' decisions can inform the evidence-	

based design of dissemination strategies for technology developers, agricultural extension services and policy makers. Many socially desirable agricultural innovations may otherwise fail to unfold their transformative potential.

Our contribution builds on a behavioural approach which emphasises the role that farmers' personal and social beliefs have for their intention to adopt spot spraying for herbicide-reduced weed management.

Methodology	***100 – 250 words***

The study is based on an incentivised survey with German arable farmers conducted between February and April 2022. We used an extension of the Theory of Planned Behaviour (TPB) as conceptual framework to assess farmers intentions to adopt spot spraying.

In its basic form, the TBP aims to predict individuals' intention to perform a certain behaviour, drawing on three psychological constructs, i.e., subjective norms (social pressures), perceived behavioural control, and the individuals' attitude towards performing the investigated behaviour. Based on related literature, we included three additional, previously validated, behavioural constructs, i.e., farmers' personal innovativeness, pro-environmental attitude and moral norms, aiming (1) to improve the explanatory power of the original theoretical framework and (2) to identify additional relationships between constructs that may be especially relevant in forming farmers' intention to adopt spot spraying for improved environmental performance in weed management.

The analysis was performed via partial least squares structural equation modelling.

Results	***100 – 250 words***

After data cleaning, the final data set consisted of 453 complete observations. The evaluation of the outer (measurement) model rendered the data of sufficient quality for further assessment.

The analysis of the baseline inner (path) model confirmed the (statistical) relevance of subjective norms, perceived behavioural control, and the attitude towards spot spraying for explaining farmers' intention to adopt spot spraying on their farm in the medium-term future. The three constructs accounted for around 60 % of the variance in the data. The standardized beta coefficients of subjective norms (0.39) and attitude towards spot spraying (0.36) were more than twice as large as for perceived behavioural control (0.15).

Results from the extended model were mixed. Farmers' moral norms were statistically significantly explained by their subjective norms (0.27) and their pro-environmental attitude (0.48). Moral norms exerted a relatively low statistically significant direct effect on intention (0.06), and had a larger statistically significant indirect effect on intention via farmers' attitude towards using spot spraying (0.32). Farmers' personal innovativeness had a somewhat smaller, also statistically significant, effect on attitude (0.14).

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

Our findings confirm for the case of spot spraying for sustainable weed management that the TBP is an adequate theoretical framework to explain adoption intention

sufficiently well. The magnitude of the coefficients of subjective norms and attitude underline the importance of social (peer) influences and famers own evaluation of spot spraying.

Moreover, we show that the extent to which farmers feel morally obliged to reduce herbicide usage for environmental benefits is driven by social influences and their attitude towards the environment. While higher degrees of moral norms did manifest in a more positive stance towards spot spraying, the direct effect of moral norms for the actual intention to adopt this SWT was comparatively low. The effect of higher degrees of moral obligations towards the environment affected the intention to adopt spot spraying rather indirectly via attitude. Farmers in our sample may not have been fully aware of the environmental benefits of spot spraying for precision application of herbicides.

Our findings suggest an information-based dissemination strategy emphasising the environmental advantages delivered by spot spraying technology. Additionally, dissemination strategies should target innovative farming communities and, for example provide financial incentives or facilitate technology access for SWT that deliver high environmental and thus societal benefits.