

# Understanding farmers' intention to participate in online sustainability training: Insights from Slovenia using an extended Theory of Planned Behaviour

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## Abstract

**This study explores the factors influencing farmers' intention to participate in sustainability-related agricultural training, with particular attention to the role of online delivery formats. Drawing on the extended Theory of Planned Behaviour (TPB), we analysed survey responses from 4742 Slovenian farmers who attended training in organic farming, animal welfare, or agri-environmental measures. Structural equation modelling was used to assess the predictive value of psychological constructs (attitudes, subjective norms, and perceived behavioural control), along with satisfaction with previous training. In addition, logistic regression examined the determinants of participation in online versus in-person sessions. Results indicate that perceived behavioural control and positive attitudes are key drivers of participation intention, while subjective norms had little influence. Satisfaction with training, particularly with content quality, was also positively associated with intention. Farmers who attended online training reported lower satisfaction compared to those who participated in person. However, online formats were more often chosen by farmers with limited time, mobility, or transport options. These included older, female, and part-time farmers. These findings suggest that while online training can expand access for certain groups of farmers, improvements in training design and delivery are needed to ensure a positive learning experience. Tailoring digital formats to farmers' needs may enhance the effectiveness and inclusiveness of advisory services.**

## INTRODUCTION

Agriculture is increasingly facing complex challenges stemming from environmental and climate crises, volatile markets, and evolving societal expectations. These challenges demand that farmers enhance their access to up-to-date information and adopt innovative practices to ensure sustainability (Krafft et al., 2022). Agricultural advisory services are key to enabling this transition, as they facilitate the dissemination of new knowledge and practices, including organic farming, agri-environmental measures, and technological innovations (Moojen et al., 2023; Österle et al., 2016; Tamini, 2011; Toma et al., 2018).

In recent years, information and communication technology (ICT) has emerged as a promising channel for delivering agricultural advisory services. ICT can improve the accessibility and personalisation of advice, enhance learning flexibility, and broaden the reach of training programs at a lower cost (Fabregas et al., 2019; Kiiza & Pederson, 2012; Klerkx, 2021; Singh et al., 2018). The relevance of ICT-based advisory support increased during the COVID-19 pandemic, which accelerated the adoption of online training formats (Mathuabirami et al., 2023; Michaelis et al., 2022). While educational studies suggest that online learning may improve accessibility and performance (Joshi et al., 2022; Means et al., 2010), its adoption in agriculture still faces concrete challenges, including uneven internet connectivity in rural areas, limited access to digital equipment, low levels of digital literacy among some farmers, and reduced opportunities for peer interaction and real-time feedback during online sessions (Segbenya et al., 2022; Yang & Yang, 2023). Moreover, farmers are not a homogeneous group; differences in socio-economic background, motivations, and learning preferences shape how they perceive and access training opportunities (Huber et al., 2024; Klerkx, 2022). Therefore, effective design of ICT-based training should consider these diverse needs (Yang & Yang, 2023).

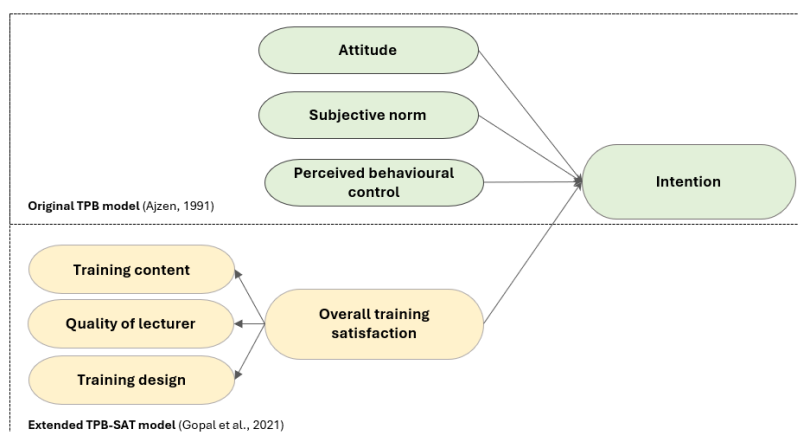
This study explores Slovenian farmers' intention to participate in sustainability-related training, delivered either online or in person, using an extended Theory of Planned Behaviour (Ajzen, 1991). By incorporating satisfaction with previous training into the TPB framework, the study aims to assess the impact of psychological, social, and experiential factors on farmers' willingness to engage in future training and to offer policy-relevant insights for designing inclusive and effective advisory services.

## METHODOLOGY

### *Theoretical framework and survey design*

To investigate farmers' intention to participate in agricultural sustainability training, we developed a structured questionnaire based on the Theory of Planned Behaviour (TPB) (Ajzen, 1991). PB is a widely used model for predicting individual behavioural intentions, which is considered the most immediate predictor of actual behaviour. According to the theory, intention is shaped by three core components: attitude towards the behaviour, subjective

norms, and perceived behavioural control (PBC) (Fishbein & Ajzen, 2010). The model has been successfully applied in both education (Hollett et al., 2020; Lung-Guang, 2019) and agriculture (Sok et al., 2021). In the agricultural advisory context, farmers' perceived ease of participating in training (PBC), their own beliefs about training value (attitudes), and the perceived expectations of others (subjective norms) shape their willingness to engage in training sessions (Hall et al., 2019). However, research suggests that TPB's explanatory power can be improved by integrating additional constructs. Satisfaction with previous educational activities has been shown to be a key factor in education (Chiu et al., 2007; Lu et al., 2019) and advisory contexts (Elias et al., 2016; Kassem et al., 2021), reflecting the perceived value of the training concerning invested time and effort (Shahsavari & Sudzina, 2017). Therefore, we extended the TPB framework by including satisfaction with past training as a proximal predictor of future training intention (Figure 1). We conceptualised satisfaction as a second-order construct composed of three dimensions: content quality, lecturer quality, and training design (Garg & Sharma, 2020; Gopal et al., 2021). This extended model allows us to analyse not only psychological and social predictors of farmers' training intentions, but also how their training experiences shape future engagement.



**Figure 1.** Theoretical research framework based on the extended Theory of Planned Behaviour (TPB).

To operationalise the extended TPB model, we developed survey items based on established measurement instruments from existing studies in agriculture and education. The wording was adapted to the context of Slovenian advisory training, and the initial questionnaire was refined through expert focus groups and pilot testing with 15 farmers and agricultural advisors. The final survey consisted of four sections: (1) informed consent and general purpose; (2) TPB constructs (attitudes, subjective norms, perceived behavioural control, and intention); (3) satisfaction with training (content, lecturer, and training design); and (4) socio-demographic and farm characteristics. For statements regarding TPB and satisfaction constructs, responses were collected on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree), where respondents indicated their agreement with statements such as 'I can easily participate in training sessions' (PBC) or 'The training content was relevant and useful' (satisfaction).

### Data collection and analysis

The survey was conducted between November and December 2021 during annual training programs for farmers participating in CAP measures of Organic Farming (OF), Animal Welfare (AW), and Agri-Environmental-Climate Measures (AECM). These included 5002 surveys submitted following 38 online training sessions across Slovenia and 469 printed forms collected at 16 in-person sessions held in central and eastern regions. Before analysis, we screened the data and excluded any questionnaires with more than 5% missing values or with protest responses (e.g. uniform answering patterns or non-engagement with reversed items).

Descriptive statistics were calculated, and variables with skewed distributions were normalised using Box-Cox transformations. Missing data were imputed using multiple imputation with predictive mean matching (Buuren and Groothuis-Oudshoorn, 2011). To examine the determinants of farmers' intention, we used Structural Equation Modelling (SEM) in R (lavaan and semTools packages; Rosseel, 2012; Jorgensen et al., 2022). We tested three models: the original TPB model, the extended TPB-SAT model including satisfaction, and a further model (TPB-SAT-Setting) that included the training delivery mode (online vs in-person) as an explanatory variable for satisfaction. Model fit was assessed using conventional indices (RMSEA < 0.07, SRMR < 0.08, CFI and TLI > 0.94) (Hair et al., 2013). Additionally, we applied binomial logistic regression to identify factors influencing farmers' participation in online versus in-person training. Lastly, linear mixed-effects models were used to test whether variation in training satisfaction was attributable to training location or delivery mode.

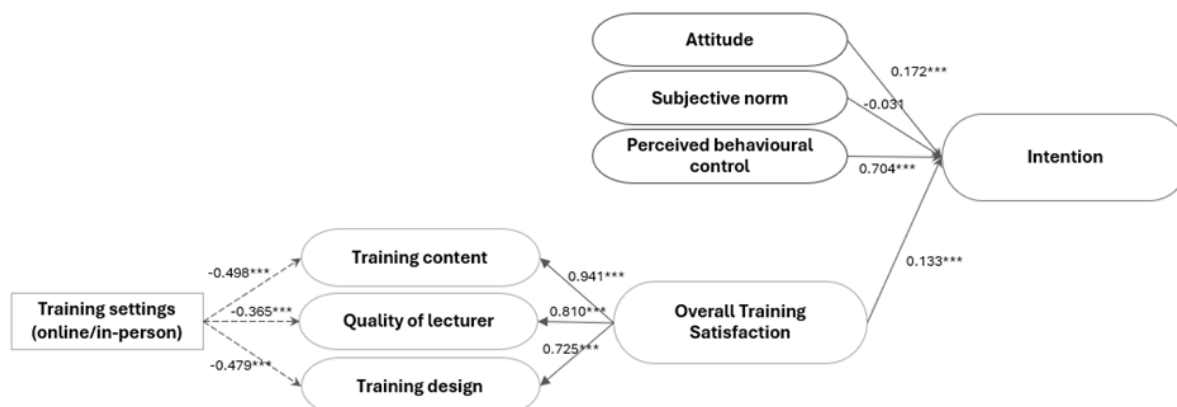
## RESULTS

### Structural equation modelling results

The original TPB model explained a substantial share of the variance in farmers' intention to participate in future sustainability training ( $R^2 = 0.852$ ). Among the latent variables, perceived behavioural control (PBC) was the most influential predictor ( $\beta = 0.766$ ,  $p < 0.001$ ), followed by attitudes ( $\beta = 0.201$ ,  $p < 0.001$ ). Subjective norms, however, showed no significant effect ( $\beta = 0.000$ ,  $p = 0.992$ ).

The extended TPB-SAT model, which incorporated satisfaction with prior training, modestly improved explanatory power ( $R^2 = 0.858$ ). In contrast to the original TPB model, the model fit indices show a weaker fit to survey data but are still at an acceptable level. In this model, satisfaction had a significant positive effect on intention ( $\beta = 0.130$ ,  $p < 0.001$ ), in addition to PBC ( $\beta = 0.705$ ) and attitudes ( $\beta = 0.174$ ). Satisfaction itself was modelled as a second-order construct comprising three components: training content (loading = 0.942), lecturer quality (0.811), and training design (0.725), confirming their strong contribution to overall training experience.

To explore differences in satisfaction between online and in-person formats, training delivery mode was included as an additional regression term in the TPB-SAT-Setting model (Figure 2). Results revealed a significantly lower satisfaction among farmers who attended online training, concerning training content ( $\beta = -0.498$ ), training design ( $\beta = -0.479$ ), and lecturer quality ( $\beta = -0.365$ ). These differences could not be explained by variation in location or individual trainers, suggesting an inherent limitation of the online format under the existing training design.



**Figure 2.** The extended TPB-SAT-Setting structural model with the effect of the mode of training (online or in-person) on the three components of overall training satisfaction.

### Logistic regression results

A binomial logistic regression was used to identify factors influencing farmers' choice between online and in-person training formats. The analysis showed that farmers with reliable internet access, ICT equipment, and digital literacy were significantly more likely to choose online training. Online training was also more commonly attended by farmers with limited time or transportation options (Table 1). Moreover, participation in online training was more frequent among older, female, and part-time farmers, as well as those with a lower proportion of household income derived from agriculture. Among the training programs, participants in animal welfare (AW) training were the most likely to attend online sessions, while those in agri-environmental-climate measure (AECM) training were more likely to attend in person.

**Table 1.** Regression model of factors influencing farmers' participation in online or in-person (baseline) training sessions

	Estimate	Std. error	Statistic	P-value
<b>(Intercept)</b>	3.47	0.66	5.27	<0.001
PBC: I have a reliable internet connection, computer equipment, and knowledge to participate in online training.	0.87	0.07	12.09	<0.001
PBC: I can easily participate in training sessions.	-0.43	0.10	-4.45	<0.001
PBC: I can easily arrange transportation if the training takes place in person.	-0.27	0.09	-2.95	0.003
Participation in animal welfare (AW) training	2.50	0.52	4.83	<0.001
Participation in agri-environmental (AECM) training	-0.59	0.15	-4.01	<0.001
Gender – Female	0.57	0.19	3.06	0.002
Age	0.02	0.01	2.49	0.013
% household income from farming	-0.15	0.07	-2.35	0.019
PBC: I find it challenging to make time for participation.	0.14	0.08	1.91	0.056
Farm size	0.00	0.00	1.82	0.069
Production results	-0.22	0.13	-1.70	0.090
Farming experience	-0.43	0.34	-1.27	0.204
Social norms	0.18	0.22	0.81	0.418
Attitudes	0.10	0.21	0.47	0.641
Farm future	0.05	0.11	0.47	0.642
Education	0.04	0.10	0.41	0.680
The economic position of the farm	-0.04	0.12	-0.35	0.727

## DISCUSSION

The results of this study provide insights into the factors that influence farmers' willingness to engage in sustainability-related training, particularly in the context of online training formats. The results show that perceived behavioural control (PBC) is the strongest predictor of farmers' intention to participate in training. This is consistent with findings from previous education (Ajzen & Madden, 1986; Hollett et al., 2020) and agriculture studies (Hall et al., 2019; Sok et al., 2021) and suggests that practical considerations, such as time availability, transport, and the ability to organise participation, play an important role in shaping engagement in future training. Attitudes also had a positive effect, indicating that farmers who see value in training are more likely to attend. On the other hand, subjective norms were not significantly associated with intention, aligning with Hollett et al. (2020) and the meta-analytical study by Armitage & Conner (2001), which found that subjective norm typically has a weak predictive power on intention. This could be due to the ex-cathedra format of the training sessions, which offered few opportunities for peer interaction. Furthermore, previous studies suggest that subjective norms tend to exert a stronger influence in contexts involving economic outcomes or technology adoption (Hennessy & Heanue, 2012; Sok et al., 2021), whereas pro-environmental behaviours may be perceived as more individually motivated and less socially pressured (Helferich et al., 2023).

Although the inclusion of overall training satisfaction only moderately improved the model's explanatory power, satisfaction proved to be a significant predictor of future participation, supporting findings from education literature (Chiu et al., 2007; Gopal et al., 2021) and underlining the value of continuous quality monitoring in advisory services. Among the satisfaction components, training content was the strongest predictor, followed by lecturer quality and training design. These results underscore the need to prioritise content relevance, engaging delivery, and well-organised sessions to enhance advisory effectiveness.

One of the most policy-relevant results is the difference in satisfaction between online and in-person training. Farmers attending online sessions consistently reported lower satisfaction with all aspects of the training. Some of this difference may be explained by methodological variation, as paper-based or in-person surveys are known to produce more favourable satisfaction responses compared to online formats (Dillman et al., 2009). However, the disparity could also stem from variations in the learning environments between the two training settings. Several factors may contribute to this difference, including reduced interaction, limited opportunities for feedback, increased cognitive load, and difficulties in maintaining concentration in online learning environments (Mayer, 2017; Means et al., 2010). Among these, dissatisfaction with training content was the most notable, possibly due to insufficient adaptation of materials for digital delivery or a misalignment between the delivery approach and farmers' preferred ways of learning.

Despite lower satisfaction levels, online training was more frequently chosen by farmers facing structural barriers to in-person participation: older age, limited time, lack of transport, and part-time farming status. These groups appear to value the flexibility of online formats, a trend echoed in other ICT-advisory studies (Yang and Yang, 2023; Michaelis et al., 2022). Interestingly, female farmers were also more likely to choose online training, a finding that deserves further investigation, as gendered preferences and responsibilities may shape how farmers engage with learning opportunities. Importantly, the results indicate that digital inequality persists, as online training is more accessible to those with the necessary infrastructure, skills, and confidence. This emphasises the need for investments in rural broadband, ICT equipment, and digital skills training, especially if online advisory services are to be scaled up equitably (Abdulai et al., 2023; Khan et al., 2022). Advisory providers should also consider diversifying their digital formats—shorter modules, interactive platforms, and blended learning options may help overcome some of the current shortcomings.

## CONCLUSION

This study used an extended Theory of Planned Behaviour framework to examine the factors influencing farmers' intention to participate in agricultural sustainability training, with a particular focus on online delivery formats. The results underline the importance of perceived behavioural control and attitudes as key predictors of intention, while subjective norms played a more limited role. In addition to these psychological drivers, the study confirmed that satisfaction with previous training is also associated with future participation, most strongly through perceptions of training content quality, followed by the lecturer quality and the training design. These findings emphasise the importance of delivering advisory services that are not only accessible but also well-structured and engaging.

Despite the lower satisfaction reported among participants in online formats, our findings also point to the potential of online training as a flexible and inclusive knowledge transfer tool. Digital delivery was particularly valuable for farmers facing constraints related to time, mobility, or location. This suggests that, when appropriately designed, online formats can complement traditional methods and extend access to groups who might otherwise be excluded. To fully realise this potential, it is important to move beyond one-size-fits-all approaches and invest in digital pedagogies that respond to farmers' learning preferences and technological capacities.

Furthermore, the results highlight the need for regular evaluation and adaptation of advisory services. Future research could examine how different training formats affect actual behavioural outcomes and long-term knowledge retention. There is also scope to explore the learning needs of different subgroups of farmers to support more targeted and effective training strategies.

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