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Understanding Intention Toward Sustainable Production Technology by Extending the Theory of Planned Behavior

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Abstract

Based on an extension of trust with the theory of planned behavior (TPB), the farmers' adoption intention model regarding formula fertilization by soil testing (FFST) is built. The independent variables include trust, attitude toward FFST, subjective norms, and perceived behavioral control, and the dependent variable is adoption intention. Based on the survey data of 778 ordinary farmers from Liaoning province and Chongqing city, this study uses structural equation modeling to conduct an analysis. The results show that the extension of trust with TPB can explain adoption intention very well; each latent variable has a certain effect on adoption intention; and the impact of the behavioral attitude is the strongest then followed by perceived behavioral control; the trust of relevant groups has a high indirect effect on willingness, and subjective norms have the least impact.

Keywords

Trust; TPB; FFST; Adoption intention

1. Introduction

Fertilizer is the 'grain' of food, and its application is crucial in ensuring China's food security. Research shows that China is the world's largest consumer of fertilizers, and the application amounts exceeded 225 kg/ha (the standard to prevent water pollution in developed countries) [1] in 1995 and have kept increasing ever since. In 2021, fertilizer applications reached a new high of 307.73 kg/ha [2], which was 36.77% higher than the standard. Excessive fertilization and unreasonable fertilizer application ratios result in significant loss of nitrogen and phosphorus, leading to environmental problems such as soil salinization and eutrophication of water bodies. The sustainable agricultural production technologies include conservation tillage, straw returning, FFST, application of organic fertilizers, and other soil and water management techniques could solve the above problem [3].

Since 2005, the central government has continuously written FFST as a major agricultural scientific and technological measure into the No. 1 central document. Field trial results show that, compared with traditional fertilization application, FFST can increase crop yield by 6~10% and increase the profit by over 450 RMB per hectare [4]. Studies have shown that if farmers are given scientific guidance on fertilization techniques, at least 30% of fertilizer application can be reduced without reducing crop yields or affecting national food security [5].

The viewpoint that adoption intention is one of the direct determining factors of adoption behavior. Previous studies have mostly focused on the factors influencing farmers' willingness, including individual and household characteristics, cultivated land characteristics, technological attributes, as well as institutional and environmental factors [6]. However, current literature lacks an analysis of the influencing factors of adoption intention from a psychological perspective. This paper constructs an extension of trust with TPB and uses survey data on 778 farmers' willingness to adopt FFST.

2. Theoretical Framework and Research Hypotheses

TPB is a classic theory in the field of social psychology and is widely used to explain and predict completely rational and not solely dependent on individuals' will [7]. Trust is considered to be a common mechanism for reducing social complexity and perceived transaction risk by increasing expectations and perceived certainty of positive outcomes for the trustee's future actions [8].

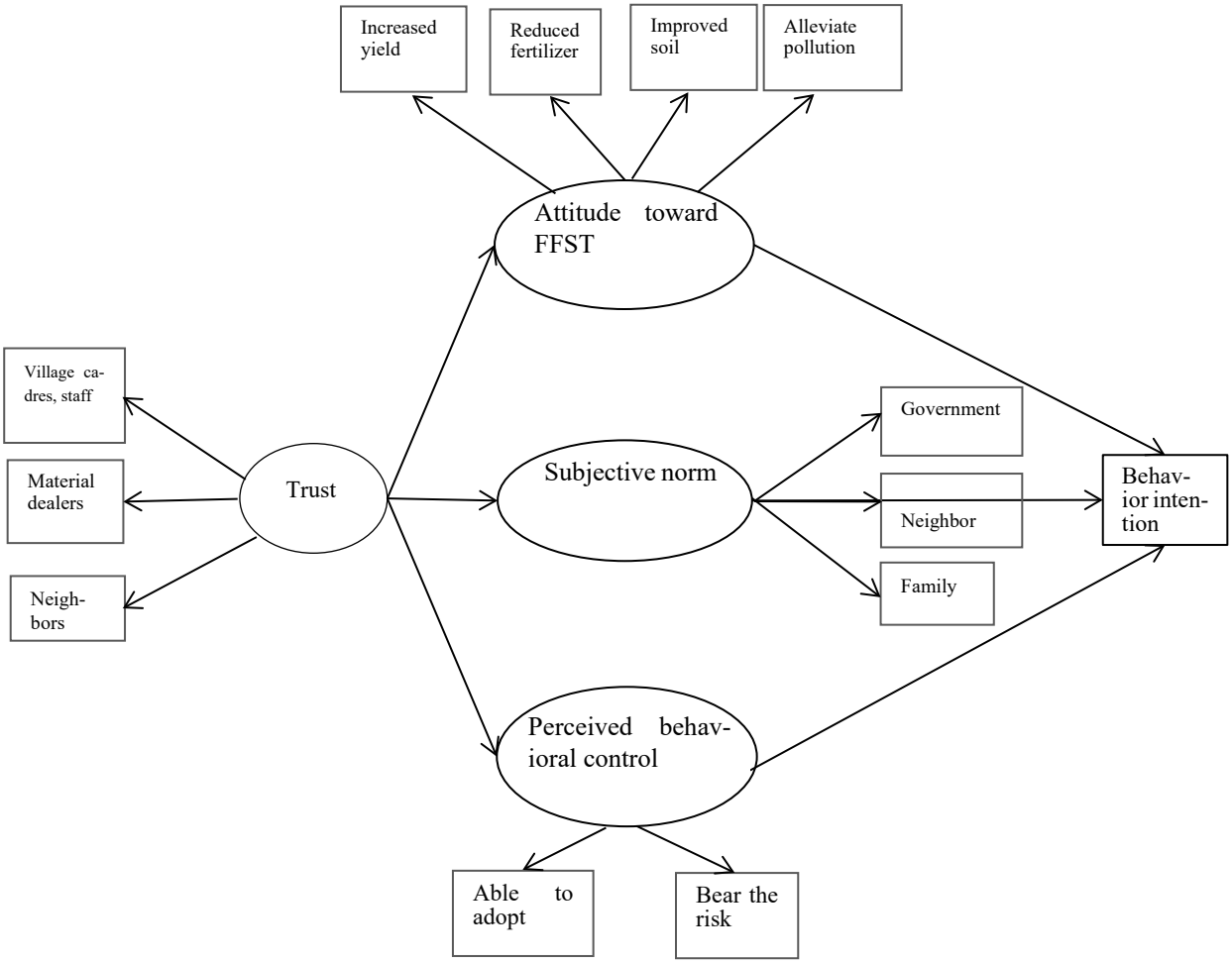

Figure 1. The research framework.

3. Research Methods

A questionnaire was developed using a five-point Likert-scale design approved by experts. An extension of trust with TPB-constructs as defined in Table 1. Data were collected in Liaoning province and Chongqing city. A total of 792 questionnaires were completed, and after excluding samples with missing important information, 778 valid questionnaires were obtained, with an effective rate of 98.23%. The SEM was employed because of its capability to analyze the relationships and interactions between latent variables and observable variables. We used AMOS 7.0 for the analysis.

4. Results and Discussions

4.1 Descriptive analysis

Table 1 shows the mean and standard error of the determinants and adoption intention based on a questionnaire survey.

Table 1. Measurement of the variables

Variables	Measurement variables	Variable definition	Mean	S.D.
Attitude towards FFST (ATT)	FFST can increase yield. (ATT1)	1=Strongly disagree, 2=Disagree, 3=Doesn't matter, 4=Agree, 5=Strongly agree	3.90	0.72
	FFST can reduce the amount of fertilizers applied. (ATT2)		3.84	0.76
	FFST can protect soil quality. (ATT3)		3.94	0.65
	FFST can mitigate water pollution. (ATT4)		3.85	0.72
Subjective norm (SN)	The government and technical extension staff think you should adopt FFST. (SN1)		3.26	1.30
	Your neighbors think you should adopt FFST. (SN2)		3.00	1.22
	Your family thinks you should adopt FFST. (SN3)		3.09	1.24
Perceived behavioral control (PCB)	Do you have the ability to adopt FFST? (PCB1)		3.16	1.06
	Can you bear the risk of adopting FFST? (PCB2)		3.14	1.03
Behavioral intention (BI)	Would you like to adopt FFST? (BI)	1=Strongly disagree, 2=Disagree, 3=Doesn't matter, 4=Agree, 5=Strongly agree	4.03	0.86
Trust (T)	Do you trust village cadres and agricultural technology extension staff? (T1)	1=Very distrustful, 2=Distrustful, 3=Indifferent, 4=Trusting, 5=Very trusting	4.03	0.84
	Do you trust agricultural material dealers? (T2)		3.50	1.08
	Do you trust your neighbors? (T3)		3.75	0.88

4.2 Measurement model: reliability and validity testing

Table 2 shows that the CA coefficients of each latent variable are all greater than 0.6, indicating that the questionnaire has good internal consistency. Except for the KMO value of the variable of PBC, which only reached 0.5, the questionnaire structure validity of all other variables was good.

Table 2. The reliability and validity of the latent variables in the measurement model

Latent variables	Number of variables	CA	KMO	Bartlett (significance)
ATT	4	0.863	0.811	1518.998 (0.000)
SN	3	0.941	0.740	2254.188 (0.000)
PCB	2	0.707	0.500	275.188 (0.000)
T	3	0.736	0.677	521.496 (0.000)

Notes: CA is an abbreviation for Cronbach's Alpha coefficient; The KMO value and Bartlett's sphericity test were obtained by factor analysis.

4.3 Structural model: adaptability test

Table 3 shows the overall model fit indicators, all of which are within an acceptable range, indicating good model fit.

Table 3. The fit indices of the structural model

Model fit index	Recommended acceptable level	Index value
Chi-square value/degree of freedom	$<5.0^{a}$	4.548
GFI	>0.9	0.946
AGFI	>0.9	0.918
RMSEA	$<0.08^{b}$	0.068
PGFI	>0.50	0.624
PNFI	>0.50	0.582
PCFI	>0.50	0.612

Notes: [a] Wheaton et al. found that a chi-square value/degree of freedom ratio with less than 5 is acceptable. RMSEA with a value less than 0.05 indicates good model fit, and a value less than 0.08 indicates good model fit.

4.4 Model hypothesis testing and analysis

Figure 2 shows a schematic diagram of the path analysis of SEM.

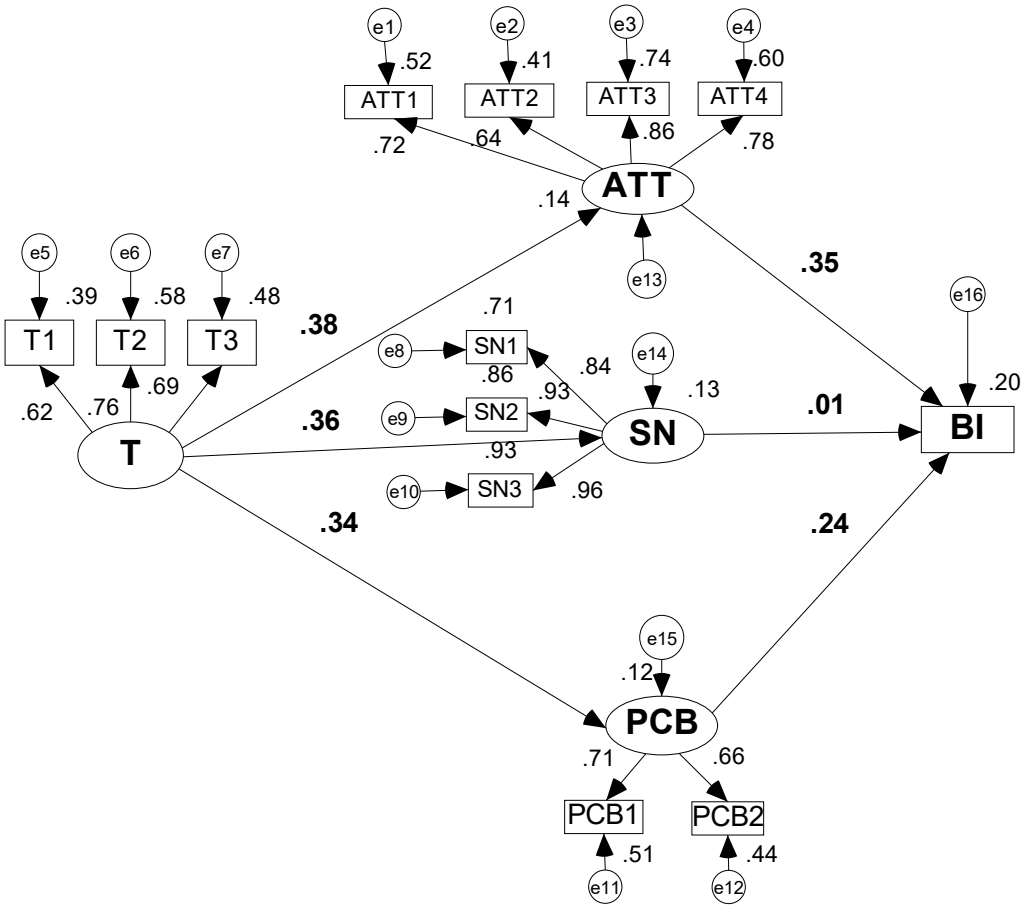

Figure 2. The standardized path coefficients and significance of the structural model.

Notes: ATT represents attitude towards FFST, SN is short for subjective norm, and PCB is short for perceived behavioral control. BI is short for behavioral intention. T is short for trust.

5. Conclusions

Based on an extension of trust with TPB, this paper used SEM to study the farmers' willingness to adopt FFST. The results showed that the extension of trust with TPB could effectively explain farmers' willingness to adopt FFST. When farmers realized that FFST could improve yields, reduce fertilizer use, protect soil quality, and reduce water pollution, they were more willing to adopt FFST. Farmers are more likely to adopt FFST when they perceive that they have sufficient capacity to adopt it and can bear the risks that may come with adopting it. If farmers trust village cadres, agricultural technology extension staff, agricultural material dealers, neighbors, and other related groups, they are more willing to adopt the technology. Farmers' attitudes towards FFST had the most significant impact on adoption intention, followed by perceptual behavior control. Farmers' trust in related groups had a high indirect effect on adoption intention, and subjective norms had the least impact on adoption intention.

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