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Farmers' Willingness to Adopt Organic Fertilizers in Shaanxi Plain: Based on Health Belief Model

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Abstract: China is the largest consumer of chemical fertilizer, while excessive use of chemical fertilizers has brought food production, but excessive use will lead to environmental problems such as soil fertility decline and soil pollution. Organic fertilizer is widely recommended as a sustainable fertilizer. However, the use of organic fertilizers in China remains low. To promote the use of organic fertilizer, this study collected 262 questionnaires from farmers in Shaanxi and investigated the factors affecting the use of organic fertilizer based on health belief model. Our results show that cues to action has a significant impact on farmers ' behavior, followed by perceived threat and perceived expectation. Therefore, we suggest strengthening the publicity of organic fertilizer at the rural level and making farmers aware of the harm of excessive use of chemical fertilizers, to promote the use of organic fertilizer and the sustainable development of agriculture.

Keywords: Farmers' behavior, Health Belief Model, Organic Fertilizer, Sustainable Agriculture.

1. Introduction

At present, China's fertilizer production and use are the first in the world. The sustainable development of agricultural production is inseparable from the use of fertilizers [1]. Due to the rich available nutrients and significant yield-increasing effect, chemical fertilizers are widely used in various crops. Fertilizer plays an increasingly important role in the development of agricultural production in China. The stable growth of various crop yields in recent years is largely due to the large amount of fertilizer input [2]. The current world application rate of chemical fertilizer is 120 kg/hm^2, and China's application rate of chemical fertilizer is 328.5 kg/hm^2, which is much higher than the world average. Excessive use of nitrogen fertilizer is common in agriculture in China, resulting in gaseous nitrogen emissions including NH_3, NO_x and N_2O have increased significantly since 1980, directly or indirectly worsening the greenhouse gas (GHG) balance and climate change. With the increase of agricultural production costs, environmental pollution, soil degradation and a series of problems [3]. Large amounts of chemical fertilizers make the nutrients in the soil surplus, and the soil cannot be fully absorbed and maintained. The retained fertilizers will diffuse into the surrounding environment with rainfall or irrigation, causing pollution of surrounding lakes or rivers and even shallow groundwater sources. The sharp decline in fertilizer reward indicates that with the long-term use of chemical fertilizer, the basic soil productivity is gradually weakening, and the weakening of basic soil productivity has become an important limiting factor affecting the sustainable development of agriculture and the high and stable yield of crops in China.

Compared with chemical fertilizer, soil microbial biomass and soil enzyme activity in soil with organic fertilizer increased significantly. Analysis of representative organic fertilizer (cow and poultry manure slurry) samples from the Bangladesh Agricultural Research Institute (BARI) and the University of Dhaka (DU) biogas plant showed that the slurry contains a considerable amount of macro and micronutrients in addition to a considerable amount of organic matter, and that the concentrations of toxic heavy metals are relatively low [4]. Organic fertilizer increased the number of soil microorganisms such as aerobes and actinomycetes in the field [5]. However, the current use of organic fertilizer in China is far from enough. According to the relevant reports of FAO (World Food and Agriculture Organization) fertilizer yearbook, multi-component, multi-function, high efficiency, high concentration and no pollution are the development trend of world fertilizer, realizing the combination of biology, organic and inorganic. In developed countries, through the vigorous development of biological fertilizers and other new fertilizers, nearly 70-80 % of the application of chemical fertilizers has been converted into the application of compound fertilizers and special fertilizers with scientific and technological content. However, in China, compound fertilizer, biological fertilizer and new fertilizer accounted for less than 7% of the total amount of fertilizer, far from 80% of the proportion of developed countries [6]. In order to promote the widespread use of organic fertilizers, it is necessary to investigate the factors that affect farmers' adoption of organic fertilizers, but there is little research on Chinese farmers.

The health belief model (HBM) is often used to explain and predict farmers' pro-environmental agricultural behavior. The health belief model believes that health beliefs are the basis for people to adopt healthy behaviors. If people have beliefs related to disease and health, they will adopt healthy behaviors and change dangerous behaviors. The structure of the health belief model includes: perception of disease threat (perception of disease susceptibility and perception of disease severity), expectation of behavior outcome (perception of the benefits and obstacles of adopting the recommended behavior), self-efficacy, sociodemographic factors, and cues that induce healthy behavior.

Therefore, in order to improve the sustainability of agricultural production and the health of farmers and farmland, it is necessary to analyze farmers' willingness to use organic fertilizer. Based on the health belief model, this paper explores the willingness and influencing factors of farmers' bio-fertilizer use in Shaanxi Province, China, and provides policy makers with suggestions to improve the

agricultural production environment and improve agricultural production efficiency [7].

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2. Methods and Materials

2.1. Methods

Based on the health belief model, this paper divides latent variables into four categories, including farmers' willingness to use organic fertilizer, perceived threat, perceived expectation, and cues to action [8]. This paper use structural equation model (SEM) to analyze the influence of different factors on farmers' willingness. SEM can process multiple latent variables at the same time, allowing independent variables and dependent variables to contain measurement errors, and further relax the measurement model to deal with complex linear relationships between variables. SEM includes measurement model and structural model, which are used to define the linear relationship between latent variables and observed variables and the linear relationship between potential independent variables and potential dependent variables. The equations are as follows:

Measurement equations:

$$x = \wedge x\xi + \delta \quad (1)$$

$$y = \wedge y\eta + \varepsilon \quad (2)$$

Structural equation:

$$\eta = B\eta + \Gamma\xi + \zeta \quad (3)$$

In the formula, x and y represent the vectors of exogenous and endogenous observation variables respectively; δ and ε are the measurement error terms of x and y respectively; ξ is the exogenous latent variable; η is the endogenous latent variable; B is the relationship between the endogenous latent variables; Γ is the influence of the exogenous latent variable on the endogenous latent variable, and ζ is the structural residual term of the structural equation model.

2.2. Materials

The survey was conducted in the Shaanxi Plain, which is located in central Shaanxi Province, between the Qinling Mountains and the Weibei Mountains. The altitude is about 325 ~ 800 meters and the length is about 300 kilometers. Flat terrain, fertile soil, warm climate, irrigation agriculture since ancient times famous, rich in wheat, cotton. This paper investigates 22 villages in four counties of Shaanxi Plain: Fuping County (seven villages), Chencang County (five villages), Fengxiang County (two villages), and Pucheng County (five villages). A total of 262 valid questionnaires were collected. Some local students assisted the survey after training. Data analysis was performed by SPSS23.0 and AMOS23.0.

3. Result and Discussion

3.1. Characteristics of Respondents

Among the respondents in the study area, there are more men than women. Most of the respondents are middle-aged, and the overall cultural level is medium. Their average age is 51 years old, and the average years of education are 11.44 years. The average annual income is 5024.12 dollars (Table 1).

Table 1. Characteristics of respondents

Socio-economic characteristic	Mean	SD
Gender of household head	0.55	0.498
Age	51.44	13.697
Education years	11.44	2.745
Annual household income (USD)	5024.12	2885.95
Cooperative participation	0.53	0.499

3.2. Variables to Description

For Perceived threat, farmers perceived that excessive use of chemical fertilizers would cause soil pollution (3.20±0.555) and soil fertility decline (3.18±0.629), and that chemical pesticide residues would threaten agricultural production (3.19±0.640), but they did not believe that this would affect future generations (2.98±0.735). For perceived expectation, Farmers recognize the benefits and possible consequences of organic fertilizers to a certain extent. For example, they believe that the use of organic fertilizers will increase soil fertility (3.11±0.597), improving the environment and human health (3.37±0.692), At the same time, they are concerned about the human and financial costs of applying organic fertilizers and the possibility of reduced production. At the same time, they are concerned about the human and financial costs of using organic fertilizers (3.39±0.712) and the possibility of reduced production (3.29±0.695). Respondents in the study area did not know much about the importance of organic fertilizer for sustainable production (2.99 ± 0.550), and the government did not regularly promote and encourage the use of organic fertilizer (3.06 ± 0.792), but they often discussed organic fertilizer with neighbors, friends and retailers (3.48 ± 0.699). Overall, farmers were hesitant to apply organic fertilizer (2.94 ± 0.712), but they were willing to further learn relevant knowledge (3.37 ± 0.692) and use organic fertilizer for environmental protection (3.23 ± 0.775) (Table 2).

Table 2. Measurement of farmers' willingness to use organic fertilizer, perceived threat, perceived expectation, and cues to action.

Factors	Items	Mean	SD
Perceived threat	PT1: I think the use of chemical fertilizer leads to soil pollution	3.20	0.555
	PT 2: I think excessive fertilizer will make the soil fertility decline.	3.18	0.629
	PT 3: I think chemical fertilizer contamination is a serious threat to agriculture production	3.19	0.640
	PT 4: I think fertilizer contamination is a serious threat to future generations	2.98	0.735
Perceived expectation	PE1: If I use organic fertilizer, the soil fertility will increase	3.11	0.597
	PE2: If I use organic fertilizer, the environment and human health will improve	3.37	0.692
	PE3: The use of organic fertilizer may lead to yield reduction	3.29	0.695
	PE4: Using organic fertilizer will cost more human resources and money	3.39	0.712
Cues to action	CA1: I have learned the importance of organic fertilizer for sustainable agricultural production	2.99	0.550
	CA2: The government encourages us to use organic fertilizer	3.06	0.792
	CA3: People and retailers around me often recommend organic fertilizer	3.48	0.699
Willingness to adopt organic fertilizer	WI1: I intend to adopt organic fertilizer in the next farming	2.94	0.712
	WI2: I will encourage my relatives, neighbors and friends to adopt organic fertilizer	3.11	0.694
	WI3: I plan to use organic fertilizer because it can improve the agricultural environment	3.23	0.775
	WI4: I will learn how to correctly use organic fertilizer	3.37	0.692

3.3. Factors Affecting Farmers' Application of Organic Fertilizer

Result showed that perceived threat, perceived expectation and cues to action all have significant impact on farmers' willingness to adopt organic fertilizers (Figure 1). Cues to action had the greatest impact on farmers ' willingness to adopt organic fertilizer (standardized path coefficient [SPC] = 0.59). This means that the surrounding social relations have a strong role in promoting farmers' behavior. The government's encouragement, the recommendation of neighbors, friends, retailers and farmers' own understanding of the sustainability of organic fertilizer are important factors affecting their adoption of organic fertilizer. This is consistent with the study of Adnan et al. [9] that groups have a significant impact on farmers' use of organic fertilizers. Followed by perceived threat (SPC = 0.55) and perceived expectation (SPC = 0.46).

The perception of threat will significantly affect farmers' agricultural behavior. In Nepal, when farmers and retailers perceive the harm of pesticides to land and body, they will adjust their pesticide use behavior [10]. In our study, farmers had some awareness of the environmental threat of chemical fertilizers, leading them to be willing to try more environmental-friendly organic fertilizers instead. Similarly, if they can see the long-term benefits of using organic fertilizer, it will also affect their fertilizer adoption decisions.

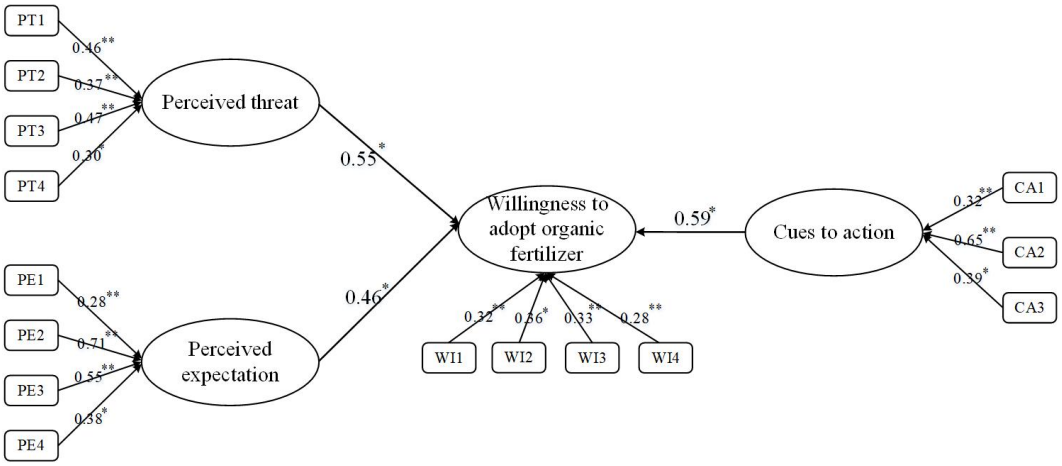

Figure 2. Factors affecting farmers' application of organic fertilizer

4. Conclusion

Although farmers are now aware of the changes in the agricultural environment and the important role of organic fertilizers in the sustainability of agricultural production, their willingness to adopt organic fertilizers is still not strong enough. This may be due to their skepticism about the yield-increasing effect of their organic fertilizers, and the use of organic fertilizers may cost them more human and financial resources. Therefore, to increase farmers' adoption of organic fertilizers, it is necessary to make them truly aware of the long-term benefits that organic fertilizers may bring and to influence their behavioral choices through farmers' social networks.

References

[1] Wu, Y. (2011). Chemical fertilizer use efficiency and its determinants in China's farming sector: Implications for environmental protection. China Agricultural Economic Review.

[2] Fu, X., Mao, J., & Shen, Z. (2017). Development status and trend of bio-organic fertilizer in china. Hubei Agricultural Sciences, 56(03), 401-404.

[3] Xuejun, L., & Fusuo, Z. (2011). Nitrogen fertilizer induced greenhouse gas emissions in China. Current Opinion in Environmental Sustainability, 3(5), 407-413.

[4] Islam, M. (2006). Use of bioslurry as organic fertilizer in Bangladesh agriculture. Prepared for the presentation at the international workshop on the use of bioslurry domestic biogas programme. bangkok, thailand,

[5] Chang, E.-H., Chung, R.-S., & Tsai, Y.-H. (2007). Effect of different application rates of organic fertilizer on soil enzyme activity and microbial population. Soil Science and Plant Nutrition, 53(2), 132-140.

[6] Wang Xinge. (2009). Research on marketing strategy of Huisen's 'Kunqier' bio-fertilizer. Southwestern University of Finance and Economics. (In Chinese)

[7] Taylor, D., Bury, M., Campling, N., Carter, S., Garfied, S., Newbould, J., & Rennie, T. (2006). A Review of the use of the Health Belief Model (HBM), the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Trans-Theoretical Model (TTM) to study and predict health related behaviour change. London, UK: National Institute for Health and Clinical Excellence, 1-215.

[8] Raheli, H., Zarifian, S., & Yazdanpanah, M. (2020). The power of the health belief model (HBM) to predict water demand management: A case study of farmers' water conservation in Iran. Journal of Environmental Management, 263, 110388.

[9] Adnan, N., Nordin, S. M., & Rasli, A. M. (2019). A possible resolution of Malaysian sunset industry by green fertilizer technology: Factors affecting the adoption among paddy farmers. Environmental Science and Pollution Research, 26(26), 27198-27224.

[10] Bhandari, G., Atreya, K., Yang, X., Fan, L., & Geissen, V. (2018). Factors affecting pesticide safety behaviour: The perceptions of Nepalese farmers and retailers. Science of The Total Environment, 631, 1560-1571.