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Literature Review of Agricultural Technology Extension

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Abstract Agriculture, as the primary industry, is the foundation of national economy. Agricultural development directly influences political, economic, and cultural construction of a state. Agricultural technology is a key factor restricting agricultural development. How to implement the agricultural technology innovation, agricultural technology extension becomes particularly important. In this literature review, current situation of agricultural technology extension was elaborated. Besides, current research situation and fields of agricultural technology extension were discussed. In the literature collected, researches about agricultural technology extension mainly included following three aspects: (i) theories of agricultural technology extension; (ii) agricultural technology extension system; (iii) behavior and effects of agricultural technology extension. On the basis of research results of literature, prediction was made for the agricultural technology extension and policy recommendations were put forward for agricultural technology extension works.

Key words Agricultural technology extension, Agricultural technology extension system, Agriculture, Literature review

1 Overview of agricultural technology extension

According to the *Law of the People's Republic of China on Agricultural Technology Extension*, agricultural technology extension refers to the activities of application of scientific and technological achievements and practical techniques in crop farming, forestry, animal husbandry and fishery to the entire process of pre-production, production and post-production of agricultural production through trial, demonstration, training, guidance and consulting services. As stated by Evenson (1997), the main function of agricultural technology extension is to transfer new technical information and good agricultural production experience and agricultural management methods to farmers. Agricultural technology extension should follow the principle of being favorable for agricultural development and respecting the intention of agricultural laborers, adapting to local conditions, and going through experiment and demonstration.

1.1 History and current situations of agricultural technology extension Since the reform and opening up, China's agricultural technology extension system has undergone commercialization and two hard reform processes. In the entire process of reform, there are still many problems despite considerable achievements have been made. At the early stage of reform and opening up, China implemented the household contract responsibility system. The land was collectively owned, while the individual farmers enjoyed the right to use. With the appearance of individual production subjects, the demand for agricultural technology started to take on diversified development trend. Such objective environment promoted the expansion of agricultural technology extension teams and the expansion of agricultural technology extension stations. In the period of commercialization, the government has implemented the decentralization and centralization of three rights and second time of decentralization of three rights. In this situation, the govern-

ment started to reduce the agricultural extension teams, resulting in "broken network, broken lines, and scattered people" problems in the agricultural extension system. As a result, the agricultural technology extension appeared to perform practically no function. In the middle stage, the government centralized the three rights and took a series of measures to expand the agricultural technology extension teams. At the late stage, the government decentralized the "three rights" again. Agricultural technology extension work of extension personnel changed to township work, which fundamentally changed main tasks of agricultural extension personnel^[1]. Since 2004, China has started to implement a series of agricultural extension model pilot. In some areas, it has made certain achievements, but it still failed to establish a sound agricultural extension system. At present, China's agricultural technology extension is facing great challenges, mainly reflected in the following aspects: insufficient investment in agricultural technology extension, backward extension methods, aging extension knowledge of agricultural extension personnel^[2], unclear about functions of grass-roots technology extension system, unsmooth grass-roots extension system, and lack of the incentive mechanism^[1]. These problems are to be solved urgently, and their existence exerts a direct impact on the effectiveness and efficiency of agricultural technology extension.

1.2 Current situations of researches about agricultural technology extension The research on the extension of agricultural technology appeared under the background of specific times. At early stage, researches mainly focused on the theoretical research. In the late 1990s, Zhang Junbiao started carrying out the theoretical research on agricultural technology extension system, and he studied the extension mode of the agricultural technology extension and the operation mechanism in market economy condition^[2]. Later, the research about agricultural technology extension changed to behavior of agricultural technology extension subjects. Through lit-

erature search, we found that related literature in recent years mainly focused on the analysis of the current situation of agricultural technology extension, the comparative analysis of agricultural technology extension between domestic and foreign areas, agricultural technology extension modes, and the rate of putting the agricultural technology extension in place. Although the current research takes on a diversified trend, there is still no literature on the coordination mechanism among the government, agricultural technology extension personnel and farmers, and no universal model for the agricultural technology extension.

2 Data and methods

In this study, we searched 266966 articles in China National

Knowledge Infrastructure (CNKI) using key words "agricultural technology extension system", "agricultural technology extension", and "agricultural technology extension mode", and filtered these articles through setting the condition of being published in core periodicals. Besides, In the process of reading the literature, we collected articles through rolling the snowball, and finally obtained 22 articles. These articles can be divided into four main types: (i) theoretical research of agricultural technology extension (2 articles); (ii) agricultural technology extension system (5 articles); (iii) agricultural technology extension behavior and effects (8 articles); (iv) others (5 articles), as listed in Table 1, Table 2, Table 3, and Table 4.

Table 1 Theoretical research of agricultural technology extension

Author	Reference number	Reference source	Issuing time
Zhang Junbiao	3	Research of Agricultural Modernization	Issue 2, 1999
Jiang Heping and Cui Kai	4	Management of Agricultural Science and Technology	Issue 6, 2010

Table 2 Research of agricultural technology extension system

Author	Reference number	Reference source	Issuing time
Liao Zujun	6	Rural Economy	Issue 11, 2011
Huang Jikun, Hu Ruifa, <i>et al.</i>	1	Journal of Agrotechnical Economics	Issue 1, 2009
Ding Jutao	14	Rural Economy	Issue 5, 2005
Research Team of Research Center for Rural Economy, the Ministry of Agriculture	13	Chinese Rural Economy	Issue 2, 2005
Duan Li	5	Rural Economy	Issue 4, 2011

Table 3 Analysis on agricultural technology extension behavior and effects

Author	Reference number	Reference source	Issuing time	Method	Effective sample size
Zeng Weizhong and Chen Xiulan	8	Journal of Agrotechnical Economics	Issue 4, 2010	Probit	512
Zhi Huayong, Huang Jikun, <i>et al.</i>	7	Management World	Issue 7, 2007	Fixed effect model	–
Lu Xinye, Zhu Xiaoli, <i>et al.</i>	11	Scientia Agricultura Sinica	Issue 4, 2011	–	–
Li Dongmei, Chen Chao, <i>et al.</i>	16	Journal of Agrotechnical Economics	Issue 4, 2009	Logistic	238
Liao Xiyuan, Wang Zhigang, <i>et al.</i>	10	Chinese Rural Economy	Issue 7, 2009	–	4831
Hu Ruifa, Li Liqiu, <i>et al.</i>	20	Issues in Agricultural Economy	Issue 11, 2006	–	–
Zhou Hong, Xia Qiu, <i>et al.</i>	12	Journal of Agrotechnical Economics	Issue 9, 2014	Stochastic frontier transcendental logarithm model	–
Wang Jianming, Li Guangsi, <i>et al.</i>	9	Chinese Rural Economy	Issue 3, 2011	Random intercept model	3795

Table 4 Other researches

Author	Reference number	Reference source	Issuing time	Effective sample size
Gao Qijie	19	Issues in Agricultural Economy	Issue 8, 2002	–
Research Team of the Reform of China's Agricultural Technology Extension System	18	Management World	Issue 5, 2004	1665
Hu Ruifa and Li Liqiu	2	Science and Technology Review	Issue 1, 2004	–
Kong Xiangzhi and Lou Dong	17	Reform	Issue 1, 2012	–
Liu Zhanping and Jiang Heping	15	Scientific Research	Issue 6, 2006	348

3 Main research fields of current agricultural technology extension

3.1 Theoretical research of agricultural technology extension
Theoretical researches on agricultural technology extension mainly include the research of its model construction theory, the principles, model types and mode operation mechanism. Zhang Junbiao stated that the model construction for agricultural technology exten-

sion should follow the efficiency, time, coordination, and feasibility principles^[3]. He stated that it is required to establish and improve the market mechanism, the coordination mechanism, the competition mechanism and the dynamic mechanism, and it is required to promote establishment and improvement of agricultural technology extension mode operation mechanism combining the characteristics of three rural issues and agricultural technology.

Jiang Heping *et al.*^[4] studied the operation mechanism of agricultural technology extension mode in market economy condition, and divided current extension mode into three types. (i) The agricultural technology extension station driven model, characterized by technical supply creates technology demands, so as to achieve the process balance of new technologies. (ii) Rural professional technology extension association mode, characterized by extension of agricultural technology services with the market as a guide through the use of technology, education, personnel advantages, and by a variety of ways. (iii) Agricultural science and technology park extension mode, characterized by high resource integration ability and wide area of demonstration.

3.2 Research of agricultural technology extension system

3.2.1 Research of reform and achievements of agricultural technology extension system. Since the reform and opening up, China's agricultural technology extension system has undergone two hard reform processes. At different stages of reform, there appeared different problems. Experts and scholars have expressed extensive opinions about the reform of the agricultural technology extension system. The Research Team of Research Center for Rural Economy, the Ministry of Agriculture (2005) proposed some reform ideas as after the survey of Changshu of Jiangsu, Yutian of Hebei, Lintao of Gansu and Tieling of Liaonin, including clear objectives and principles of reform, selecting the key fields of reform, and reform of the revenue and expenditure system, *etc.*^[13]. In the effectiveness of the system research, through a series of macro data analysis, Duan Li concluded that the current agricultural technology system becomes gradually stable and operating mechanism is constantly being innovating^[5].

3.2.2 Research on the innovation mode of agricultural technology extension system. Through the study, Liao Zujun (2011) found that Chengdu has established a new agricultural social service system with leading enterprises as the backbone, other social forces as supplement, and special services and comprehensive services coordinated. This was called Chengdu Mode and has given certain enlightenment to the innovation system of national agricultural technology extension. Current exploration on the innovation mode is mainly focusing on supporting people with money and cause, promising to provide services from bottom to top, innovating upon the mechanism, managing the objectives, orienting towards demands, and obtaining remuneration according to performance^[1]. In various innovation modes, there are still many limitations and challenges.

3.3 Research on the behavior and effects of agricultural technology extension

3.3.1 Research on the behavior of agricultural technology extension at the government level. The government plays a leading role in the agricultural technology extension. Besides, the government is the creator of agricultural technology extension system and the maker of the extension policies. From the perspective of government investment, Zhi Huayong, Huang Jikun, *et al.*^[7] studied the effects of government investment on the public welfare technology extension through grass-roots agricultural machinery extension personnel. It is found that the increase of government investment will not increase the time for agricultural technicians to engage in public welfare technology extension, but can significantly increase

their working time under the county and township management system. This indicates that increasing government investment depends to some extent on the type of management system. We should not blindly increase the government investment in order to raise the efficiency of agricultural technology extension.

3.3.2 Research on the behavior of agricultural technology extension at the agricultural technician level. The research at the agricultural technician level mainly includes factor analysis on participation of agricultural technology extension personnel and efficiency of agricultural technology extension. Through the survey, Zeng Weizhong and Chen Xiulan^[8] found that the female participation in technology extension is lower than that of the male, while older ones are lower than those in younger ones, those with lower educational level are lower than those with higher educational level, and those in developed areas are lower than those in less developed areas. Using the hierarchical linear model (HLM), Wang Jianming, Li Guangsi *et al.*^[9] analyzed the influence of the grass-roots agricultural technology extension system on the behavior of agricultural technicians, and found that the fund guarantee system, job design system, personnel management system, external cooperative development system, and agricultural technician individual characteristics will influence the extension behavior of agricultural technicians.

3.3.3 Research on the behavior of agricultural technology extension at the farmer level. The research on the behavior of agricultural technology extension at the farmer level is a popular perspective. Farmers, as actual users of agricultural technologies, gradually attract attention of researchers. Liao Xiyuan, Wang Zhigang, *et al.*^[10] carried out a nationwide survey and found that the larger guidance number of agricultural technicians, higher frequency of going to the field, more prompt guidance period, higher the degree of familiarity of farmers, and the better guidance content will have better agricultural technology extension performance.

3.3.4 Research on the effects of agricultural technology extension. The research on the effects of agricultural technology extension is mainly measured by the rate of putting agricultural technology into place. Such research belongs to empirical research. For example, Lu Xinye, Zhu Xiaoli *et al.*^[11] using the super efficiency DEA model, found that the efficiency of agricultural technology extension not only influences the yield, but also influences the planting cost in the planting management. With the aid of transcendental logarithmic stochastic frontier production function, Zhou Hong, Xia Qiu *et al.*^[12] analyzed the effects of the rate of putting agricultural technology into place on the technology efficiency. They found that there exist differences in the production efficiency between farmers and non-farmers and pointed out that it is possible to raise the rate of putting the agricultural technology into place through reducing the time of key links.

4 Conclusions and policy recommendations

4.1 Conclusions According to analysis of literature data, with the progress of science and technology, the research on agricultural technology extension changed from theoretical research to empirical research and from institutional system to agricultural technology ex-

tension subject behavior. In addition, some scholars compared China's agricultural technology extension and other countries. In the past two years, very few researches on agricultural technology extension were published in the core journals. It can be seen that the research on agricultural technology extension meets a bottleneck, and it is necessary for the scholars to explore new and meaningful research fields. On the whole, the future research of agricultural technology extension will change to agricultural technology extension efficiency, the combination of agricultural technology extension efficiency and agricultural production efficiency. Besides, it will continue to explore the agricultural technology extension innovation mode. This interactive mechanism of government, agricultural extension personnel and farmers may influence the research of agricultural technology extension.

4.2 Policy recommendations for agricultural technology extension

The research of agricultural technology extension is a continuous process. It needs to find out the problems through continuous research and come up with corresponding solutions to promote the agricultural technology innovation process. On the basis of the current research conclusions, we come up with following recommendations for the agricultural technology extension. (i) It is recommended to increase investment in agricultural technology extension, take the government investment as the main and introduce a certain percentage of commercial capital to enrich the investment structure of agricultural technology extension. (ii) It is recommended to improve the agricultural technology extension system and strengthen the innovation mode of agricultural technology extension, to make it adapt to local conditions, accordingly improve the effectiveness and efficiency of technology extension. (iii) It is required to strengthen the construction of agricultural technology extension teams, improve the training of agricultural technicians, comprehensively improve the comprehensive quality of agricultural technicians, and increase the introduction of relevant graduates of universities, to inject fresh blood into agricultural technology extension teams. (iv) It is recommended to establish and improve the incentive mechanism for agricultural technology extension personnel, to stimulate their enthusiasm and initiative to serve the farmers.

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