International Journal of Engineering and Management Research e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-13, Issue-3 (June 2023)
https://ijemr.vandanapublications.com https://doi.org/10.31033/ijemr.13.3.3

Review and Prospect of the Promotion of Agroforestry System Technology in Southern Collective Forest Areas

Zhang Xue
Postgraduate Student, College of Economics and Management, Zhejiang Agricultural and Forestry University, Hangzhou-311300, CHINA

Corresponding Author: m17647316256@163.com

Received: 02-05-2023 **Revised:** 19-05-2023 **Accepted:** 30-05-2023

ABSTRACT

The promotion of agroforestry technology in undergrowth cultivation can alleviate the degradation of forest land. However, the slow progress in the implementation of this technology has become a concern for decision-makers and the academic community. This article systematically reviews the main policies and evaluations of the implementation effects of undergrowth agroforestry technology, and identifies the possible constraints on the policy implementation. It also provides prospects for future research directions, offering insights for policy improvements and references for related studies. The research findings indicate that undergrowth agroforestry technology not only affects the economic benefits of rural households but also contributes to ecological benefits such as soil erosion control and reduction of chemical fertilizer use. However, the effectiveness of undergrowth agroforestry technology is constrained by various factors, including resource endowment, household characteristics, and external environment. Lastly, there is a need for further investigation into the deepening and optimization of the promotion of undergrowth agroforestry technology.

Keywords-- Undergrowth Agroforestry Technology, Economic Forests, Constraining Factors, Undergrowth Management

I. INTRODUCTION

Forest land degradation is severe in southern collective forest areas, and policymakers hope to alleviate this issue through the promotion of undergrowth agroforestry technology. However, the implementation of this technology has been slow in reality, making it a focal point for policymakers. Soil degradation in forest land is mainly found in timber and economic forests, where large amounts of fertilizers and pesticides are used annually, leading to soil compaction and disruption of self-regeneration mechanisms (Li Yunkun and Xiao Zhongwu, 2015). It is known that China's existing forest area is 310 million hectares, with 69.33 million hectares of artificial forests, of which timber and economic forests account for about 70%. Southern collective forest areas are mainly composed of artificial forests, with more severe soil degradation, requiring urgent attention. Considering the contradiction between increasing income for farmers and ecological protection, undergrowth agroforestry technology has received policy support. Theoretically, adopting undergrowth agroforestry technology can provide farmers with higher economic benefits, enhance their motivation to protect forest land, and the multi-layered structure formed under the forest canopy can improve soil fertility, soil structure, and water conservation while reducing the use of chemical fertilizers and herbicides (Huyan Li et al., 2017; Chen Lei et al., 2019). Therefore, the government has first proposed vigorous support for undergrowth agroforestry in the 2010 Central Document, and subsequently emphasized support for the development of undergrowth agroforestry technology in the 2012, 2013, and 2016 Central Documents, accompanied by corresponding development plans and support policies. However, the promotion of undergrowth agroforestry technology has been slow in reality.

To date, undergrowth agroforestry technology has undergone long-term development and accumulation, but it has not been widely accepted by most farmers. Therefore, this article aims to review the relevant research and promotion policies of undergrowth agroforestry technology, comprehensively summarize the possible constraints on the policy implementation, and provide prospects for future research directions to improve undergrowth agroforestry technology policies and related studies.

II. ANALYSIS OF CONSTRAINTS ON THE PROMOTION OF UNDERSTORY AGROFORESTRY TECHNOLOGY

Existing studies have confirmed that understory agroforestry technology can indeed enhance economic and environmental benefits. However, few scholars have systematically sorted out and analyzed the constraining factors for the promotion of understory agroforestry technology. Therefore, this article will analyze the influencing factors that restrict the promotion of understory agroforestry technology from the perspectives of resource endowment and external social environment.

2.1 Resource Endowment

The development of understory agroforestry technology is inevitably constrained by resource endowment in terms of infrastructure, capital, land, technology, and management (Chen Tianyi, 2014; Xu Chao, 2014; Zhi Ling et al., 2019). Firstly, different regions have different levels of development in terms of land conditions, infrastructure construction, and capital investment. The first category of regions has harsh natural environmental conditions, with perennial drought and insufficient rainfall, making it unsuitable for the development of understory agroforestry technology. The second category of regions has forests mainly distributed in remote mountainous areas with poor infrastructure such as forest roads and water channels, which hinders the promotion of understory agroforestry technology. The third category of regions has not yet formulated development plans related to understory agroforestry technology and has not introduced incentives related to its adoption. The fourth category of regions has the conditions for promoting understory agroforestry technology, but there are high risks in subsequent development, a lack of leading enterprises that can play a driving role in the market, and insufficient market development (Huang Daguo, 2012; Tang Zhihua et al., 2012; Zhou Hui, 2016; Zhang Yanhui, 2016). Secondly, due to the uniqueness of understory agroforestry technology, it is also constrained by variety selection, which directly affects the economic benefits of the technology. A key consideration for mixed-layer cultivation is the competition between different plant species. Plant competition is caused by traits that express the monopolistic growth space obtained by capturing resources (Jenning and Jesus, 1968; Chauhan and Johnson, 2011; Munda et al., 2019). In the process of mixed-layer cultivation, two different crop varieties intercropped may have the same root zone, and tall genotypes can shade short genotypes. Compared to monoculture, multi-layer cultivation can affect the characteristics of plants (Aschehoug et al., 2016).

From ancient times to the present, the wise working people have made countless attempts with understory agroforestry technology. However, factors such as farmer age, educational level of household head, forest area, non-agricultural income proportion, shortage or inadequacy of family labor, awareness of understory agroforestry technology, distance from the county seat, level of forestry technology mastered by farmers, and labor shortage can all affect the development of understory agroforestry technology (Li Ya, 2013; Xu Chao, 2014; Wang Tuanzhen et al., 2016; He Changhui et al., 2017).

2.2 External Social Environment

From practical experience and existing research, the promotion mechanisms of understory agroforestry technologies can be summarized into two types: peer effect generated by mutual learning and imitation among farmers, and community effect generated by collective organization and coordination of villages for promotion (Han Qingling, 2020; Shen Qian, 2021). Peer effect refers to the benefits generated from making decisions similar to those of peers with equal social relationships, considering not only individual economic interests but also the benefits derived from the decisions made by peers (Wilson, 1987; Manski, 1993). In behavioral economics, individuals' behavior is often influenced by psychological factors such as loss aversion, status quo bias, reference dependence, and risk preferences (Tversky and Kahneman, 1991; Hashemi and Damalas, 2010; Vieider, 2016). The information transmission and risk-sharing functions of peer effect theoretically promote the adoption of understory agroforestry models by farmers. However, they cannot overcome the inhibitions caused by farmers' risk preferences and the difficulty of implementing the models.

On one hand, in the absence of a well-developed agricultural insurance market, farmers tend to adopt risk-avoidance behaviors, leading them to prefer traditional production and management models (Huang Jikun et al., 2008). On the other hand, the application of new management models by farmers is influenced by the combined effects of opportunity costs and conditions. When the difficulty of adopting a new model is high, such as uncertainty about opportunity costs or when farmers' resource endowments do not support the application of understory agroforestry models, farmers are more likely to abandon the use of such new management models. Thus, under the constraints of farmers' risk preferences and the difficulty of implementing the models, the information transmission and risk-sharing functions of peer effect are suppressed.

Community effect refers to the influence exerted by the collective organization and coordination of villages in utilizing political and social resources on individuals' behavior within the same village (Han Qingling, 2020; Shen Qian, 2021). Throughout history, humans have gathered together based on kinship and geographical relationships, and after thousands of years of evolution, villages have emerged as communities with dual functions of social and economic support, providing social security and welfare to villagers (Pan Lu, 2021). Community effect primarily influences farmers' adoption of understory agroforestry technologies through the technical extension services provided by village collectives and investments in public goods. However, the effects and utilization of public goods provided by village collectives are also influenced by the difficulty of technology adoption and the degree of dependence on agricultural income. When the difficulty of technology adoption is high, the lack of targeted technical extension services makes it challenging to address substantial problems for farmers. Moreover, when farmers have a low dependence on agricultural income, their production decisions tend to favor capital-intensive technologies due to income constraints and labor supply (Zhu Yuchun and Wang Lei, 2014; Zhong Funing et al., 2016).

e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-13, Issue-3 (June 2023)
https://doi.org/10.31033/ijemr.13.3.3

2.3 Comprehensive Review

As a green agricultural management technology, the agroforestry system has attracted increasing attention in recent years, leading to a large number of studies on its impact assessment. These studies have provided a foundation for the comprehensive evaluation of the ecological and economic benefits of the agroforestry system, as well as the effectiveness and constraints of its technology dissemination. However, there are still areas in existing literature that require further exploration and improvement regarding research perspectives and content when studying the promotion of the agroforestry system.

Firstly, the existing research lacks systematic discussions on the mechanisms and constraints of technology dissemination. Currently, most studies have limitations in terms of their systematic approach, focusing more on specific pathways or functions without considering the overall picture. Additionally, limited attention has been given to the obstacles posed by factors related to farmers themselves and technological aspects in technology promotion. Instead, more emphasis has been placed on directly analyzing the impact of such factors on farmers' technology adoption behavior, neglecting a deeper exploration of the mechanisms behind technology dissemination.

Secondly, the existing research has taken a relatively traditional perspective and has rarely analyzed the diffusion of technology from the perspective of peer effects and community effects that exist in the external environment. Current studies primarily focus on examining the influence of different factors on farmers' technology adoption, and when discussing the external environment, they only analyze individual factors, paying little attention to the research on peer effects and community effects.

In this study, a systematic review is conducted from the perspectives of internal resource environmental endowment and external social environment. The main constraints affecting the promotion of the agroforestry system technology include the following aspects: Firstly, the dissemination of the agroforestry system technology is influenced not only by the farmers themselves but also by external environmental constraints, such as liquidity constraints, technological proficiency, dependence on forestry income, land area, and availability of family labor, among other factors. Secondly, research on the impact of peer effects and community effects on technology adoption is still in its early stages in China. Besides examining whether peer effects and community effects can influence technology adoption, it is also important to understand the nature and extent of their influence and the conditions that constrain their role in the diffusion of agroforestry system technology.

III. CONCLUSION AND OUTLOOK

China's forestry management model has undergone a transformation from extensive management to refined management. The promotion policy of agroforestry system has also experienced a shift from rapid development to high-quality development. In this process, agroforestry system has transformed from spontaneous behavior to a policy-supported model. As an effective attempt in the agricultural supply-side reform and an important driver for rural revitalization, agroforestry system technology can help increase farmers' income and promote common prosperity while protecting the environment.

The Chinese government has provided strong policy support for agroforestry system technology. This is mainly due to the influence of factors such as liquidity constraints, technological proficiency, dependence on forestry income, land area, availability of family labor, peer effects, and community effects during the technology dissemination process. However, the actual progress of technology promotion has been relatively slow.

Based on the existing policy trajectory and research trends in the literature, future policy improvements and research in related areas regarding the promotion of agroforestry system technology can focus on the following aspects. In terms of policy improvements, first, training and promotion targeting rural elites can leverage peer effects to enhance farmers' awareness and acceptance of the technology. Second, by establishing professional expert teams and mechanisms for business capital to enter rural areas, through talent development and dedicated support funds, the promotion of agroforestry system technology can be deepened.

In terms of research in related areas, further exploration can be conducted on the inherent mechanisms of agroforestry system technology's constraints by the external environment, and the driving factors behind the promotion of agroforestry system technology can be identified. Additionally, policy evaluation can be carried out to assess the effectiveness of current policies, ensuring precise support for agroforestry system technology and facilitating its rapid dissemination.

REFERENCES

[1] Aschehoug, E.T., R. Brooker, D.Z. Atwater, J.L. Maron & R.M. Callaway. (2016). The mechanisms and consequences of interspecific competition among plants. *Annual Review of Ecology, Evolution, and Systematics, 47*, 263-281.

[2] Chauhan, B.S. & DE Johnson. (2011). Competitive interactions between weedy rice and cultivated rice as a function of added nitrogen and level of competition. *Journal of*

e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-13, Issue-3 (June 2023)
https://doi.org/10.31033/ijemr.13.3.3

Weed Biology and Management, 11, 202-209.

[3] DANGERFIELD C W & HARWELL R L. (1990). An analysis of a silvopastoral system for the marginal land in the Southeast United States. *Agroforestry Systems, 10*(3), 187-197.

[4] HASHEMI S M & DAMALAS C A. (2010). Farmes perceptions of pesticide efficacy: Reflections on the importance of pest management practices adoption. *Journal of Sustainable Agriculture, 35*(1), 69-85.

[5] Jenning, P.R. & J Jr. De Jesus. (1968). Studies on competition in rice I. Competition in mixtures of varieties. *Evolution, 22*, 119-124.

[6] MANSKI C F. (1993). Identification of endogenous social effects: The reflection problem. *The Review of Economic Studies, 60*(3), 531-542.

[7] Munda, S.,S. Saha,T. Adak, N. Jambhulkar, P. Sanghamitra & B.C. Patra. (2019). Performance of cultivated indica rice (Oryza sativa L.) as affected by weedy rice. *Experimental Agriculture, 55*, 875-884.

[8] Neupane R.P & Thapa G.B. (2001). Impact of agroforestry intervention on soil fertility and farm income under the subsistence farming system of the middle hills, Nepal. *Agriculture Ecosystems & Environment, 84*(2), 157-167.

[9] Sangeetha Tupili & Ezhumalai P. (2020). Enhanced and cost-effective techniques used for plant growth in vertical agriculture. *Materials Today: Proceedings*.

[10] Prinsley R.T. (1992). The role of trees in sustainable agriculture—An overview. *Agroforestry Systems, 20*(1-2), 87-115.

[11] TVERSKY A & KAHNEMAN D. (1991). Loss aversion in risk-less choice: A reference-dependent mode. *Quarterly Journal of Economics, 106*(4), 1039-1061.

[12] VIEIDER F M. (2016). Certainty preference, random choice, and loss aversion: A comment on "violence and risk preference: Experimental evidence from Afghanistan". *Economics Discussion Papers em-dp2016-06, Department of Economics, Reading University*.

[13] WILSON W J. (1987). *The truly disadvantaged: The inner city, the underclass, and public policy*. Chicago: University of Chicago Press.

[14] Chen Lei, Xiong Kangning & Tang Xiaopeng. (2019). Overview of research on agroforestry systems. *World Forestry Research, 32*(6), 25-30.

[15] Chen Tianyi. (2014). An empirical analysis of the current situation and demands of farmers' development of understory economy: A survey in Neihuang County, Henan province. *Forestry Economics, 36*(6), 45-47+63.

[16] Chen Weiping, Zhu Qingke & Xue Zhide, et al. (2008). Research progress on planning and design of agroforestry systems. *Journal of Northwest Forestry University, 4*, 127-131.

[17] Diao Jun, Guo Zhenyuan & Wang Jingcai, et al. (2013). Analysis of understory economic benefits in Fujian province. *Green Technology, 2013*(11), 225-227.

[18] Feng Yaoxue. (1992). *Structure and function of agroforestry systems*. Beijing: China Science and Technology Press, pp. 45-50.

[19] Gu Xiaojun, Cao Liming & Ye Zhengwen, et al. (2008). Research on understory economic models and industrial development countermeasures. *Journal of Shanghai Agricultural Sciences, 24*(3), 21-24.

[20] Cai Wenbo. (2018). *Research on understory economic models and industrial development countermeasures in Anhui province*. Hefei: Anhui Agricultural University.

[21] Guo Jing, Wang Guibin & Feng Chaonian, et al. (2017). Classification and comprehensive benefit evaluation of understory economic models in ginkgo biloba plantations. *Journal of Central South University of Forestry & Technology, 37*(1), 118-122.

[22] Han Qingling. (2020). Village-community coordination: Organizational mechanism for the organic integration of small farmers and modern agriculture. *Journal of Nanjing Agricultural University (Social Sciences Edition), 20*(3), 34-43.

[23] He Changhui & Mo Yeyong, Yang Lin, et al. (2017). A survey study on understory economy in private para rubber gardens in hainan province from the perspective of farmers. *Tropical Agricultural Science, 37*(9), 88-93.

[24] Huyan Li & Chu Yongxing. (2017). Study on the implementation effect of compound techniques in understory economy of walnut plantations. *China Forestry Economics, 2017*(5), 57-58+93.

[25] Huang Jikun, Qi Liang & Chen Ruijian. (2008). Technical information, risk preference, and farmers' pesticide application. *Management World, 2008*(5), 71-76.

[26] Huang Dongfeng, Wang Limin & Li Weihua, et al. (2014). Effects of intercropping with forage grass in tea plantations on crop yield and soil fertility. Chinese *Journal of Eco-Agriculture, 22*(11), 1289-1293.

[27] Huang Daguo. (2012). Discussion on the development of understory economy: a case study of Anhui province. *Anhui Agricultural Science, 40*(21), 10926-10928.

[28] Jia Sixie. Qimin Yaoshu [O]. *Late Northern Wei Dynasty* (533-544).

[29] Monitoring Group for Reform of Collective Forest Rights System, Zhang Sheng & Wen Caiyun, et al. (2014). Study on the development status and problems of understory economy:

e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-13, Issue-3 (June 2023)
https://doi.org/10.31033/ijemr.13.3.3

Field research in 70 sample counties. *Forestry Economics, 36*(2), 11-14+109.

[30] Ke Shuifa, Yan Ruhe & Qiao Dan. (2018). Cost-benefit analysis of adaptive management of forestland: A case study of understory medicinal plant cultivation in Chunfeng village, Junlian County. *Journal of Agro-Forestry Economics and Management, 17*(2), 169-176.

[31] Kong Xiangzhi, Fang Songhai & Pang Xiaopeng, et al. (2004). Analysis of the influence of farmers' endowment on the adoption of agricultural technologies in western China. *Economic Research Journal, 2004*(12), 85-95+122.

[32] Li Ya & Han Changzhi. (2013). *Research on the development path of understory economy in yunnan province based on farmers' willingness*[C]//The 19th Sub-Forum of the 15th Annual Meeting of China Association for Science and Technology: Proceedings of the Academic Symposium on Western China's Ecological Forestry, Livelihood Forestry, and Technological Innovation, May 25, 2013, Guiyang, Guizhou, China: China Academic Journal Electronic Publishing House, 2013: 182-186.

[33] Li Ya & Han Changzhi. (2012). Current situation and countermeasures of walnut industry development in Yunnan province. *Nonwood Forest Research, 30*(4), 162-167.

[34] Li Anjun, Guo Yuancheng & Ma Chengzhan, et al. (2013). Discussion on the concept of "understory economy". *Modern Horticulture, 2013*(19), 15.

[35] Li Wenhua & Lai Shideng. (1994). *Agroforestry in China*. Beijing: China Science and Technology Press, pp. 5-20.

[36] Li Yunkun & Xiao Zhongwu.(2015). Soil pollution, degradation, and loss in China's forestland: Problems and countermeasures. *Forestry Economics, 37*(9), 3-15.

[37] Ling Chuanjun. (2018). Discussion on the development of understory economy and economic forestry industry. *Friend of Farmers' Wealth, 2018*(3), 185.

[38] Pan Lu. (2021). Village-community-based agricultural organization: a path for the organic integration of small farmers and modern agriculture. *China Rural Economy, 2021*(1): 112-124.

[39] Shen Qian. (2021). Embedding process, community foundation, and governance mechanism of village-community cooperative society. *Beijing Social Sciences, 2021*(9), 111-120.

[40] Sun Yuan, Liang Ziyu & Wang Guibin, et al. (2020). Analysis of research hotspots and frontiers in the field of agroforestry management. *Journal of Nanjing Forestry University (Natural Sciences Edition)*, *44*(6), 228-235.

[41] Tang Zhihua & Liu Xiaohua. (2012). Models, issues, and countermeasures of understory economy development in guangxi province. *Guangxi Social Sciences, 2012*(11), 27-30.

[42] Wen Huaming & Li Guanqun. (2016). Operational models and development trends of understory economy. *Rural Science and Technology, 2016*(29), 89-90.

[43] Wang Tuanzhen, Chen Qin & Zhu Boyi, et al. (2016). Study on influencing factors of farmers' willingness to develop understory economy: based on survey data of 220 farmers. *Journal of Fujian Agriculture and Forestry University (Social Sciences Edition), 19*(1), 56-60.

[44] Wang Jinrong & Diao Jun. (2014). Research on the current situation and countermeasures of understory economic development in southern collective forest areas. *East China Forestry Management, 28*(4), 1-4.

[45] Wang Ling. (2018). Analysis of policies for the development of understory economy in Yunnan. *Southern Agriculture Machinery, 49*(2), 196+231.

[46] Wei Zebin, Guo Xiaofang & Wu Qitang, et al. (2014). Study on the continuous remediation effect of plant intercropping and chemical enhancement on heavy metal-polluted soils. *Environmental Science, 35*(11), 4305-4312.

[47] Xu Chao. (2013). *Empirical study on the development of understory economy in sanming region of fujian province*. Beijing: Beijing Forestry University.

[48] Xu Guangqi. Nongzheng Quanshu [O]. Ming Dynasty, Wanli Period.

[49] Xu Xiuying, Ma Tianle & Liu Junchang. (2006). Research on the reform of forest tenure system in southern collective forest areas. *Forestry Science, 2006*(08), 121-129.

[50] Zhang Yanhui. (2016). Analysis of suggestions for the development of understory economy from the perspective of farmers. *Beijing Agriculture, 2016*(1), 155-156.

[51] Zhong Funing, Lu Wuyi & Xu Zhigang. (2016). Does rural labor outmigration harm grain production? - an analysis of farmers' factor substitution, cropping structure adjustment behavior, and constraints. *Chinese Rural Economy, 2016*(7), 36-47.

[52] Zhou Hui. (2016). Current situation and countermeasures of understory economic development in ningxia hui autonomous region. *Modern Agricultural Science and Technology, 2016*(24), 162-163.

[53] Zhou Yingheng, Yang Meili & Wang Tuzhan. (2007). Empirical analysis of the influence of rural public utility development on farmers' agricultural production investment. *Journal of*

e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-13, Issue-3 (June 2023)
https://doi.org/10.31033/ijemr.13.3.3

Nanjing Agricultural University (Social Sciences Edition), 2007(1), 32-36+70.

[54] Zhu Yuchun & Wang Lei. (2014). Analysis of demand willingness for farmland water conservancy facilities among farmers with different income levels: validation based on survey data from shaanxi and henan. *Chinese Rural Economy, 2014*(1), 76-86.

[55] Zheng Hao, Yang Zhijian & Feng Jinling, et al. (2015). Influence of different understory interplanting patterns on soil chemical properties and microorganisms in camellia oleifera young forests. *Journal of Fujian Agriculture and Forestry University (Natural Science Edition), 44*(2), 147-153.

[56] Zhi Ling, Gao Jing & Zhi Ming, et al. (2019). Government actions for understory economic development and farmers' response in tianbao district. *Forestry Economics, 41*(3), 108-118.

[57] Zhong Chongxi. (2003). Discussion on the development of understory economy and the cultivation of medicinal plants in northern China. *Forestry Exploration and Design, 2003*(1), 46-48.

[58] Zheng Xiaodong, Shangguan Shuangyue & Fang Xiangming. (2020). A review of the effects of new rural social pension insurance policies. *Agricultural Economic Issues, 2020*(05), 79-91.

[59] Zheng Fengtian, Ruan Rongping & Kong Xiangzhi. (2009). Retrospect and analysis of forest tenure system reform in southern collective forest areas. *China Population, Resources and Environment, 19*(01), 25-32.

This study is supported by the Zhejiang Provincial University Student Science and Technology Activity Program and Emerging Talents Program Funding Project (2021R412042).