An Empirical Research on Contribution of Agricultural Mechanization to Ecological Protection and Restoration in Rural of China

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Abstract. [Purpose/significance] In order to explore the supporting mechanism and influence relationship of agricultural mechanization on rural ecological restoration and then put forward the improvement strategy of rural ecological restoration in combination with the development of agricultural mechanization, the structural equation model was built based on a number of related indexes of 31 provinces and cities from 2005 to 2017. [Results/conclusion] The results show that the direct effect of ecological construction and protection investment on agricultural mechanization is 1.126, while the direct effect of agricultural mechanization on ecological construction and protection investment is -3.060. In terms of the impact of various variables on ecological protection and construction investment, the direct impact of agricultural mechanization is the most significant, with the largest degree of effect, followed by the area of water-logging removal, soil and water loss control ranked third, and machine tillage rate ranked fourth. Empirical evidence shows that agricultural mechanization development is a powerful means to promote the efficiency of rural ecological protection and restoration, so we should further promote the development of agricultural mechanization, optimize the structural level of various measures in the development of agricultural mechanization, and strengthen the combined effect of direct impact and indirect impact to vigorously develop ecological conservation and restoration in rural areas.

1. Introduction
The Land and space ecological protection and restoration is a systematic project that comprehensively adopts various ecological projects and technologies to support or help the damaged ecosystem to restore or generally restore its original ecological structure and service functions. With the increasing impact of the economic situation on the global environment, the global ecosystem has been facing a precarious and dangerous situation. [1] It is difficult to restore it to an undamaged state only by its own repair function. Therefore, various ecological projects and technologies are comprehensively adopted. Ecological restoration is indispensable. [2] At present, domestic and foreign scholars have carried out continuous and systematic research on ecological protection and restoration, [3] but the current research mainly focus on the restoration of urban sub-ecosystems, and the importance of rural ecological restoration is obviously insufficient. Compared with cities with faster development in rural areas, [4] due to the cultural level of rural residents, the management perfection of various systems and measures, and the lack of environmental protection ideas, the probability and possibility of their ecosystems being destroyed is much higher than that of cities. [5] At the same time, the distribution of mountain, forest, water and other systems in rural areas is much larger than that in cities, so the situation of ecological protection and restoration in rural areas is much more severe than in
cities. Among the research results of ecological protection and restoration in rural areas, more restoration methods are mostly concentrated in the renovation projects of rural water and soil subsystems, and the research on agricultural mechanization and the support of rural ecological restoration is still blank. [6] Rural ecological restoration is a complex system engineering. The supporting mechanism and promotion relationship of agricultural mechanization are likely to start from the path of its influence on its subsystems. Therefore, the research tries to start with the multiple paths of agricultural mechanization affecting rural ecological restoration. The structural equation model method builds a structural equation model of the interaction between agricultural mechanization and rural ecological restoration, and combines the data of 31 provinces and cities across the country from 2005 to 2017 to verify and measure the theoretical model, and the article then put forward that agricultural mechanization can accelerate the development of rural agricultural economy, and propose effective measures to improve rural ecological protection and restoration of unfavorable situations, so as to promote rural ecological restoration for the current development of agricultural mechanization in China. The sustainable development of the project provides effective empirical suggestions and reference for policy making.

2. Research design

2.1. Research method

Structural equation modeling was a confirmatory path analysis method. First, it was necessary to verify the theoretical structural equation model based on the causal relationship and mechanism model assumed by the theoretical framework, and then combined the sample data to verify the theoretical model, and the theoretical model passed the verification. After that, the model parameters could be evaluated, and the covariance analysis method was used to measure the fit of the model, so as to achieve the purpose of analyzing and measuring the correlation between the dependent variable and the independent variable in the model. The software for subsequent path analysis was Analysis of Moment Structures. [7]

2.2. Model building

The comprehensive evaluation of agricultural mechanization in China could be comprehensively measured using agricultural mechanization power indicators, which could be decomposed into two main aspects: machine farming and machine seeding rate. Ecological protection and restoration were measured by ecological construction and protection investment due to the limitation of data acquisition. The two main aspects of water-logging prevention and soil erosion control were used to measure. The ecological protection and restoration of other rural life aspects were not closely related to agricultural mechanization, so theoretical models were not introduced. Based on the theoretical causal relationship between the above-mentioned total indicators and sub-indices, the theoretical structural equation model was shown in Figure 1.[8]

![Figure 1. The construction of theoretical model.](image-url)
3. Results and analysis
After verifying the theoretical structural equation model with sample data, it was found that the model failed the test. After removing the insignificant path, the final model is shown in Figure 2. The path coefficients between the variables in the final model all pass the hypothesis test. The final model's fitness parameters CMIN/DF=0.425<2, RMSEA= 0.015<0.05, TLI=1.015, NFI=1, and CFI=1 are all very close to 1. It shows that the model fitting effect is good. The model fitting effect is better.

![Figure 2. The construction of tested model.](image)

The analysis shows that the direct impact of ecological construction and protection investment on agricultural mechanization is 1.126, while the direct impact of agricultural mechanization on ecological construction and protection investment is -3.060. The difference is that ecological construction investment has a positive impact on agricultural mechanization. The relationship between agricultural mechanization has a negative impact on ecological construction protection and investment. The results indicate that although the two are related, they are not all positive relations. The rural ecological restoration should be strengthened, and the ecological construction investment should be strengthened. It will also increase, and the effect of agricultural mechanization will be enhanced at this time. Regarding the mechanism of agricultural mechanization on ecological construction investment, it shows that even if agricultural mechanization is strengthened, it will not increase ecological construction investment. It shows that the intensity of agricultural mechanization should be further increased. This will not increase the burden of ecological construction, but on the contrary. Promoting agricultural development is of great benefit. Water-logging removal and water and soil management have a positive direct impact on ecological protection and construction, and the direct impact effects are 2.482 and 1.174. Water-logging removal has a greater contribution to the investment in ecological construction, indicating that the return on investment efficiency of water and soil erosion is better than removal Water-logging, it also shows that under the premise that the total amount of ecological investment in some areas is limited, the proportional structure between the two can be appropriately adjusted according to the contribution rate of the two to ecological investment. In addition, both the mechanical tillage rate and the mechanical seeding rate obviously have a direct impact on agricultural machinery, and the impact of the mechanical seeding rate is relatively higher than that of the mechanical farming rate. At the same time, the mechanical farming rate and mechanical seeding rate have an indirect impact on the investment in ecological protection construction, but their indirect impact is less than their direct impact. The next step can be to optimize the structural level of various measures in the development of agricultural mechanization to strengthen the direct impact and further promote rural ecological protection and restoration.

From the perspective of the degree of impact of multiple variables on ecological protection and construction investment(Table 1), agricultural mechanization has the most significant direct impact on it, with the greatest degree of effect, followed by the area of water-logging removal, soil erosion control ranked third, and mechanical farming rate ranked fourth. Bit. At the same time, the relationship between agricultural mechanization and the investment expenditure of ecological
protection construction exists between the role and the reaction. From the perspective of the standardized path coefficient, the degree of reaction of agricultural mechanization on the investment of ecological construction is slightly higher than the positive effect, which is just a good hint. It shows that the development of agricultural mechanization will not only have a large negative impact on the rural environment, but also greatly benefit the conservation of investment in ecological construction. However, from the perspective of effects, these two aspects undoubtedly have a significant impact on ecological benefits, so we should not pay too much attention to the return on investment like other economic investments, because after all, the evaluation of ecological restoration must be distinguished from other economic benefit evaluations.

Table 1. The List of standardized regression coefficients.

| Variable                                                   | Path coefficient |
|------------------------------------------------------------|------------------|
| Total power of agricultural mechanization                  |                 |
| Ecological construction and protection investment          | -3.060           |
| Ecological construction and protection investment          | 0.165            |
| Total power of agricultural mechanization                  | 0.723            |
| Ecological construction and protection investment          | 0.194            |
| Total power of agricultural mechanization                  | -0.219           |
| Ecological construction and protection investment          | 0.311            |
| Total power of agricultural mechanization                  | -3.060           |
| Ecological construction and protection investment          | 1.126            |
| Machine farming rate                                       | 0.523            |
| Machine sowing rate                                        | 0.723            |
| Water logging prevention area                              | 0.444            |

4. Conclusion and discussion

4.1. Conclusion

The study uses multiple relevant indicator data from 31 provinces and cities in China from 2005 to 2017 to verify and measure the theoretical model of agricultural mechanization and ecological protection and restoration, and the purpose is to achieve a thorough empirical analysis of the two supporting mechanisms. The model analysis verifies the mutual influence of agricultural mechanization on ecological protection and restoration, and provides a policy reform direction for the current development of agricultural mechanization in China to promote rural ecological protection and restoration. Through the above empirical research, it is showed that:

1. The direct effect of ecological construction and protection investment on agricultural mechanization is 1.126, and the direct effect of agricultural mechanization on ecological construction and protection investment is -3.060.

2. From the perspective of the impact of multiple variables on ecological protection and construction investment, the direct impact of agricultural mechanization is the most significant, with the greatest impact, followed by the area of water-logging removal, the third is soil erosion control, and the rate of mechanical farming is in fourth place.
(3) Water-logging removal and water and soil management have a positive direct impact on ecological protection and construction, and the direct impact effects are 2.482 and 1.174. Water-logging removal has a greater contribution to ecological construction investment, which indicates the efficiency of return on investment in soil erosion is better than flood removal.

4.2. Discussion
The current situation of rural ecological protection and restoration is very severe, and the investment is huge but the results are not so ideal. The research has verified the promotion relationship between the two based on the research perspective of agricultural mechanization, which is sufficient to prove that the development of agricultural mechanization is promoting a powerful method for rural ecological protection and restoration to improve efficiency. However, due to the difficulty of collecting rural ecological restoration data, it is inevitable to be biased to measure it completely based on ecological protection and construction investment alone. With the increase in rural ecological restoration, the data system will be further improved. Later, we can collect more complete data to measure the relationship between multiple variables. This is also the direction of the author's future efforts.

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References
[1] Lena, Neuenkamp, Suzanne, et al(2019). Benefits of mycorrhizal inoculation to ecological restoration depend on plant functional type, restoration context and time - ScienceDirect[J]. Fungal Ecology, 40:140-149.
[2] Yang J , Huang Z , Zhang X , et al(2013). THE RAPID RISE OF CROSS-REGIONAL AGRICULTURAL MECHANIZATION SERVICES IN CHINA[J]. American Journal of Agricultural Economics, 2013, 95(5):1245-1251.
[3] Yao, W. , Xu, W. , Wang, J. , Wang, H. , & Jiang, C. . (2020). Research on dynamic monitoring and ecological restoration of mining environment in the source region of the yellow river. E3S Web of Conferences, 194(1), 05006.
[4] Goswami, R. , Bedia, S. , & Pandit, N. . (2020). Restoring employment and rural landscapes can ecological restoration usher rural economic revival in the 'post-pandemic' period?. Economic and Political Weekly, 55(49), 48.
[5] Wang, L. J. , Ma, S. , Qiao, Y. P. , & Zhang, J. C. . (2020). Simulating the impact of future climate change and ecological restoration on trade-offs and synergies of ecosystem services in two ecological shelters and three belts in china. International Journal of Environmental Research and Public Health, 17(21), 7849.
[6] Zhang, Z. , & Ma, X. . (2021). Research on design of the landscape inside mountain torrent basin based on ecological restoration – take the research base in wenling city, zhejiang province as an example. E3S Web of Conferences, 237, 04013.
[7] Jr D J K(2013) . A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)[J]. Long Range Planning, 46(1-2):184-185.
[8] Schmidt K T , Maltz M , Ta P , et al(2020). Identifying Mechanisms for Successful Ecological Restoration with Salvaged Topsoil in Coastal Sage Scrub Communities[J]. Diversity, 2020, 12(4):150.