An analytical study of the degree of barriers to digitalisation and modernisation of agriculture

Xiao Yang
Guilin University of Technology, Guangxi, Guilin, 541004

Abstract: Digitalisation and agricultural modernisation have attracted widespread attention in contemporary agriculture as key factors in promoting agricultural development and efficiency. However, there are still some barriers to the implementation of digitalisation technologies and the promotion of agricultural modernisation. This study aims to provide an in-depth analysis of the barriers to digitalisation and agricultural modernisation in order to improve our understanding of these issues. Through literature review and field research, we identify factors that affect the application of digitalisation in agriculture, including weak technological infrastructure, digital divide, and limited quality of farmers. At the same time, we also explored the problems that may be faced in the process of agricultural modernisation, such as irrational land use and imperfect market systems. On the basis of analysing these obstacles, we propose a series of potential solutions, such as strengthening technological infrastructure, promoting rural digital education, and improving market regulation. By overcoming these barriers, we expect to better promote digitalisation and modernisation of agriculture, contributing to sustainable agricultural development and higher incomes for farmers.

Keywords: Digitalisation; Agricultural Modernisation; Barriers; Barrier Degree Analysis; Technological Infrastructure

1 Introduction.

The rapid development of digital technologies over the last few decades has provided unprecedented opportunities for agriculture. Through technological tools such as smart farm machinery, the Internet of Things (IoT), and big data analytics, farmers can manage their farmland more accurately, monitor the growth of their crops, and fine-tune their agricultural production. At the same time, digitisation also provides new ways to sell and expand markets for agricultural products, increasing income sources for farmers .

However, the advancement of digitalisation and agricultural modernisation has not been smooth. First, technological infrastructure is still weak in some rural areas, which affects the diffusion and application of digital technologies. Second, the existence of digital divide makes it difficult for some farmers to enjoy the convenience of digitisation, which exacerbates the information asymmetry in rural areas. The quality level and digital skills of farmers are also one of the constraints, and they need appropriate training and education to better apply digital technology . In addition, the process of agricultural modernisation may also face problems such as irrational land use and imperfect market system, which further affects the advancement of digitalisation and agricultural modernisation.

Therefore, this study will focus on the analysis of the degree of barriers to digitalisation and agricultural modernisation, and seeks to dig deeper into the impact of these barriers on agricultural development. By identifying and profiling these barriers, we can provide targeted recommendations for policy makers and decision makers to overcome these barriers and promote the joint progress of digitalisation and agricultural modernisation. Meanwhile, this study is also expected to provide new perspectives and ideas for innovation and sustainable development in agriculture .

2 Modelling

The model uses “factor contribution”, “index deviation” and “obstacle degree” to analyse the key factors hindering the development of digitalization and agricultural modernization. The key factors hindering the level of digitalisation and agricultural modernisation development. The factor contribution degree is , represents the influence of the indicator on the overall size, and is replaced by the weight W_j .

$u_j=W_j$ (1)

I_{ij} denotes the indicator deviation between the indicators of modernisation and digitisation of agriculture and the indicators, normalised by 1 minus the extreme deviation. The formula is.

$I_{ij}=1-X'_{ij}$ (2)

O_{ij} indicates the value of the impact of the indicator on the modernisation and digitalisation of agriculture, i.e. the size of the obstacle degree of an indicator, which is used to determine the relationship between the high and low obstacle rankings in digitalisation and modernisation of agriculture, and the obstacle degree is calculated as follows.

$$O_{ij}=\frac{I_{ij}w_j}{\sum_{j=1}^{n}(I_{ij}w_j)} \quad (3)$$

3 Analysis of obstacles

Using the overall degree of obstacles to the modernisation of agriculture across the country for analysis (temporarily disregarding the differences in the geographical location of each province and the differences in the available land resources in each province), the degree of obstacles to each of the selected indicators of modernised agriculture is calculated separately, and the degree of obstacles to the

modernisation of agriculture is ranked in descending order from the largest to the smallest, and then the top 2 are selected as the factors that hinder the development of modernised agriculture.

Table 1 Obstacles to agricultural modernisation indicators

Sort	Indicators of agricultural modernisation	Obstacles %
1	Land output rate	0.359449287
2	Effective irrigation rate of arable land	0.284215336
3	Rural per capita disposable income	0.135076516
4	Level of agricultural mechanisation	0.124238546
5	Yield per hectare	0.062092372
6	Rural Engel's coefficient	0.015433314
7	Intensity of fertiliser use	0.014276485
8	Intensity of pesticide use	0.005218145

The analysis of Table 1 shows that under the premise of the indicators in the table, the key indicator hindering the development of agricultural modernisation is the land output rate, whose obstacle degree is 0.36, which is the highest obstacle degree, indicating that the land output rate greatly hinders the development of agricultural modernisation . Another key indicator hindering the development of agricultural modernisation is the effective irrigation rate of arable land, which has an obstacle degree of 0.28, indicating that the effective irrigation rate of arable land is a greater obstacle to the development of agricultural modernisation.

Using the overall obstacle degree of national digitisation for analysis (temporarily disregarding the differences in the geographical location of each province and the differences in the available land resources of each province), the obstacle degree of each indicator of selected digitisation is calculated separately, and the obstacle degree of digitisation is ranked in descending order from the largest to the smallest, and then the top 2 are selected as the factors impeding the development of digitisation.

Table 2 Barrier degree of digitisation indicators

Sort	Digital Indicators	Obstacles %
1	Express Revenue	0.267259085
2	Number of Internet domain names	0.172651644
3	Total e-commerce transactions	0.170879227
4	Total Telecom Business	0.159075697
5	Length of fibre-optic lines	0.067487208
6	Number of Internet users	0.065647297
7	Number of mobile phone base stations	0.064905768
8	Telephone penetration rate	0.032094074

The analysis in Table 2 shows that with the indicators in the table, the key indicator that hinders digital development is express revenue, which has the highest barrier degree of 0.27, indicating that express revenue greatly hinders digital development. Another key indicator that hinders the development of digitalisation is the number of Internet domain names, which has a barrier degree of 0.17, indicating that the number of Internet domain names greatly hinders the development of digitalization .

4 Conclusion.

First, the lack of technological infrastructure limits the spread of digitisation technologies in rural areas. In some remote areas, the lack of stable network connections and advanced hardware equipment limits farmers' ability to make full use of digital technologies to improve agricultural efficiency.

Second, the digital divide exacerbates the problem of information asymmetry . Some farmers lack digital skills and experience in using digital devices, which prevents them from enjoying the convenience of digitalisation. This leads to unbalanced access to information in rural areas and constrains the spread of digitalisation and agricultural modernisation.

In addition, the lack of farmers' quality and digitalisation skills is also a constraint. The application of digital technology requires a certain level of technical knowledge and operational skills, while the relatively low education level of some farmers makes it difficult for them to adapt to the digital transformation .

In the process of agricultural modernisation, problems such as irrational land use and imperfect market systems also have an impact on digitalisation and agricultural modernisation. Inappropriate planning and utilisation of agricultural land may limit the sustainable development of agriculture, while imperfect market systems may affect the marketing and profitability of agricultural products .

In order to overcome these obstacles, a number of measures need to be taken. Firstly, the technological infrastructure in rural areas should be strengthened to provide stable network connections and advanced digital devices. Second, promote digital education for rural

residents to improve their digital literacy and skill levels . At the same time, improve market regulation and sales channels for agricultural products to promote the healthy development of the market. Most importantly, the government, enterprises and all sectors of society need to work together to form a multi-party co-construction pattern to jointly promote the process of digitalisation and agricultural modernisation.

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