



# Resource basis, ecosystem and growth of grain family farm in China: Based on rough set theory and hierarchical linear model<sup>☆</sup>



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## ABSTRACT

Based on resource-based theory and enterprise ecosystem theory, this paper used the sample of Huang-huai-hai plain 487 grain family farms, in the basis of attribute reduction by rough set theory, introduce the important individual-level and provincial-level factors into hierarchical linear model, in order to reveal different level factors affect growth of grain family farm in structural differences and interaction. The results showed that 65.68% of the differences were caused by individual-level factors, and 34.32% were caused by provincial-level factors. The factors at the individual level, including the improvement of production equipment (*IPE*), education of farmers (*EOF*), regularization of management rules (*RMR*), and difficulty level of getting loans (*DLL*), had positive effects on growth of family farm, whereas the frequency of staff participating in training (*FST*) had a negative effect. At provincial level, improvement of the support policy system (*IDSPS*) could strengthen the positive correlation between *RMR* and growth of family farm. Moreover, the factor *IDSPS* combined with ability of agricultural cooperatives providing social services (*AACPS*) and spacious degree of technology access channel (*SDTAC*) could strengthen the positive correlation between *EOF* and growth of family farm, and reduced the negative correlation between *FST* and dependent variable. The results suggested that government should support farms to improve production equipment and financing pattern, transfer the method of re-education of grain family farmers, promote the standardization of grain family farms, establish a sound policy support system, improve the social service ability of agricultural cooperatives, and broaden the channels of technology acquisition.

## 1. Introduction

Family farms have a variety of functions, such as ensuring food security (Zhou et al., 2015), increasing farmers' income (Vliet et al., 2015), and reducing the gap between urban and rural areas (Mao et al., 2014). In China's No. 1 Central Document in 2013, encouraging and supporting the development of family farm was raised for the first time in national document. Furthermore, in China's No. 1 Central Document in 2016, Chinese government puts forward that family farm is supposed to play a leading role in the application of mechanical, technological achievements and agricultural insurance; exploration of green food; market development and industry convergence.

Family farms originated in Europe and America, and had long history in the United States, Holland, France and other countries.

Scholars have completed lots of theoretical and empirical research on the growth of family farm. Human factors are the primary reason for growth of family farm. Family farm which cannot identify an heir will either disinvest or enter a static management mode (Inwood and Sharp, 2012). Land management scale, land transfer efficiency, family farm financing environment and other physical factors play a key role in the long-term development of the family farm (Amanda, 2011; Fernandes and Woodhouse, 2008). Farmers and scientists participating in the innovation process will be in favor of promoting sustainable development of family farms (Dogliotti et al., 2014). Ecosystem services, technology, market, financing, nature, policy, and cultural environment have subtle effects on growth of family farm (Sandhu et al., 2012). Factors supporting farm growth intentions are the relative changes in farm size in recent years, farm related sunk costs, farm diversification

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and farm size (Huber et al., 2015). In addition, cooperation between family farms will achieve common development (Pérez et al., 2011).

Clear agricultural development ideas, suitable land system, strong technological support, stable legal environment, and impeccable agriculture social service lead to put family farm's support policy into practice, and these are important experiences which agricultural developed country to obtain successes (He et al., 2014). Graeub et al. (2015) argued that every country is supposed to improve support policy for family farm based on its realistic context. There are huge differences in growth stage, land systems, agricultural subsidies, social services and quality of the operators and other aspects between Chinese family farm and agricultural developed countries. Specifically, first, the family farm in China is a new agricultural management practice, and is still in infancy. Second, land in China is owned by the state and China takes household contract responsibility system,<sup>1</sup> so that land use rights belong to each household, showing fragmentation characteristics. For family farm, it is necessary to consult and negotiate with many stakeholders in order to achieve moderate scale management. Third, Chinese agricultural subsidy policy is far from perfect and systematic. The benefit which subsidy policy of good seed, grain and oil, means of agricultural production and so on bring to family farm is little. Fourth, agricultural social services in China are lagging than other countries, such as agricultural technology extension, technology service, extermination of disease and insect pest. That made family farms provide social service by themselves, and not only cost high price but also waste resources. Fifth, most Chinese family farmers have little knowledge of legal, innovation, environmental protection and others, and lack of management skills and professional skills. Therefore, the application of foreign research results in China has yet to be further studied and tested.

In recent years, drawing lessons from foreign research and considering the environment that Chinese family farms operate within, Chinese scholars have conducted a wide range of family farm growth researches. For example, Ling et al. (2015) showed that the growth of family farm is restricted by many factors, such as the nature of the environment, land circulation, agricultural social service system and comprehensive quality of farmers. Among them, human capital can improve agricultural efficiency and family farm's income, which is the fundamental factor affecting growth of family farm (Chen et al., 2014). It is known that the institutional supply lag is an important factor affecting growth of family farm (Guo, 2013). The rural land system is a basic system environment where policy support is a strong backbone, agricultural cultivation and training system is an important propeller, and agricultural social service is an important support (Du and Xiao, 2014). At present, the difficulties that our family farms generally face is the expansion of business scale and the level of improvement, credit financing, social services, support policy coverage and so on (Xu, 2014). We should reform the agricultural land property rights system, cultivate professional farmers, accelerate the development of rural, financial, and insurance industry, improve socialized services, and increase policy support (Yu and Chen, 2016). Most Chinese authors take macro perspective of normative research and qualitative analysis, but lack of empirical study. Research based on micro perspective and combining various methods such as theoretical analysis, empirical research and quantitative analysis are relatively lacking.

In addition, the problems of existing literature are: First, the existing research agree that growth of family farm is restricted by resource basis and ecological environment, and its influence factors not only come from individual level of family farm but also from regional level, the two level factors often interact. However, most existing studies have not

<sup>1</sup> In 1978, the household contract responsibility system was put into practice in China, the land property right was divided into ownership and use right. The ownership still belongs to community, but individual households were allocated land formerly managed communally.

discussed the relationships among different levels of variables and the problems of data structure. Second, most of existing researches were based on qualitative analysis of the variables, which means that the possible influencing factors were introduced into empirical model, and quantitative screening of the influencing factors was ignored.

In fact, the hierarchical linear model is mainly applied to solve the problem of hierarchical data structure and analyze the relationship between different levels of variables. It provides an effective way to explore how different factors affect the growth of family farms (Raudenbush, 1988; Zhang et al., 2016). Currently, hierarchical linear model has gradually been used in fields such as education (Kreft, 1995), psychology (Chen and Wen, 2010), health (Adewale et al., 2007), organization management (David and Mark, 1998), which made convincing conclusions. Rough set theory can identify and evaluate the dependence of data in the premise of keeping key information, and reveal the importance of the condition attribute to the decision attribute, to remove redundant or unimportant condition attributes (Pawlak, 1982). As a powerful tool for attributes reduction, rough set theory attracts the attention of scholars in the whole world. In order to improve the quality and performance of attribute reduction, a large number of improved rough set models are proposed. For example, the combinations between rough set and classification algorithm, clustering algorithm (Gu et al., 2015; Zheng et al., 2015), and combinations between rough set and optimization algorithm (Deng et al., 2012; Deng et al., 2015). This paper attempts to make up for the shortcomings of existing research on growth of family farm by using hierarchical linear model and rough set theory.

Food steady, the world is steady. The growth of grain family farm is a powerful guarantee for China's grain security. In view of this, this paper taken the 487 grain type family farms in Huang-huai-hai plain as examples, applied resource-based theory and enterprise ecosystem theory to structure possible factors affecting the growth of grain family farm, followed by the attribute reduction to remove unimportant factors by rough set theory. Then, the important factors were introduced into hierarchical linear model to reveal the individual and provincial level variables affect growth of grain family farm in structural differences and interaction, so that we can clarify the growth mechanism of family farms, more focus is given on the provide reference of operability family farm support system.

Compared to previous studies, the mainly contributions of this paper are as follows: firstly, enriching international literature of exploring family farm growth in China. Secondly, expanding dimension constitution of resource-based theory. This paper added financial capital resource to explore the influence mechanism about family farm growth. Thirdly, the rough set theory is introduced into the research of family farm growth, which not only ensures the accuracy of the empirical results, but also extends the application of rough set theory. Fourthly, revealing the structural and interactive effects of resource basis and ecosystem on growth of family farm based on organic integration resource-based theory and enterprise ecosystem theory.

## 2. Theoretical framework

Family farm is a special type of family firms (Glover and Reay, 2015). Enterprise growth theory has been applied to explain the growth of family farm (Glover, 2010), so it is applicable to research on growth of family farm. In addition, family farm growth is influenced by the common factors at individual and provincial levels. Resource-based theory and enterprise ecological theory are the theoretical basis for individual level and provincial level, respectively in the paper.

### 2.1. Resource-based theory

Resource-based theory was first proposed by Penrose (1959), who pointed that the internal resources of enterprises are driving force and source of long-term growth; and that material capital resources, human

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