

# An Empirical Research on Farmer Innovation in Agriculture Industrial Clusters

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**Abstract**—This document establishes the model on the factors that influence farmer innovation by using a questionnaire survey and SEM. Results indicate knowledge-sharing in agriculture industrial clusters, farmer's absorptive capacity, knowledge from the newspapers and books and other farmers can significantly improve farmer innovation, knowledge from the customers, suppliers, research institutions and peer not only directly influence absorptive capacity, but also indirect influence farmer innovation through absorptive capacity.

**Keywords**- farmer innovation; knowledge-sharing; agriculture industrial clusters

## I. INTRODUCTION

With the reflection and criticism of the traditional development theory, there is the rise of endogenous development theory and participatory development theory in 1960s. In the late 1980s, in the field of agricultural technology innovation, farmers' participatory research model is developed. This model emphasizes the participation of farmers- the ultimate users of the technology, local knowledge and existing skills of the local residents, and the exploitation of "local resources". Academic circles have made in-depth researches on the issue of farmers' innovation. Such as the Bin Wu suggested that with economic liberalization and globalization, the capital is floating from remote areas to the central area, which makes innovation and organization of the farmers in remote areas more important for the sustainable development of these remote areas. Paul Richards, (1985), Veldhuizen (1998) think the knowledge and creativity of farmers innovators are the important foundation for development. Aid projects of world development organizations and policies of developing country governments promote the development and utilization of indigenous knowledge and innovative. In many parts of our country, especially in the maturely developed agricultural industry cluster, a number of farmer innovations emerge. Farmers improve cultivation technology, cultivate new varieties and establish their own research institutions, showing great surprising innovative ability. This paper conducted questionnaires in the agricultural industry cluster areas to analyze the factors influencing farmer innovation by using structural equation model.

## II. LITERATURE REVIEW AND HYPOTHESIS

### A. Factors Influencing Farmer Innovation

As for the factors affecting farmers' innovation, Ellis (1998) and A.K.Gupta (2000) discussed about the farmer innovation environmental factors. Wu Bin studied the farmer innovation organizational conditions and mechanisms, factors affecting the farmers' innovation, the relationship between organizational form and family's innovative capability, the relationship between the organization mode of the farmers and the information communication network of farmers and the way how farmers use and develop their communication network (FCN) to technological learning and innovative cooperation. According to Bin Wu, farmers innovative communication includes vertical communication (between farmers and external) and horizontal communication (among farmers). When vertical communication is barred, farmers have to rely on their own communication network for knowledge dissemination and sharing. Environment limits the applications of traditional technologies and innovations, which leads to the farmers' self-organizational innovation (FSI). Fetien Abay Mitiku, Haile and Ann Waters Bayer thought that the innovation of poor smallholder farmers will have a more intensive use of the resources than that of the rich farmers due to the environment factor. Based on the case study approach, Ye Jingzhong studies the driving force behind farmer innovative development. Scholars also have analyzed the relationship between knowledge networks and farmers' innovation. A.K.Gupta (2007) believes that it is necessary to strengthen knowledge networks among farmer innovators to inspire more creative efforts to resolve regional problems in a sustainable way.

Many scholars have made a lot of researches on farmer innovation, but these results are not enough for the further study on the factors affecting farmers' innovation capability. This paper used questionnaire and structural equation model to analyze factors affecting farmers' innovation capability.

### B. Model Assumptions

The studies on the relationship between knowledge and innovation have shown that farmer innovation is related to knowledge-sharing behavior (KSB) in rural areas. Rural knowledge-sharing behavior can be formal or informal. Official sharing behaviors include training programs and knowledge sharing promotion technical system. Informal

sharing behaviors are based on the trusts between individuals, which contribute to face-to-face communication and knowledge sharing. Within agriculture clusters, the formal knowledge sharing behaviors mainly include the regular or irregular lectures, training programs by local government and farmers' technical associations. In informal interactive knowledge sharing behavior, the farmers share knowledge through informal group or personal relationship, and such sharing behavior can compensate for the defects of the formal sharing behavior. So, we can assume that:

H1: Positive correlation between the rural knowledge sharing behavior and farmer innovation (FI).

Farmer innovation originates not only from the knowledge sharing behavior of farmers in rural areas but also from the knowledge from the outside world and farmers' absorption capacity (FAC). For example, when farmers associate with customers, suppliers, research institutions and exchanges with their peers (competitors), they may have close ties or form relation networks with them. This will help the knowledge sharing among network members. Farmer absorption ability is of great significance for adopting new technology and learning from the practice of competitors in order to achieve imitative innovation. Thus, this research proposes:

H2: There is a positive correlation between farmer innovation and the knowledge obtained from external agencies;

H3: There is a positive correlation between farmer innovation and the knowledge from peers (competitors);

H4: There is a positive correlation between farmer innovation and the information gained from the outside;

H5: There is a positive correlation between farmer innovation and their absorptive capacity.

Knowledge-sharing in rural areas is mainly affected by knowledge characteristics and sharing wishes. Tacit knowledge can be considered as skills gained through personal experience, it is not easily to be encoded, and difficult to be communicated or used. In contrast, explicit knowledge can be expressed in systematic knowledge and shared in the form of data, scientific formulas, manuals, brochures and other forms. Explicit knowledge can be disseminated and communicated easily. Another feature of knowledge is its degree of decentralization, whether knowledge exists in the individual's thinking, or scattered among the members of "group thinking". Personal knowledge exists in the minds of members, expressed as individual knowledge and personal skills. Shared knowledge refers to the shared and distributing methods and ways in the villages or among farmers' association members. It means the cumulated knowledge in the village or farmer association, it exists in the form of rules, practices and a common code of conduct. The decentralization of knowledge affects the knowledge sharing between members. More centralized knowledge is easier to be shared than more dispersed knowledge. More decentralized the knowledge is, less likely it will become the source of farmers' innovative capability.

Based on the above discussion, we can get the following hypothesis:

H6: There is a negative correlation between tacitness of agriculture knowledge and farmer innovation.

H7: There is a negative correlation between the dispersion of agricultural knowledge and farmer innovation.

According to the definition of knowledge sharing, and analysis of the characteristics of knowledge, we can get the following assumptions:

H8: There is a negative correlation between the implicit of knowledge and rural knowledge sharing behavior;

H9: There is a negative correlation between the dispersivity of knowledge and rural knowledge sharing behavior.

The greater the benefits of knowledge sharing, individuals will be more willing to share their personal knowledge. Studies have shown that the existence of appropriate incentive factors will make knowledge sharing more effective. If there is no strong personal motivation and suitable environment, it will be impossible to share knowledge. For individuals, if he can improve his knowledge and skills from the knowledge sharing, or solve the problems encountered at work through the sharing of knowledge, he will want to share knowledge with other members. Studies have shown that in firm's knowledge sharing, if the knowledge is more valuable, the holder will be more reluctant to share. But this conclusion does not apply to the rural communities, because the presence of kin and affection, the more valuable the knowledge is, the higher the level of sharing. Therefore, we can draw the following assumptions:

H10: There is a positive correlation between knowledge-sharing benefits and rural knowledge sharing behavior;

H11: There is a positive correlation between the value of knowledge owned by individuals and rural knowledge-sharing behavior.

The learner of the knowledge must acquire the knowledge with certain purpose, and integrate the existing knowledge with the learnt knowledge to exploit the new knowledge. However, for individuals, the understanding of the same knowledge takes the same amount of time and energy. The scale of the use of knowledge is undoubtedly closely related to the absorptive capacity of the learner. The absorptive capacity has two important parts: the prior knowledge and the degree of efforts. Prior knowledge is an important platform for learning, because the existing knowledge affects the increase of new knowledge in the future. If part of prior knowledge is connected with new knowledge, it can promote the absorption of new knowledge. The degree of effort refers to the investment of efforts in the application of absorptive capacity. If the effort is just external or only internal, both of these are not enough. There is a correlation between farmers' absorptive capacity and knowledge from the external environment. Therefore, we can draw additional assumptions as follows:

H12: There is a positive correlation between farmer absorptive capacity and knowledge obtained by farmers from outside agencies;

H13: There is a positive correlation between farmers' absorptive capacity and knowledge obtained from competitors.

### III. QUESTIONNAIRE DESIGN AND DATA DESCRIPTION

#### A. The design of the Questionnaire

Farmer innovation has its own special features. Compared with enterprises' innovation, farmer innovation is less formal and has spontaneous feature. Farmer innovation is smaller in scale; farmer innovation is based on the indigenous knowledge, while enterprise innovation is based on the scientific knowledge. The measurement for farmer innovation is different from that for enterprises' innovation. Farmers' innovation is measured from the individual point of view. Five indicators are selected to measure farmer innovation; nine indicators about the factor affecting farmer innovation are selected. Totally 27 items are used. All the items in this research are measured in Likert5 points scale. Then this paper analyzed the reliability and validity of these items and has exploratory and confirmatory factor analysis (analysis results omitted).

#### B. Survey Area Selection

In our country, farmer innovation shows unbalanced in region, in some regions farmer innovation is quite active, while in other regions there is very few innovation activities. In order to make the data collection more easily, we choose the area of agricultural industry clusters to conduct survey. And due to the time and budget restraints, we limit our survey in the vegetable industry cluster of Shouguang in Shandong province and the flower industry cluster of Qingzhou in Shandong province. The subjects of the investigation are those planting-skilled farmers. The survey is mainly carried in following ways: first, we recruited some university students as investigators and conducted some training program. Those investigators can do the research when they go home on holiday. The other way is to mail the questionnaire or through the introduction of friends and send the investigating team to carry the survey directly. 400 questionnaires are sent out, 200 of them for Shouguang and 200 for Qingzhou. We reclaimed 180 questionnaires from Shouguang, the reclaiming rate is 90%. After eliminating the incomplete questionnaires, we got 170 questionnaires finally. We reclaimed 150 questionnaires from Qingzhou, the reclaiming rate is 75%. After eliminating the incompletely answered questionnaires, we got 130 effective questionnaires finally. The sum of the effective questionnaires is 300.

### IV. RESULTS AND STRUCTURAL EQUATION MODEL

#### A. Structural Equation Model

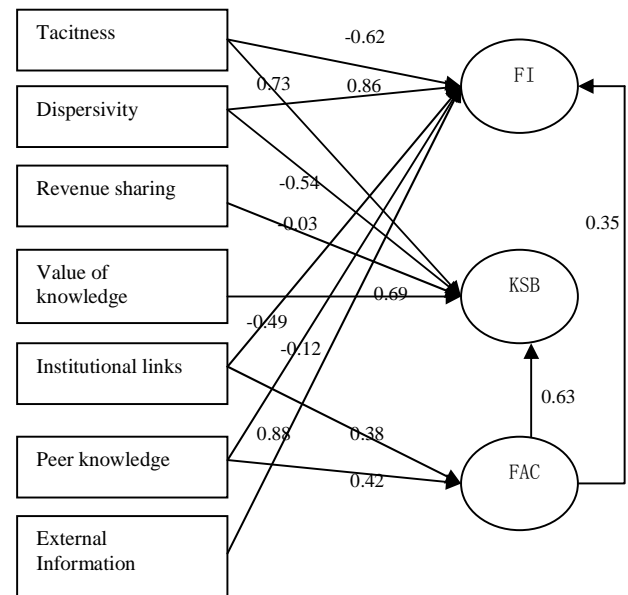
According to the above analysis, we can design a comprehensive empirical model, which includes 3 endogenous latent variables of the "shared behavior", the "absorptive capacity" and "innovative capacity", and seven exogenous latent variables: the "tacitness", "dispersion", "revenue sharing", "knowledge value", "institutional linkages", "peer knowledge" and "external information". Additional 17 exogenous observed variables are corresponding to their correspondent latent variables. The relationship between the endogenous latent variable is as follows: "sharing behavior" and "absorption capacity" have direct impact on "innovative capability"; exogenous latent variables as "tacitness", "dispersion",

"institutional linkages" and "peer knowledge" not only have direct impact on the "innovative capability", but also have indirect effect on "innovative capability" through "shared behavior" and "absorption capacity". Finally, the "sharing behavior" is influenced by 4 exogenous latent variables like the "tacitness", the "decentralization", "revenue sharing" and "knowledge value". We use Lisrel8.70 to analyzed structural equation model of the 32 observed variables and 10 latent variables, and we get parameter estimation results and goodness of fit index of the model, seen in the following path diagram of the structural equation model (Figure 1).

#### B. The Results

The model results show that the parameters of the structural model of factors affecting farmers' innovative capacity do not violate estimation. It can be seen from the goodness of fit index in Figure 1,  $\chi^2 / df < 3$ , RMSEA is 0.059, so the model and the data have a "good fit".

It can be seen from Figure 1 and Table 2 that standardized total effect of variables like "shared behavior" and "absorption capacity" to "innovative capacity" is 0.63 and 0.35, respectively, the corresponding t-values (1.76 and 2.86, respectively) to learn clearly that the positive correlation between these two sets of variables is in the level of 0.1 and 0.01 undoubtedly. This shows that the rural knowledge sharing and the absorptive capacity of farmers are important factors affecting the local technological innovative ability and verifies the assumptions H1 and H5.



Chi-Square=881.10, df=430, RMSEA=0.059, P-value=0.00000

FIGURE 1. THE STRUCTURAL EQUATION MODEL OF FACTORS AFFECTING FARMER INNOVATION.

In knowledge acquisition, the total effect of institutional linkages and peers on farmers' innovative capability is negative but not significant. This shows that the knowledge acquired by farmers from the institutions and peer do not significantly improve farmer innovation. One possible reason that farmers do not translate the knowledge acquired from the institutions into the ability is the lack of adequate information exchange and communication between agencies and farmers. While the reason that knowledge obtaining from peers do not significantly improve farmer innovation is the approximation of skills and technology of farmers and their peers. So assumption H2 and H3 could not be verified. In addition, the total effect of external information on the innovative capacity is always positive and significant at the 0.05 level, so assumption H4 gets verified. This shows that the information from newspapers, magazines and other farmers can significantly improve farmers' innovative capability. Therefore we can improve farmers' innovative capability through the books and magazines to spread technology knowledge.

The effect of tacitness of knowledge on farmers' innovation is negative and the effect of the dispersivity of knowledge on farmer innovation is positive, but these effects are not significant. Both the direct effects of the tacitness and dispersivity of knowledge on farmer innovation have been indirectly neutralized by the effect of knowledge sharing. Assumption H6 and H7 could not be verified.

TABLE I. PATH COEFFICIENT AND HYPOTHESIS

Hypothesis	Path Coefficient	T	Results
H1	0.63	1.76*	Supported
H2	-0.49	-1.12	not significant, unsupported
H3	-0.12	-0.77	not significant, unsupported
H4	0.88	1.97**	Supported
H5	0.35	2.86***	Supported
H6	-0.62	0.12	not significant, unsupported
H7	0.86	1.17	not significant, unsupported
H8	0.73	0.90	not significant, unsupported
H9	-0.54	-1.64*	Supported
H10	-0.03	-1.21	not significant, unsupported
H11	0.69	2.53**	supported
H12	0.38	4.08***	Supported
H13	0.42	3.96***	Supported

Notice: \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

The impact of tacitness of knowledge on sharing behavior is positive, but t-test is not significant, so H8 could not be verified. The effect of the dispersivity of knowledge on sharing behavior is negative, and is significant at the 0.1 level, which confirms the hypothesis H9.

The effect of revenue on sharing behavior is negative, but the t-test was not significant. So assumption H10 could not be verified.

This may be because the measure of sharing behavior mainly from the official sharing behavior of government building knowledge-sharing facilities. In the survey design, the informal sharing index were deleted because they will influence the questionnaire reliability in the exploratory factor analysis. The correlation between revenue sharing and government knowledge sharing facilities are not significant. What's more, in this study, there is a significant positive correlation between the knowledge value and sharing behavior, which verified the assumption the H11. As for farmers' access to knowledge, the institutional linkage and the effect of peer knowledge on farmers' absorptive ability is significant at 0.01 level, which verifies the assumption the H12 and H13.

## V. CONCLUSIONS

In summary, rural knowledge sharing and farmers' absorptive capacity have significant direct effect on farmer innovation; the information obtained from books, newspapers can greatly improve farmer innovation.

Knowledge coming from customers, suppliers, research institutions and peers do not only have significant direct impact on the absorptive capacity of farmers, but also have indirect effect on the farmers' ability through the effect of the absorptive capacity.

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