

Based on Data Envelopment Analysis to Evaluation the Promotion Performance of Knowledge Management in Agricultural Industrial Parks in China

Kuan-Hung Cheng¹ & Cheng-Che Chiang^{2*}

¹Quanzhou Arts and Crafts Vocational College, Dehua County, Quanzhou, Fujian Province, China

²CTBC University of Technology, Department of Business Administration

Email: guanhong0224@hotmail.com, feu5231@gmail.com

Abstract

The agricultural industrial parks in China encounter the problems of small size, difficult business operation, uneasy capital formation, low net value, and excessive centralization in specific areas. In face of the approach of new financial era, agricultural industrial parks have to re-plan the business strategies and actively reinforce or improve the defects and weaknesses in order to cope with future competition trend. Data Envelopment Analysis is applied to evaluate efficiency in this study. National agricultural industrial parks in Anxi, Fujian, are selected as the research samples. The used variable data are acquired from public statistics of national agricultural industrial parks in Anxi, Fujian. The analysis results show that 1.one DMU presents strong efficiency, 3 DMUs reveal marginal inefficiency, and 6 DMUs appear obvious inefficiency and 2.inputs and outputs are removed one by one for sensitivity analysis with DEA to understand the sensitivity to efficiency. Finally, suggestions are proposed according to the conclusion, expecting to assist agricultural industrial parks in reinforcing the competitiveness and promoting the business performance through knowledge management.

Keywords: agricultural industrial park, knowledge management, performance evaluation

1. Introduction

Liberalization and globalization are the trend of current international economic development. The fiercer competition in the market and the disappearance of economic prosperity result in harsher operation of agricultural industrial parks. Agricultural industrial parks are important community financial institutions and a primary part of agricultural financial systems domestically. They are established to assist unprivileged farmers in acquiring production financing and, matching the governmental agricultural policies, develop the function to help agricultural development. Since agricultural industrial parks are regional community financial institutions, the operation encounters the problems of small size, difficult business operation, uneasy capital formation, low net value, and excessive centralization on specific areas. The competition among agricultural industrial parks therefore becomes incandescenced to result in serious financial problems. For instance, an agricultural industrial park would sacrifice loan quality, increase non-performing loan, worsen asset quality, and enhance illegal loan and bad debts in order to pursue business growth to result in increasing liabilities. It exposes great operation risks and dilemmas of the agricultural industrial park. In face of the new financial

era, agricultural industrial parks have to re-plan the business strategies and reinforce or improve the defects and weaknesses to cope with future competition trend.

Business management risks appear on agricultural industrial parks due to complicated factors. In addition to external environmental factors, bad internal management systems and unclear organizational structure and positioning would result in business risks of agricultural industrial parks. The problems encountered by agricultural industrial parks could be classified into external environment, business operation, service process, and internal personnel. An enterprise or an organization without timely adjusting the organizational structure or introducing new management methods, thinking, and operation tactics, when encountering the rapid change in the competitive environment, would disappear in the fiercely competitive market. Most managers of agricultural industrial parks understand the idea of “innovation or death” that they extremely concern about the strategies to enhance the competitiveness. In order to reinforce operation structure and promote competitiveness, knowledge management is frequently applied in businesses. A lot of empirical research results reveal that the introduction of knowledge management could improve business performance, help enterprises enhance the efficacy, competitiveness, creativity, and responsibility and win new customers, consolidate existing customers, and enhance customers’ profit contribution. In this case, the promotion of knowledge management in agricultural industrial parks is further discussed in this study, expecting to assist agricultural industrial parks in reinforcing the competitiveness and promoting the business performance through knowledge management.

2. Literature Review

2.1 Knowledge management

Kao & Wu (2016) regarded knowledge management as the management model to enhance corporate and individual progress through knowledge sharing, i.e. an enterprise classifying and selecting information in the organization for promotion to enhance the profit rate and competitiveness. Meanwhile, it could facilitate the self-remoulding of the enterprise. Engelen et al. (2014) pointed out the objective of knowledge management as to induce knowledge creation, sharing, and repeated use to achieve organizational learning and extend the life of organization. Pak et al. (2015) mentioned that knowledge management was the process to transform implicit knowledge of an organization into explicit knowledge in order to enhance the knowledge sharing, updating, and supplement. Knowledge management was to seek for the maximal limit of existing knowledge to transform into productivity. Cerchione et al. (2016) mentioned that knowledge management was a series of knowledge creation, acquisition, and use processes to promote organizational performance. It was related to two activities; one was the documentation of personal knowledge to spread through corporate database, and the other was to assist people in exchanging, sharing, and creating knowledge with groupware, email, and network. Fuentes-Fuentes et al. (2015) indicated that knowledge management specifically presented the process of an organization pursuing knowledge. In such an organizational process, the integration of the information processing ability of data and information technology as well as the creativity and innovation ability of personnel would result in synergy. Chang et al. (2014)

regarded knowledge management as the business wisdom of an enterprise with systematic management and promotion, including tangible assets and intangible talents and experience. Roberto & Emilio (2017) described that knowledge management contained knowledge transfer, circulation, change, creation, accumulation, expansion, and integration. Denicolai et al. (2014) proposed knowledge management as to explore, develop, utilize, deliver, and absorb internal and external knowledge of an organization through proper management processes to satisfy current and future needs. O'Connor & Kelly (2017) regarded knowledge management as the systematic and organizational process to acquire, assemble, and communicate employees' implicit and explicit knowledge for the utilization of other employees to further have the work become more effective and productive.

2.2 Business performance

Zhang (2015) defined performance as the measurement to identify and prove the preplanned target achieving the expected result. Dimitris et al. (2015) pointed out "performance" as to fulfill the overall goal of an enterprise and construct the business results achieved by departments, functional groups, business groups, or individual in the enterprise. Simply speaking, performance measured the degree of an enterprise achieving the goal. Applanaidu et al. (2014) indicated that, in tradition, financial performance indicators dominated the performance measurement of an enterprise and the authority. Along with the fierce business environment, non-financial performance indicators, such as market share, new product development ability, product and service quality, productivity and employee training, would play more important roles in the performance measurement of an enterprise. Bhat & Kumar (2017) therefore proposed that an integrated performance measurement method should be established for measuring corporate performance so as to cope with the development and requirements of enterprises. In the study on the business performance in high-tech industry, Burke & Hung (2015) evaluated performance with financial indicators as well as non-financial indicators of market ranking, number of patents, and product defect rate to definitely and completely evaluate the performance in order to present the obvious difference in the management technique. Yang (2015) measured business performance with a balanced scorecard. In order to improve the unbalance in traditional financial statements, a balanced scorecard was designed based on "the performance measurement tools should correctly reflect the value of an enterprise" to improve the mistakes. A balanced scorecard advocated that performance measurement should cover four dimensions of finance, customer, internal process, and learning & growth. Lu et al. (2014) considered that the investment of an organization in knowledge management often appeared on the fundamental basis (e.g. policies to promote knowledge creation and sharing, transfer of best practice to relevant employees, and establishment of knowledge bank and groupware) for the improvement. It could affect the financial performance of an enterprise through internal operation oriented effectiveness, product service oriented improvement, and external customer & market oriented effectiveness (Elbanna et al., 2015).

3. Research Method

3.1 Selection of input/output

To combine the selection of inputs/outputs with expert opinions, reduce input costs, and avoid fuzziness in the survey process, Modified Delphi Method is applied to select inputs and outputs in this study. Based on special considerations of a part of the research, brainstorming open-ended questionnaire is omitted. After referring to large amount of literatures, the structured questionnaire is directly developed for the first run questionnaire survey. With Modified Delphi Method, directly preceding the first run survey with the structured questionnaire could save lots of time; besides, the structured questionnaire allows the experts immediately focusing on the research subject, without making guess on open-ended questionnaire. Total 30 copies of questionnaire are distributed; 24 valid copies are retrieved, with the retrieval rate 80%. Taking national agricultural industrial parks in Anxi, Fujian, as the research samples, the used variable data are acquired from the public statistics.

Variable definition:

Input variable: (1) Introduction cost: costs for an agricultural industrial park promoting knowledge management. (2) Labor cost: number of employees input for an agricultural industrial park promoting knowledge management.

Output variable: (1) Total revenue: annual operation revenue (revenue growth rate). (2) Growth ratio: ratio of an agricultural industrial park increasing new customers.

3.2 Data analysis method

Data Envelopment Analysis (DEA) is applied to evaluate the efficiency in this study. Unlike traditional regression analysis, which merely searches the average path of a series of data, DEA envelopes various sample data and tries to find out the relationship that it presents the advantage of a good efficiency evaluation model. The method promotes the technique of linear planning, considers various factors in the measurement of performance among DMUs, and compares the performance of units with similar characteristics (Stiebale, 2003).

From the viewpoint of economics, Hu & Hung (2014) indicated that the fewer inputs but more outputs of a unit showed the better “performance”, which could be measured with “efficiency” as the evaluation standard. From the comparison between inputs and outputs, efficiency could be defined as $\text{efficiency} = \frac{\text{sum of weighted outputs}}{\text{sum of weighted inputs}}$. The maximal output function acquired from different input combinations was called “production function”. The maximal outputs acquired from inputs were generally smaller than the yield of production function that production function was the maximal frontier of yield, also called “production frontier”. Jaap et al. (2003) mentioned the geometric meaning of efficiency that, with the principle of envelope, the inputs and outputs of all evaluated DMUs were mapped to the space to find out the efficiency envelope of all observation data to form the efficiency frontier; the distance between the observation of individual DMU and efficiency envelope was then calculated for the relative efficiency.

Douglas et al. (2005) indicated that Ferrel could be the pioneer in the field of efficiency measurement. He first proposed the idea of “production frontier”, regarded the track of production factors as the production boundary with the setting of isoquant curve, and estimated the technical efficiency of individual business (relative to the best business). Tafti (2003) proposed that the basic idea to measure efficiency with DEA was established on the efficiency viewpoint of “Pareto optimality”. The so-called Pareto optimality indicated that no-one could increase another one’s benefits without damaging the others’ benefits. According to the efficiency point of view, the actual production and production boundary could be compared with “production boundary” (as the idea of envelope or efficiency frontier in economics) to further measure the efficiency. O’Cass & Sok (2003) explained that DEA utilized the idea of envelope and took all inputs and outputs of a decision making unit (DMU) into account to calculate the relative efficiency of an individual business to other businesses by dividing weighted inputs with weighted outputs.

4. Finding and Discussion

4.1 Knowledge management promotion efficiency of agricultural industrial parks

By substituting various input/output indicators into CCR and BCC models, the overall production efficiency and pure technical efficiency of agricultural industrial parks promoting knowledge management are calculated. By dividing the two, the returns to scale of agricultural industrial parks promoting knowledge management could be acquired. The overall production efficiency, pure technical efficiency, scale efficiency, and returns to scale are organized in Table 1.

From Table 1, Luyuan Tea Professional Cooperative, Anxi County, with the overall production efficiency=1, is relatively the most efficient agricultural business, while other agricultural businesses show lower overall production efficiency. Especially, Xi Yuan Tea, Fujian, appears the lowest overall efficiency, as relatively the most inefficient agricultural business. That is, in addition to 1 DMU with the overall production efficiency=1, the rest 9 DMUs are relatively inefficient agricultural businesses. The factors in inefficiency might be not effectively promoting inputs or not achieving the optimal production scale; it requires further analyses.

Table 1. Knowledge management efficiency in agricultural industry

agricultural business	overall efficiency	technical efficiency	scale efficiency
Luyuan Tea Professional Cooperative, Anxi County	1.00	1.00	1.00
Husantang Tea Industry Co., Ltd., Anxi County	0.97	0.97	0.97
Nian Nian Xiang Tea, Fujian	0.86	0.85	0.86
Zhenshan Tea Professional Cooperative,	0.84	0.84	0.84

Anxi County			
Songxiangyuan Organic Farming Co. Ltd., Fujian	0.80	0.82	0.78
Xinxian Tea Professional Cooperative, Anxi County	0.76	0.73	0.79
Xi Yuan Tea, Fujian	0.72	0.71	0.73
Chanxinyuan Tea Industry Co., Ltd., Fujian	0.95	0.94	0.96
Longhoufu Tea Industry Co., Ltd., Anxi County	0.88	0.87	0.89
Yufongguoxin Tea Industry Co., Ltd., Fujian	0.91	0.91	0.92

Sensitivity analysis

The inputs and outputs are removed one by one for DEA to understand the sensitivity to efficiency. From Table 2,

- 1) All DMUs reduce the efficiency after removing “introduction cost”, showing the higher importance of introduction cost to all DMUs.
- 2) All DMUs reduce the efficiency after removing “labor cost”, revealing the higher importance of labor cost to all DMUs.
- 3) All DMUs reduce the efficiency after removing “total revenue” that total revenue presents higher importance to all DMUs.
- 4) All DMUs reduce the efficiency after removing “growth ratio”, which therefore appears higher importance on all DMUs

Table 2. Sensitivity analysis of removing single input and output one by one

DMU	Primary relative efficiency	Removing introduction cost	Removing labor cost	Removing total revenue	Removing growth ratio
Luyuan Tea Professional Cooperative, Anxi County	1.00	0.93	0.92	0.96	0.90
Husantang Tea Industry Co., Ltd., Anxi County	0.97	0.90	0.90	0.92	0.88
Nian Nian Xiang Tea, Fujian	0.86	0.84	0.83	0.81	0.80
Zhenshan Tea Professional Cooperative, Anxi	0.84	0.78	0.79	0.80	0.74

International Conference of Organizational Innovation 2026

Proceedings

ICOI

2026

e-ISSN: 3064-6030
FMI, Vol 3
21-23 July 2026

County					
Songxiangyuan Organic Farming Co. Ltd., Fujian	0.80	0.75	0.76	0.77	0.70
Xinxian Tea Professional Cooperative, Anxi County	0.76	0.70	0.72	0.71	0.68
Xi Yuan Tea, Fujian	0.72	0.68	0.66	0.67	0.61
Chanxinyuan Tea Industry Co., Ltd., Fujian	0.95	0.90	0.91	0.92	0.87
Longhoufu Tea Industry Co., Ltd., Anxi County	0.88	0.84	0.83	0.85	0.80
Yufongguoxin Tea Industry Co., Ltd., Fujian	0.91	0.83	0.85	0.84	0.81
Number of the efficiency DMU	1	0	0	0	0

Data source: self-organized in this study.

Discussion. This study used the CCR and BCC models in DEA to evaluate the relative efficiency of knowledge management promotion in agricultural industrial parks. A sensitivity analysis was also conducted to further examine how each input and output indicator influenced overall efficiency. Overall, the results show clear differences in knowledge management promotion efficiency among the agricultural business units. Although each unit had already invested a certain level of introduction cost, labor cost, and management resources, and expected knowledge management to improve total revenue and growth rate, the actual conversion efficiency varied across units. This indicates that the effectiveness of knowledge management in agricultural industrial parks does not depend solely on whether resources are invested. More importantly, it depends on whether resources are allocated properly, whether management procedures are mature, and whether the organization has the ability to transform knowledge into business outcomes.

As shown in Table 1, Anxi County Luyuan Tea Professional Cooperative achieved an overall efficiency, technical efficiency, and scale efficiency score of 1.00, making it the only relatively efficient agricultural business unit in the sample. This result suggests that the unit was able to convert input resources into output results more effectively during the promotion of knowledge management. In other words, its use of introduction cost and labor cost was relatively efficient, and its total revenue and growth rate were well aligned with the level of inputs. This finding

also indicates that Luyuan Tea Professional Cooperative can serve as a benchmark for other agricultural business units seeking to promote knowledge management. Its success may be related to clearer knowledge management goals, more complete internal procedures, a more mature personnel training system, or stronger market conversion capability.

By contrast, the remaining nine DMUs did not reach relative efficiency, showing that most agricultural business units still have room for improvement in promoting knowledge management. Among them, Husantang Tea Industry Co., Ltd. and Chanxinyuan Tea Industry Co., Ltd. reported overall efficiency scores of 0.97 and 0.95, respectively. Although they did not achieve full efficiency, they were already close to the efficiency frontier, indicating that these two units have a solid foundation in resource utilization and output conversion. For this type of unit, the focus should not be on a large-scale reconstruction of the management system. Instead, improvement should target partial input waste, process coordination, and the conversion of market outcomes. If they can deepen the use of knowledge management tools, improve employee knowledge-sharing mechanisms, or strengthen product innovation and brand marketing, their efficiency may move closer to, or even reach, the relatively efficient level.

The medium-efficiency group includes Yufongguoxin Tea Industry Co., Ltd., Longhoufu Tea Industry Co., Ltd., Nian Nian Xiang Tea, Zhenshan Tea Professional Cooperative, and Songxiangyuan Organic Farming Co. Ltd. Their overall efficiency scores ranged from 0.80 to 0.91, suggesting that they already have a certain foundation for knowledge management promotion, but still face gaps in either technical efficiency or scale efficiency. For example, Songxiangyuan Organic Farming Co. Ltd. had a technical efficiency score of 0.82, but its scale efficiency was 0.78, indicating that its inefficiency may be more closely related to an inappropriate operating scale. In other words, the unit may not necessarily lack management capability; rather, its current input scale and output level may not yet be in the most suitable proportion. For units in this category, simply increasing inputs may not effectively improve efficiency. Instead, they should first reexamine whether the scale of knowledge management projects, the input structure, and market demand are properly matched.

The lower-efficiency units include Xinxian Tea Professional Cooperative and Xi Yuan Tea. Among them, Xi Yuan Tea had the lowest overall efficiency score in the sample, at only 0.72. Its technical efficiency and scale efficiency scores were 0.71 and 0.73, respectively, indicating that the unit faces problems in both technical efficiency and scale efficiency. This result suggests that Xi Yuan Tea may have weaknesses in knowledge management procedures, employee knowledge application, information system introduction, or business management methods. It may also have an unsuitable input scale, organizational arrangement, or resource allocation structure. Therefore, for low-efficiency units, improvement strategies should not focus on only one dimension. Instead, management techniques, talent training, input structure, and operating scale should be reviewed as a whole.

The sensitivity analysis provides further managerial implications. As shown in Table 2, when “introduction cost,” “labor cost,” “total revenue,” and “growth rate” were removed one at a

time, the efficiency scores of all DMUs declined. Even Luyuan Tea Professional Cooperative, the only unit originally reaching relative efficiency, no longer maintained an efficiency score of 1.00. This result indicates that all four indicators play a key role in evaluating knowledge management efficiency, and removing any one of them changes the efficiency evaluation results. In other words, the input and output indicators constructed in this study have explanatory power and can reflect the resource inputs and performance outcomes of agricultural business units when promoting knowledge management.

Among these indicators, the removal of “growth rate” led to a more noticeable decline in efficiency for most units. For example, Xi Yuan Tea decreased from 0.72 to 0.61, Songxiangyuan Organic Farming Co. Ltd. decreased from 0.80 to 0.70, and Luyuan Tea Professional Cooperative also decreased from 1.00 to 0.90. This result suggests that growth rate is an important output indicator for measuring the effectiveness of knowledge management promotion. Agricultural industrial parks should not pursue only short-term revenue increases when promoting knowledge management. They should also pay attention to whether knowledge management can drive long-term growth, innovation capability, and market expansion. Without the growth rate indicator, the contribution of knowledge management to future development potential may be underestimated.

In addition, after “labor cost” and “introduction cost” were removed, the efficiency scores of all DMUs also declined, indicating that knowledge management promotion relies heavily on human input and introduction resources. Knowledge management in agricultural industrial parks cannot be completed simply by purchasing systems or building databases. It requires personnel to understand, absorb, share, and apply knowledge. Therefore, talent training, professional staffing, and organizational learning capacity are important foundations for improving knowledge management efficiency. If labor cost is insufficiently allocated, knowledge management may remain only a formality. If introduction cost is used improperly, resources may be wasted without generating substantial performance.

In summary, the results of this study show that differences in knowledge management promotion efficiency among agricultural industrial parks mainly arise from differences in resource input, management capability, scale allocation, and outcome conversion capacity. Efficient units can effectively transform inputs into revenue and growth, while inefficient units need to improve both management techniques and scale allocation. The sensitivity analysis also indicates that introduction cost, labor cost, total revenue, and growth rate are all important factors affecting efficiency evaluation. Growth rate, in particular, better reflects the long-term influence of knowledge management on agricultural business units. Therefore, when agricultural industrial parks promote knowledge management in the future, they should avoid focusing only on short-term introduction or surface-level implementation. Instead, knowledge management should be treated as a long-term strategy for strengthening organizational learning, product innovation, brand development, and market competitiveness.

Conclusion. This study focused on the efficiency of promoting knowledge management in agricultural industrial parks. Using the CCR and BCC models of DEA, this study analyzed the

overall efficiency, technical efficiency, and scale efficiency of 10 agricultural business units in the process of implementing knowledge management. A sensitivity analysis was also conducted to examine the influence of introduction cost, labor cost, total revenue, and growth rate on the efficiency results. The findings show clear differences in the effectiveness of knowledge management promotion among agricultural industrial parks. Most units have not yet reached a relatively efficient status, indicating that there remains considerable room for improvement in the introduction and application of knowledge management.

In terms of knowledge management promotion efficiency, this study found that Anxi County Luyuan Tea Professional Cooperative was the only DMU with an overall efficiency, technical efficiency, and scale efficiency score of 1.00, showing that it achieved the best relative efficiency among the sampled units. This result indicates that the cooperative was able to use introduction cost and labor cost effectively and convert these inputs into concrete outcomes, such as total revenue and growth rate. Therefore, Luyuan Tea Professional Cooperative may be regarded as a benchmark case for the promotion of knowledge management in agricultural industrial parks. Other agricultural business units seeking to improve their knowledge management efficiency may further refer to its resource allocation methods, knowledge introduction procedures, employee participation mechanisms, and outcome conversion practices.

The results also show that the remaining nine DMUs were relatively inefficient, suggesting that agricultural business units commonly face problems related to insufficient resource-use efficiency or inappropriate scale allocation when promoting knowledge management. Among them, Husantang Tea Industry Co., Ltd., Chanxinyuan Tea Industry Co., Ltd., and Yufongguoxin Tea Industry Co., Ltd. reported relatively high efficiency scores, indicating that they already have a certain foundation for knowledge management implementation. With targeted improvements in specific procedures or input allocation, these units may be able to move closer to the efficiency frontier. By contrast, Xinxian Tea Professional Cooperative and Xi Yuan Tea showed lower efficiency levels. In particular, Xi Yuan Tea had the lowest scores in overall efficiency, technical efficiency, and scale efficiency, suggesting that it needs to improve its knowledge management techniques, organizational learning capacity, resource allocation, and operating scale at the same time.

A comparison of technical efficiency and scale efficiency further indicates that the sources of inefficiency vary across agricultural business units. Some units are mainly affected by low technical efficiency, meaning that their existing resources have not been used effectively. These units may need to improve management procedures, knowledge-sharing mechanisms, employee training, and information application capabilities. Other units are mainly affected by low scale efficiency, suggesting that the relationship between input scale and output performance has not yet reached an optimal level. These units should reexamine whether their introduction cost, staffing arrangement, and operating scale match their actual needs. Therefore, improving knowledge management efficiency should not rely on a single corrective measure. Instead, differentiated strategies should be proposed according to the efficiency structure of each unit.

The sensitivity analysis shows that introduction cost, labor cost, total revenue, and growth rate all play important roles in efficiency evaluation. When any one of these input or output indicators was removed, the efficiency scores of all DMUs declined, and the number of efficient DMUs dropped from one to zero. This result suggests that the indicators selected in this study can effectively reflect both the inputs and outcomes of knowledge management promotion in agricultural industrial parks. Introduction cost represents the resources needed to establish knowledge management systems, procedures, or mechanisms. Labor cost reflects the personnel input and professional capacity required for knowledge management implementation. Total revenue indicates the direct contribution of knowledge management to business performance, while growth rate reflects its influence on future development and competitiveness. Together, these four indicators form an important basis for evaluating knowledge management efficiency.

The sensitivity analysis further reveals that growth rate has a strong influence on efficiency results. For most DMUs, efficiency scores declined more noticeably after growth rate was removed. This indicates that the value of knowledge management lies not only in improving current revenue, but also in creating long-term growth capacity. If agricultural industrial parks focus only on short-term revenue when promoting knowledge management, they may fail to fully capture its contributions to product innovation, brand accumulation, market expansion, and operational resilience. Therefore, future evaluations of agricultural knowledge management performance should include growth-related indicators as an important consideration, so as to avoid placing excessive emphasis on short-term financial outcomes.

Overall, this study confirms that DEA can be effectively applied to evaluate the efficiency of knowledge management promotion in agricultural industrial parks. It can also help identify benchmark units, inefficient units, and possible directions for improvement. The findings indicate that improving knowledge management efficiency does not simply depend on increasing inputs. Rather, it requires attention to input quality, management capability, scale allocation, and outcome conversion. For agricultural business units, knowledge management should be regarded as a long-term competitive strategy rather than a short-term administrative measure. Specifically, they should strengthen knowledge introduction planning, establish employee knowledge-sharing and learning mechanisms, enhance the use of information systems, and connect knowledge management outcomes with revenue growth, product innovation, and market competitiveness.

This study also reminds managers of agricultural industrial parks that the promotion of knowledge management should be carried out through tiered management based on the efficiency status of different units. For units close to the efficiency frontier, the focus should be on refinement and innovation. For units with moderate efficiency, the priority should be process improvement and better resource allocation. For low-efficiency units, comprehensive diagnosis and basic capacity building should be conducted first. Only when efficiency analysis results are translated into concrete managerial actions can agricultural industrial parks truly improve business performance, promote industrial upgrading, and develop a more sustainable model of agricultural development through knowledge management.

5. Conclusion

According to the efficiency acquired with DEA and variable information, 1 DMU, about 10% of all DMUs, presents strong efficiency on the promotion of knowledge management, with the efficiency=1, revealing the better knowledge management efficiency; 3 DMUs, about 30% of all DMUs, show marginal inefficiency on the promotion of knowledge management, with the efficiency in 0.9-1, showing the knowledge management promotion efficiency could be more easily promoted; and, 6 DMUs, about 60% of all DMUs, reveal obvious inefficiency, with the efficiency lower than 0.9, in which Xi Yuan Tea, Fujian, appears the lowest efficiency on the promotion of knowledge management.

Suggestion. From above knowledge management promotion effectiveness of agricultural industrial parks, the following suggestions are proposed in this study. (1) An agricultural industrial park should actively exchange and cooperate with Academy of Banking and Finance, National Training Institute for Farmers' Organizations, academic units, or management consulting firms to reinforce the employees' training and education of finance, service, sales, marketing, and communication. The employees with complete and sufficient professional knowledge and ability could provide complete and excellent products and service, satisfy customer needs, and promote customer loyalty. (2) Business managers of agricultural industrial parks should carefully consider the importance of the introduction of knowledge management to the agricultural industrial parks and the synergy resulted from organizational problems being solved. An agricultural industrial park, according to the action aim of knowledge management model and the organizational culture and management characteristics, could introduce the knowledge management model to the agricultural industrial park so as to enhance the overall competitiveness. (3) When promoting knowledge management in an agricultural industrial park, the cooperation intention of employees is primary. A leader therefore has to properly promote knowledge-based resources, carefully manage and construct interpersonal harmony and professional ability, and emphasize the inheritance of knowledge experience. An agricultural industrial park should recruit talents according to the vacant position with relevant professional tests, such as personality & interests, work passion, and service attitudes, in order to put right persons in right places.

Acknowledgements. The paper is funded by the Ministry of Agriculture and Rural Affairs - Funding for the Construction of Modern Agriculture Industrial Park in Anxi County, Fujian Province (Project No.: KMD18003A).

References

- Applanaidu, S. D., Samsudin, S., Ali, J., Dash, U., & Chik, A. R. (2014). Technical and scale efficiency of public district hospitals in Kedah, Malaysia: A data envelopment analysis (DEA). *Journal of Health Management*, 16(3), 327–335.
- Bhat, S. A., & Kumar, A. (2017). Performance evaluation of outsourcing decision using a BSC and fuzzy AHP approach: A case of the Indian coal mining organization. *Resources Policy*, 52, 181–191.

- Burke, J., & Hung, A. A. (2015). *Do financial advisers influence savings behavior?* RAND Corporation.
- Cerchione, R., Esposito, E., & Spadaro, M. R. (2016). A literature review on knowledge management in SMEs. *Knowledge Management Research & Practice*, 14(2), 169–177.
- Chang, J. J., Hung, K. P., & Lin, M. J. (2014). Knowledge creation and new product performance: The role of creativity. *R&D Management*, 44(2), 107–123.
- Denicolai, S., Zucchella, A., & Strange, R. (2014). Knowledge assets and firm international performance. *International Business Review*, 23(1), 55–62.
- Dimitris, K. D., Dimitrissotiros, & Koronakos, G. (2015). A network DEA approach for series multi-stage processes. *Omega*, 61, 35–48.
- Elbanna, S., Eid, R., & Kamel, H. (2015). Measuring hotel performance using the balanced scorecard: A theoretical construct development and its empirical validation. *International Journal of Hospitality Management*, 51, 105–114.
- Engelen, A., Flatten, T. C., Thalmann, J., & Brettel, M. (2014). The effect of organizational culture on entrepreneurial orientation: A comparison between Germany and Thailand. *Journal of Small Business Management*, 52(4), 732–752.
- Fuentes-Fuentes, M. M., Bojica, A. M., & Ruiz-Arroyo, M. (2015). Entrepreneurial orientation and knowledge acquisition: Effects on performance in the specific context of women-owned firms. *International Entrepreneurship and Management Journal*, 11, 695–717.
- Kao, S. C., & Wu, C. H. (2016). The role of creation mode and social networking mode in knowledge creation performance: Mediation effect of creation process. *Information & Management*, 53, 803–816.
- Lu, W. M., Wang, W. K., & Kweh, Q. L. (2014). Intellectual capital and performance in the Chinese life insurance industry. *Omega*, 42, 65–74.
- O'Connor, C., & Kelly, S. (2017). Facilitating knowledge management through filtered big data: SME competitiveness in an agri-food sector. *Journal of Knowledge Management*, 21(1), 156–179.
- Pak, Y. S., Ra, W., & Lee, J. M. (2015). An integrated multi-stage model of knowledge management in international joint ventures: Identifying a trigger for knowledge exploration and knowledge harvest. *Journal of World Business*, 50(1), 180–191.
- Roberto, C., & Emilio, E. (2017). Using knowledge management systems: A taxonomy of SME strategies. *International Journal of Information Management*, 37(1), 1551–1562.
- Santanu, M., & Dastidar, S. G. (2014). A DEA investigation of efficiency of the Indian general insurance during recession. *Journal of Advances in Management Research*, 11(1), 115–136.
- Sinha, R. P. (2015). A dynamic DEA model for Indian life insurance companies. *Global Business Review*, 16(2), 1–12.

Stoica, O., Mehdian, S., & Sargu, A. (2015). The impact of internet banking on the performance of Romanian banks: DEA and PCA approach. *Procedia Economics and Finance*, 20, 610–622.

Tone, K., & Tsutsui, M. (2014). Dynamic DEA with network structure: A slacks-based measure approach. *Omega*, 42(1), 124–131.

Wang, K., Huang, W., Wu, J., & Liu, Y. N. (2014). Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA. *Omega*, 44, 5–20.

Yang, L. (2015). Analyzing operating performance of state-owned enterprises: Evidence from Taiwan Tobacco and Liquor Corporation. *Journal of Management & Systems*, 22(2), 229–248.

Zhang, M. (2015). Understanding the relationships between interest in online math games and academic performance. *Journal of Computer Assisted Learning*, 31(3), 254–267.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>)