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Analysis of the Simulation Merger and Economic Benefit of Local Farmers' Associations in Taiwan

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Abstract

Farmers' Association and the service area in Taiwan may encounter the major restructuring or integration based on the administrative division of future territorial planning. This study investigates the questions about how to choose the merger targets and evaluate the economics benefit after mergr. No previous studies used the simulation to evalute the efficiecy of the merger. Therefore, we used the data of 266 farmers' association in 2012 to 2013 in Taiwan to simulate the effiency of the merge. We first find the best combination by using simulation and then analyze the economic benefit. The results showed that only 108 farmers' associations left after merger, which is the 40% of the total farmers' associations in Taiwan. There is no significant cost savings after merger but there exists a significant growth in the cost efficiency. The merger also reaches the economies of scale and economies of scope.

Keywords— Simulation Merger, Assurance Region, Efficiency, Economies Benefit

Introduction

In Taiwan, farmers' associations are divided into National Farmers' Association, Republic of China, county-level/municipal farmers' associations and the grassroots. In grassroots associations, there are mainly departments of credit, supply & marketing, insurance and marketing. As nonprofit organizations where their inputs are proportional to the outputs, farmers' associations have nearly two million members and apply to the Farmers' Association Act. Although it is clearly stipulated in Article 7 of the Farmer's Association Act that farmers' associations within an area shall act based on the principle for organizing a common association, their merger shall be approved by central competent authorities in realities. These associations greatly differ from each other in their operations and forms owing to distinct industry development and characteristics of different villages and towns.

For future national spatial planning of Taiwan, the drafted Law of Administrative Division was approved in 2012, expecting to integrate 368 rural and urban areas into 100 to 150 all over China (The Executive Yuan, 2012). Hence, all administrative areas would be further divided in China, and farmers' associations would face significant changes to their service targets due to the constraints from the Farmers' Association Act.

Recently, some problems have appeared in operations of farmers' associations, which belong to multifunctional organizations where all departments shall deal with a great deal of business. As a consequence, the business results aren't ideal in some associations. Credit departments of farmers' associations have successively encountered crises arising from trade/finance internationalization, financial storms, and excessive loans and rising non-performing loan ratio in Taiwan. In 2001, up to 27 problematic credit departments of these associations were mandatorily taken over by financial institutions.

In Japan, agricultural cooperative associations were ever amalgamated because of poor management. At that time, agricultural government organizations and central federations of agricultural cooperative associations tended to improve their operational efficiency by merger of the agricultural cooperative associations, because the financial conditions were unfavorable in these associations. Based on nature of businesses, these agricultural cooperative associations may be categorized into comprehensive and special ones. Similar to grassroots farmers' associations of China, comprehensive agricultural cooperative associations involve undertakings of credit, insurance, transportation, sales and marketing, whereas they are more inclined to credit and insurance departments in their operations, so other departments mostly suffer losses. In 1988, policies were launched for extensive merger. Thereafter, agricultural

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cooperative associations were integrated into 4,072 at the end of 1987, 2,058 in 1997, 1,766 in 1998, only 1,032 in October 2002 and 717 in 2012, for which a hierarchical system (including upper, middle and lower levels) came into being among Japanese agricultural cooperative associations.

This paper focuses on discussing objectives of combining farmers' associations in different counties and cities and economic benefits from the mergers. Analysis is performed according to data on four major departments' input and output of the period from 2012 to 2013 as reported by the Yearbook of Taiwan Farmers' Associations. The merger is simulated by Data Environment Analysis (DEA) to calculate overall indexes of all departments of the associations and integrate their input/output elements. Nevertheless, different business characteristics or poor operating conditions would lead to zero weight of output. To be exact, indexes of all outputs are firstly aggregated by DEA and Assurance Region (AR) models are adopted, in order that output weights of all associations' departments may be defined within an appropriate range. Subsequently, the merger is simulated for different counties and cities according to aggregated comprehensive output and input indexes.

For simulations of this study, neighboring farmers' associations are amalgamated in different phases and only an association is incorporated one time. Five farmers' associations may be amalgamated at most. Previously, farmers' associations were merged in Taiwan in 1975 when five township farmers' associations were integrated into a county farmers' association at best. Furthermore, 4.2 agricultural cooperative associations are merged one time on average in Japan. Thus, the number of farmers' associations to be merged is limited as 5 in this study. At last, the associations will be further merged until the efficiency won't increase and the standard deviation won't decline any longer, so as to find out the optimal combinations of these associations.

Once the optimal combinations are confirmed for merging farmers' associations of different counties and cities. Based on cost functions, cost benefits, values of economies of scale and scope before and after the merger are estimated and economically evaluated. Based on these results, references are provided for future managers of farmers' associations to set goals of merger.

Literature Review

Farmers' Associations

The first farmers' association, founded in September 1900, is a folk organization that emerged during the Japanese colonial period in Taiwan and named "Taibei Sanjiaoyong Union", previously founded for the major purpose of protecting rights and interests of farmers and reducing burden of land rent. In 1907, the Governor–General of Taiwan announced "Taiwan Rules for Farmers' Associations and Detailed Rules for Implementation", transforming farmers' associations into body corporate in 1908 to formally establish a system for managing farmers' associations, through which farmers embarked on agricultural extension and business activities.

In farmers' associations, there are mainly departments of credit, supply and marketing, promotion and insurance. As financial institutions, credit department is mainly responsible for deposits and loans of members. Supply and marketing department handles matters about operations, including transportation, marketing, warehousing and processing. Promotion department is mainly in charge of promoting excellent seeds, fertilizers and special agricultural products, guiding members and farmers, so as to facilitate operations in special agricultural areas. Entrusted to handle businesses related to agricultural insurance, insurance department assists farmers in insurance undertakings and construction of farmhouses.

In Article 7 of the Farmers' Association Act, it is mentioned in some parts that administrative areas are used for organizing farmers' associations and named after those areas. In principle, only a farmers' association can be formed within an area. Concerning the establishment of farmers' associations, it is clearly provided that the establishment of farmers' associations across administrative areas is prohibited that only a single farmers' association can be organized within an administrative area. To merge such associations, approval of central competent authorities is needed. Unless otherwise approved, farmers' associations shall be established in areas where all levels of governments, township and urban administrative offices are.

Literature on Merging Credit Departments of Farmers' Associations

In pertinent literature on merger of farmers' associations, Huang and Chen (1999) discussed the benefits of consolidating credit departments of 185 farmers' associations and 50 credit cooperatives. They also analyzed the benefits from scale expansion and reformed management capabilities resulting from mergers by non-presupposed allocation method. Furthermore, cost benefits of mergers among different groups were measured by advance simulation of Shaffer (1993). For instance, Chen and Fu (2004) divided quartile of their average costs into four groups. Then, they observed cost benefits of mergers within and across groups, to know if costs could be saved by different methods of mergence. The results suggested that it was more cost-effective to merge across groups, and

related methods have been used in research on bank mergers. Studying benefits of merging credit departments of 279 farmers' associations in counties and cities, Chou, Woo and Chen (2006) considered all possibilities of mergers. According to results of their research, costs could be saved in almost all counties and cities. Meanwhile, the mergers of these credit departments are deeply impacted by geographical locations. Besides, they knew about effects of economies of scale and scope in credit departments of large and small farmers' associations.

All previous literature on mergence of farmers' associations focused on studying credit departments of farmers' associations, where the situation was improved after the mergence. Some scholars have proposed that the mergers across counties or cities and groups are better than those within groups. However, in a former practical case of merging farmers' associations, Dapu Township Farmers' Association merged with Jhuci Township Farmers' Association, taken over by it and renamed as Jhuci District Farmers' Association. Both of them were merged across areas, so thereafter some farmers considered the Jhuci District Farmers' Association hadn't performed its obligations of coaching and thereby aroused disputes. Therefore, mergers won't be simulated across counties, cities or areas in this paper.

As regards merger simulation, four major departments of 266 grassroots farmers' associations in Taiwan will be studied. Farmers' associations of each county and city are merged by merely integrating with one neighboring farmers' association one time. At last, a farmers' association wouldn't be merged with other farmers' associations, integrated with two, three and even over four associations. These associations will be selected by referring to research of Kao and Yang (1992), Lin and Huang (2009). The most suitable combination will be found out according to post-simulation efficiency and standard deviation. The mergers won't be suspended until there is no increase in the efficiency.

Resarch Methodology

Data Envelopment Analysis

As an efficiency model, data envelopment analysis was initially developed for the purpose of evaluating efficiency of nonprofit organizations. Nevertheless, thereafter it has been widely used in production and industrial departments. Relative efficiency of branches within a company may be also measured by assessing such efficiency of the companies in private sectors. As a method for analyzing non-parametric efficiency frontier, DEA may be used for assessing relative efficiency of decision making units (DMU) with high inputs and outputs, to separately determine their efficiency.

Charnes, Cooper and Rhodes (1978) firstly developed a CCR model for evaluating values of relative efficiency of high inputs and outputs. According to the concept of Plato optimality, a mathematical programming model was developed by Farrell's concept of efficient frontier for efficiency measurement and belonged to constant returns to scale in the process of production. It is divided in forms of ratio, multiplier and envelopment.

Banker, Charnes and Cooper (1984) modified the CCR model into BCC model at variable scale. Shephard's concept of distance functions was introduced and decision making units' variable scale of production was taken into account, so as to measure values of technical efficiency, scale efficiency and returns to scale and so on for the purpose of expanding the applications of DEA.

DEA of Assurance Region

For DEA, extreme values may be possibly encountered in calculations. As a result, the weight of certain input or output would be negative and even zero, which meant that input is unrelated to the efficiency of that item at all. Charnes, Cooper and Rhodes (1979) mentioned such irrationality in their research and suggested that weights should be appropriately restricted. In general, weights may be restricted by three methods. Firstly, upper and lower limits are independently determined for weights as absolute ranges. Secondly, weights may be determined according to relative standards. In other words, different weights are supposed to have relative relationships to confirm their relative ranges. Thirdly, all decision making units use a common weight, so as to consider important ratios between practical inputs and outputs.

Thompson, Singletion, Thrall and Smith (1986) modified the CCR model and put forward that, in performing DEA, relative weights of inputs and outputs should be determined within a reasonable range, which is known as assurance region. Subsequently, all decision making units shall look for the most favorable weights for themselves. Thus, when weights are determined within certain range, they can reach the upper limit of the designated range at most, in contrast, the lower limit of the range at minimum. Therefore, the efficiency evaluation will be more reasonable by adding a formula to the model for restricting weights, which may be represented by Formula (1) as follows.

$$\begin{aligned} \alpha_i^L \le & v_i / v_l \le \alpha_i^U \quad i = 2,\ldots,m \\ \beta_r^L \le & u_r / u_l \le \beta_r^U \quad r = 2,\ldots,s \end{aligned} \tag{1}$$

Where, α_i^L and α_i^U are upper and lower bounds of input to weight ratio; β_r^L and β_r^U are upper and lower bounds of output to weight ratio. The solutions will be infinite for initial ratio form of DEA, so linear programming models of BCC will be utilized in this paper and denominator will be determined as 1 for DEA. Besides, after imposing the limits on the assurance region, the analysis model may be as follows:

$$\begin{aligned} Min\ & w_j = \sum_{i=1}^{m} v_i X_{ij} + v_0 \\ s.t.\ & \sum_{i=1}^{s} u_r Y_{rj} = 1 \\ & \sum_{i=1}^{s} u_r Y_{rj} + \sum_{i=1}^{m} v_i X_{ij} \ge 0, \qquad j = 1,\ldots\ldots,n \\ & u_r, v_i \ge \varepsilon > 0, \quad i = 1,\ldots\ldots,m\ ; \quad r = 1,\ldots\ldots,s \\ & \alpha_i^L \le v_i / v_l \le \alpha_i^U \quad i = 2,\ldots,m \\ & \beta_r^L \le u_r / u_l \le \beta_r^U \quad r = 2,\ldots,s \end{aligned} \tag{2}$$

Assuming certain DMU has s and m inputs and outputs respectively, there are n DMUs, Y_{rj} is the r th output of j th DMU, and X_{ij} is the i th output of the j th DMU. All weights including u_r and v_i are set within specific upper and lower limits. ε is the minimal positive and known as non-Archimedean number.

Aggregation in DEA

Kao (1994) proposed the aggregation in DEA, by which the maximum output was firstly deflated to narrow relative relationships among DMUs. Next, their weights were calculated through DEA as basis for aggregation. In terms of measurement, the output was assumed to be fixed to calculate outputs. Weights of outputs were objectively determined and aggregated by DEA models according to data structures of outputs. Hence, the efficiency determined by aggregation in DEA equaled to aggregate value of outputs (Lu and Fu, 2005).

Farmers' associations are multifunctional organizations with multiple objectives, where all departments have numerous items of outputs. Thus, several output variables shall be firstly aggregated in model analysis, so as to analyze aggregated output and input indexes. Therefore, the indexes at all levels will be calculated by aggregation in DEA in this paper. Through the aggregation, indexes of all departments will be calculated, and the assurance region model of DEA will be utilized to ensure that output weights of all departments are within specific range, so as to avoid errors and get the most suitable results.

Methods and Procedures of Merger Simulation

To simulate mergers and combinations of grassroots farmers' associations in this paper, overall efficiency of these associations in the period from 2012 to 2013 is calculated by AR-DEA model, and their mergers are simulated based on the principle of integrating with one region in a merger (Lin and Huang, 2009). In case of high efficiency and low standard deviation (Kao and Yang, 1992), the combination will be judged to be optimal for merger. Based on mergers of Taiwan farmers' associations and Japanese agricultural cooperative associations in 1975, five associations are merged once at most. Hence, no more than 5 associations will be eventually consolidated at one time in this paper, and the optimal combination of these associations will be sought by the selection method mentioned above.

First of all, merger of neighboring farmers' associations will be simulated in the first stage of merger simulation. Assume that there are five farmers' associations, including A, B, C, D and E, among which A is close to B and C; B is adjacent to A, C and D; C is in the vicinity of A, B, D and E; D is near B, C and E; E is next to C and D, as shown in Fig 3-1 as follows. In this case, 12 combinations may form, including A, B, C, D, E, AB, AC, BC, BD, CD, CE and DE. The optimal combination is determined by judging efficiency and standard deviations of these 12 combinations. Hypothesizing the efficiency is the highest and the standard deviation is the lowest in the AB combination after the merger of the first stage, then only six combinations, including C, D, E, CD, CE and DE are remained for evaluation.

Meanwhile, CE is the second best combination, and only D is left at last, as shown in Fig 3-2 as follows. Thus, three farmers' associations are combined in the first stage.

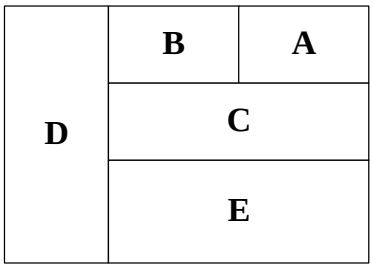

Figure 1: Locations of Farmers' Associations

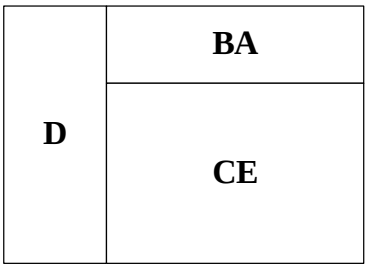

Figure 2: Merger after the 1st Stage

Furthermore, combinations of AB, CE and D are simulated in the 2nd stage. AB is adjacent to CE and D; CE is close to AB and D; D is near AB and CE. Then, there are six possible combinations, namely AB, CE, D, ABD, CDE and ABCE, which are subsequently measured based on efficiency and standard deviations. Provided ABD is judged to be the optimal combination in the second stage, only CE combination is left at last. In the second stage, two farmers' associations are suggested to be combined, as shown in Fig 3-3. If the efficiency can't further increase in the 2nd stage, two farmers' associations will be eventually merged. Inferred from this, in case that the efficiency can further increase, merger simulation will be continued in the 3rd and even the 4th stage until no improvement can be made in the efficiency any longer.

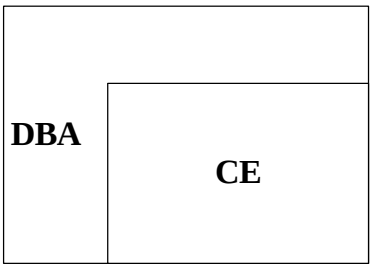

Figure 3: After the Merger of the 2nd Stage

Evaluation of Economic Benefits

Once confirmed by above merger simulations, merged farmers' associations will be classified. The same or different types of farmers' associations may be merged in former simulations, so it is necessary to redefine categories of these associations. After such classification, cost benefits, values of economies of scale and scope before and after mergers are further economically estimated by stochastic frontier approach and a common cost frontier model. Once empirical results of two stages are confirmed, a complete analysis will be performed on merger of farmers' associations, in order to provide important references for future managers of farmers' associations to set goals of merger.

Cost Savings

It is hypothesized in this study that after merger, the merged region is divided into economies of scale and efficiency differences.

Post-merger total cost = $\hat{cost}\ (X_{A+B}|C)$

$= [\ \hat{cost}\ (X_A|C_i) + \hat{cost}\ (X_B|C_j) +$ economies of scale]

Saved cost after merger may be represented by a formula as follows:

Saved cost after merger = $\hat{cost}\ (X_{A+B}|C) - [\hat{cost}\ (X_A|C_i) + \hat{cost}\ (X_A|C_j)]$

$=$ economies of scale $+ [\hat{cost}\ (X_B|C_i) - \hat{cost}\ (X_B|C_j)]$

= economies of scale + improved efficiency $(X_{AB}|C \leftarrow Cij)$

Improved efficiency is represented by $(X_{AB}|C \leftarrow Cij)$. In case of given inputs, grassroots farmers' associations may face cost changes from C_{ij} to C owing to improvement of their production technologies after merger, which indicates saved cost after the efficiency improvement. When no improvement is made in efficiency, it means the cost is lower or cost saving in case of the same input (X_{AB}) because of technological improvements. On the contrary, the cost will increase when the value of improved efficiency is higher than zero.

Empirical Models of Cost Functions

In this study, empirical models will be used by referring to determination of cost functions proposed by Chen and Fu (2004). In this study, three inputs are fund, capital and labor respectively, while four outputs are departments of promotion, insurance, supply & marketing and credit. The empirical models are shown as follows from Formula (3):

$$C = f(Y_1, Y_2, Y_3, Y_4, P_1, P_2) + \varepsilon \qquad (3)$$

Where, C is standard total cost, Y_1 is marketing department, Y_2 is insurance department, Y_3 is supply and marketing department, Y_4 is credit department, P_1 is standard fund price, P_2 is standard price of capital, and ε is random error.

Economies of Scale and Scope

For scale of economies (SE), long-run average cost will decline with increase in output. Economies of scope (SC) mean a manufacturer's total costs of simultaneously producing two kinds of outputs are supposed to be lower than those spent in separate production of those two outputs. In other words, the costs for combined production of two outputs are below the sum of their separate production costs, which indicates that economies of scope exist in the manufacturer.

Empirical Analysis

Data Sources and Variable Determination

In this study, the data are secondary, mainly from yearbooks of Taiwan farmers' associations at all levels compiled and printed by the National Farmers' Association, Republic of China. The efficiency was lower in the 2nd year of the research period than the 1st year's, so statistical data of four major departments of farmers' associations in 2012 and 2013 were analyzed. 266 grassroots farmers' associations of Taiwan are studied. Some credit departments have been taken over by financial institutions due to their past poor management. In terms of inputs, overall inputs, including total number of employees (X_1), cost of capital (X_2) and cost of funds (X_3), are utilized.

The output variables of the promotion department include methods of promotion guidance, promotion fees, continuing education and project plans. For the insurance department, outputs are divided into income from livestock insurance and farmers' insurance. In the supply and marketing department, outputs mainly include income from supply and marketing, transportation, marketing, and other economic income, among which the transportation and marketing are concerned about number of live pigs and metric tons of transported/marketed vegetable. At first, weights are limited by aggregation in DEA in combination with AR-DEA to combine two variables. In the credit department, outputs are classified into general loans, policy loans and other interest revenues. Above output variables are combined through aggregation in DEA, and weights are set within a reasonable range by AR-DEA, so as to calculate output indexes of all departments of the associations. Output variables are described in Table 4 as follows.

Table 1:

Output Variables for the 1st Stage of Empirical Analysis

Output	Variables
Promotion Department (Y_1)	Methods of Promotion Guidance Promotion Fees Continuing Education Project Plans

Insurance Department (Y_2)	Income from Livestock Insurance Income from Farmers' Health Insurance
Supply & Marketing Department (Y_3)	Income from Supply and Marketing Transportation and Marketing Other Economic Returns
Credit Department (Y_4)	General Loans Policy Loans Other Non-interest Income

Table 2 shows descriptive statistics of input and output variables of the period from 2012 to 2013 for the 1st stage of the empirical analysis. Y_1 represents outputs of the promotion department, the mean of which was 0.1844 and 0.1867 in 2012 and 2013 respectively. It is thus clear that the mean in 2013 was slightly higher than that in 2012. Y_2 indicates outputs of the insurance department, where the mean output was 0.2618 and 0.2629 in 2012 and 2013 respectively, which also reveals the mean was higher in 2013. Y_3 shows the outputs of the supply and marketing department, equaling to 0.1379 in 2012 and 0.1341 in 2013 on average (higher in 2013 too). Y_4 represents the outputs of the credit department, where the mean was 0.1739 in 2012 and 0.1630 in 2013.

Concerning inputs, X_1 refers to use of laborers, namely the sum of the number of employees from all departments. There were nearly 56 and 55 employees on average in 2012 and 2013 respectively. The mean cost of capital (X_2) amounted to TWN 0.26 billion within 2 years on the whole, and was RMB 0.02 billion higher in 2013 than that in 2012. Indicating cost of input capital, X_3 was about TWN 0.17 billion in both 2012 and 2013. Therefore, the utilization of capital didn't greatly fluctuate between those two years.

Table 2

Descriptive Statistics of Variables in the 1st Stage

Year	2012		2013		2012-2013	
Variable	Mean	SD	Mean	SD	Mean	SD
Y_1	0.1844	0.2110	0.1867	0.2149	0.1855	0.2128
Y_2	0.2618	0.2162	0.2629	0.2163	0.2624	0.2161
Y_3	0.1320	0.1663	0.1341	0.1740	0.1330	0.1700
Y_4	0.1739	0.1558	0.1630	0.1387	0.1684	0.1475
X_1	55.17	32.48	54.34	31.17	54.76	31.80
X_2	253,805	275,845	272,897	300,995	263,351	288,580
X_3	172,563	140,450	175,644	143,713	174,104	141,965

In the 2nd stage of the empirical analysis, economies of scale and scope, etc after merger are analyzed based on cost functions. Variables are determined by referring to research of Chen and Fu (2004) and Lu *et al* (2006), divided into inputs, outputs and factor price. The same as those used in the first stage of the empirical analysis, variables of outputs are calculated via the aggregation in DEA, and weights are limited by AR-DEA. Cost variables are classified into cost of funds, cost of capital, labor cost and total cost, among which cost of fund is only incurred in the credit department, so corresponding data are about deposit interest and accrued interest. The cost of capital is determined based on research of Chen and Fu (2004). In this study, it is transformed into lease expense, other business expenditures, business expenses, conference expenses, management fees and depreciation expenses of four major departments. Labor cost means personnel expense, and total cost refers to the aggregate of three costs mentioned above.

At last, factor price is categorized into prices of capital, funds and labor. Price of funds is determined by dividing the cost of funds by expenditures of four major departments. The price of capital is calculated by dividing the cost of capital by net amount of fixed assets, and the price of labor is confirmed by dividing personnel expenses by the number of employees.

Table 3 shows descriptive statistics of variables in the 2nd stage of this study, which are the same as those of the first stage in terms of outputs. Thus, only variables of costs and factor prices are shown in Table 4-3. As regards cost variables, cost of funds is represented by C_1, which was about TWN 0.084 billion in 2012, increased by nearly TWN 0.086 billion in 2013 and equaled to TWN 0.085 billion on average. Cost of capital, indicated by C_2, was appropriately TWN 0.089 billion in 2012 and tended to increase by about TWN 0.094 billion in 2013. C_3, as labor cost, didn't change much between 2012 and 2013, almost amounting to 0.122 billion in both years. Indicating total cost, TC was almost TWN 0.295 billion in 2012, with an increase in about TWN 0.302 billion in 2013, and up to TWN 0.299 billion within above two years on average.

Concerning variables of factor prices, P_1, representing price of funds, was TWN 934.6 on average and slightly higher in 2013 than that in 2012. Showing price of capital, P_2 was higher in 2013 compared with that in 2012 and TWN 480 on average within those two years. Indicated by P_3, the mean price of labor was TWN 2,126,000 in 2012 and TWN 2,163,000 in 2013, which revealed a little increase in 2013.

Table 3

Descriptive Statistics of Variables in the 2nd Stage

Year/	2012		2013		2012-2013	
Variable	Mean	SD	Mean	SD	Mean	SD
C_1	83,695	107,742	85,607	111,118	84,651	109,192
C_2	88,894	72,126	93,933	84,377	91,414	78,349
C_3	122,576	100,082	122,963	102,535	122,769	101,080
TC	295,165	263,998	302,074	281,314	298,620	272,180
P_1	0.9221	0.9601	0.9470	0.9285	0.9346	0.9423
P_2	0.4745	0.2969	0.4855	0.3170	0.4800	0.3065
P_3	2,126	1,084	2,163	1,102	2,145	1,091

Results of Merger Simulations

This paper intends to find out optimal combinations for merging grassroots farmers' associations of all counties and cities. It also attempts to explore whether cost savings and economic benefits are realized after the mergers. In the first stage, mergers of 266 grassroots farmers' associations of the period from 2012 to 2013 are simulated within different counties and cities. First of all, output indexes of all departments are calculated by aggregation in DEA. Next, weights of all variables are determined by AR-DEA to calculate values of efficiency. In the 2nd stage, cost effectiveness, economies of scale and scope before and after the mergers are compared based on cost functions.

Farmers' Associations of All Counties and Cities before Merger

It may be known from Table 4-4 that there are 24 farmers' associations in New Taipei City, among which the minimum efficiency is 0.0181 and the overall mean efficiency is 0.0630. In Taoyuan County, there are 12 farmers' associations, where the minimum efficiency and the overall mean efficiency are 0.6196 and 0.9103 respectively. Taoyuan County is the place where the overall mean efficiency is the highest among all counties and cities. Hsinchu County has 11 farmers' associations, for which the efficiency is 0.0315 at minimum and the overall efficiency is 0.8925 on average. There are 17 farmers' associations in Miaoli County, in which the minimum efficiency is 0.0120, while the overall mean efficiency is 0.4661, which is the lowest among all counties and cities of Taiwan.

In Taichung City, there is a total amount of 21 farmers' associations, among which the minimum efficiency is 0.0137 and the overall average efficiency is 0.6202. There are 26 farmers' associations in Changhua County, which is

the 2nd place with the largest number of farmers' associations among all counties and cities. For these associations, the minimum efficiency is 0.0409 and the overall average efficiency is 0.6871. Nantou County has 13 farmers' associations, where the minimum efficiency is 0.0409, and the overall efficiency is 0.6520 on average. In Yunlin County, there are 20 farmers' associations, among which the efficiency is 0.0100 at minimum among all farmers' associations across Taiwan, and the overall average efficiency is 0.5088. Jiayi County has 17 farmers' associations, in which the minimum efficiency is 0.0166, and the overall efficiency is 0.6717 on average.

Tainan City has the most farmers' associations across Taiwan, including 31 associations altogether, among which the minium efficiency is 0.0166 and the overall mean efficiency is 0.6554. In Kaohsiung City, there are 24 farmers' associations, where the minimum efficiency is 0.0441 and the overall mean efficiency is 0.6554. Pingtung County has 23 farmers' associations, in which the minium efficiency is 0.0268 and the overall average efficiency is 0.5749. In Yilan County, there are 10 farmers' associations, among which the minium efficiency is 0.0159 and the overall mean efficiency is 0.7000. Hualien County has 9 farmers' associations, where the minimum efficiency is 0.0190 and the overall mean efficiency is 0.8305. Taitung County is the place with the least amount of farmers' associations across Taiwan and merely has 8 farmers' associations, among which the minimum efficiency is 0.0395 and the overall mean efficiency is 0.8151.

Farmers' Associations of Counties and Cities after Merger

Table 4 shows simulation results of this study. Mergers of farmers' associations are separately simulated for different counties and cities. In merging these associations, their inputs and outputs are directly aggregated. The associations of different counties and cities are respectively merged, five counties and cities in the 2nd stage, 7 in the 3rd stage, 1 in the 4th stage and 2 in the 5th stage. The mergers are simulated for 944 times in total. Actual consolidation processes of all counties and cities are listed from Schedule 2 to 31.

At first, 24 farmers' associations of New Taipei City are merged into 11 associations. These mergers are simulated for 3 stages and 87 times. 12 farmers' associations of Taoyuan County are consolidated into 4 associations for 3 stages and 30 simulations. 11 farmers' associations of Hsinchu County are integrated into 6 associations for 3 stages and 44 simulations. Consolidated from 17 into 5, farmers' associations of Miaoli County are merged for 3 stages through 53 simulations. Although their efficiency isn't the highest, it has been improved to certain extent.

Consolidated into 8, 21 farmers' associations of Taichung City are simulated for 3 stages and 77 times. In Changhua County, there were originally 26 farmers' associations, which are consolidated into merely 11 associations for 3 stages and 103 simulations. 13 farmers' associations of Nantou County are merged into 9 for 2 stages and 47 times. 20 farmers' associations of Yunlin County are incorporated into 7 associations for 3 stages and 66 simulations. Integrated into 7 associations, 17 farmers' associations of Chiayi County are simulated for 2 stages and 50 times.

Consolidated into 9 associations, 31 farmers' associations of Tainan City are simulated for 5 stages and 143 times. 24 farmers' associations of Kaohsiung City are merged into 8, simulated for 4 stages and 83 simulations. In Pingtung County, 23 farmers' associations are consolidated into 8, simulated for 5 stages and 86 times. 10 farmers' associations of Yilan County are integrated into 5 for 2 stages and simulated for 31 times. Incorporated into 5 associations, 9 farmers' associations of Hualien County are merged for 2 stages and simulated for 24 times. 23 farmers' associations of Taitung County are consolidated into 8 associations for 5 stages and 17 times.

As shown in Table 4, results of grassroots farmers' associations before and after merger are summarized and compared. According to the results, the merger situation of all counties and cities is evident. At first, the minimum efficiency was 0.0181 before merger, has increased to 1 after merger in New Taipei City, where the mean efficiency also equals to 1 on the whole. In Taoyuan County, the minium efficiency was 0.6196 before merger, and has increased to 1 after merger. For Hsinchu County, it was 0.0351 before merger, and has increased to 1 too after merger. In Miaoli County, the minium efficiency was 0.0120 before merger, has increased to 0.6738 after merger and equals to 0.9096 on average as a whole. In Taichung City, the efficiency of farmers' associations was 0.0137 before merger and has increased to 1 after merger, with an overall efficiency equaling to 1 as well. For farmers' associations of Changhua County, the minimum efficiency increases from 0.0159 to 0.7744, with an increase from 0.6871 to 0.9464 in terms of their overall mean efficiency. In Nantou County, the minimum efficiency rises from 0.0409 to 0.887, while the overall mean efficiency increases from 0.65250 to 0.9899. With a minimum efficiency of 0.0100 for its farmers' associations before merger, Yunlin County is a place where such associations' efficiency is the lowest before merger. In these associations, the minium efficiency increases to 1 after merger and the overall average efficiency reaches 1 too.

For farmers' associations of Chiayi County, the minimum efficiency was 0.0166, and has increased to 1 after consolidation. It was 0.0153 for farmers' associations of Tainan City, but has increased to 0.9448 after merger, and their overall mean efficiency has risen from 0.6826 to 0.9969. In Kaohsiung City, the minium efficiency of farmers' associations was 0.0411, having increased to 0.7212 after merger, and their overall mean efficiency has risen from

0.6554 to 0.9339. In Pingtung County, the minimum efficiency of farmers' associations has presented an increase from 0.0268 to 0.07914 and their mean efficiency has been improved from 0.5749 to 0.9767 on the whole. For farmers' associations of Yilan County, the minium efficiency has increased from 0.0159 to 1 after merger. In Hualien County, the minimum efficiency of farmers' associations has shown an increase from 0.0190 to 1. The efficiency was 0.0395 before merger, but has increased to 1 thereafter in farmers' associations of Taitung County, where the overall efficiency has shown an increase from 0.8151 to 1.

Table 4

A Comparison of Grassroots Farmers' Associations in Different Counties and Cities before and after Merger

Areas	Merger Situation (times)	Merger Scenario	Number of Associations	Efficiency			
				mean	SD	Max	Min
New Taipei City	87	Before	24	0.6279	0.4150	1	0.0181
		After	11	1	0	1	1
Taoyuan County	30	Before	12	0.9103	0.1231	1	0.6196
		After	4	1	0	1	1
Hsinchu County	44	Before	11	0.8925	0.2273	1	0.0315
		After	6	1	0	1	1
Miaoli County	56	Before	17	0.4661	0.4513	1	0.0120
		After	5	0.9096	0.1462	1	0.6738
Taichung County	77	Before	21	0.6202	0.4324	1	0.0137
		After	8	1	0	1	1
Changhua County	103	Before	26	0.6871	0.3684	1	0.0159
		After	11	0.9764	0.0665	1	0.7744
Nantou County	47	Before	13	0.6520	0.4459	1	0.0409
		After	9	0.9899	0.0303	1	0.8871
Yunlin County	66	Before	20	0.5088	0.4577	1	0.0100
		After	7	1	0	1	1
Chiayi County	50	Before	17	0.6717	0.4087	1	0.0166
		After	7	1	0	1	1
Tainan City	143	Before	31	0.6826	0.4068	1	0.0153
		After	9	0.9969	0.1311	1	0.9448
Kaohsiung City	83	Before	24	0.6554	0.3857	1	0.0441
		After	8	0.9339	0.0965	1	0.7212
Pingtung County	86	Before	23	0.5749	0.4495	1	0.0268
		After	8	0.9767	0.0644	1	0.7914
Yilan County	31	Before	10	0.7000	0.4243	1	0.0159
		After	5	1	0	1	1
Hualien County	24	Before	9	0.8305	0.3596	1	0.0190
		After	5	1	0	1	1
Taitung County	17	Before	8	0.8151	0.3699	1	0.0395
		After	5	1	0	1	1

After mergers, efficiency has somewhat increased in farmers' associations of all counties and cities. The overall mean efficiency has even increased to the optimal value equaling to 1 in nine counties and cities. The efficiency just hasn't reached the optimal in Miaoli County, Changhua County, Nantou County, Tainan City, Kaohsiung City and Pingtung County, but has more or less improved after merger.

Estimates of Economic Benefits

After merger of farmers' associations across Taiwan are simulated in the 1st stage, cost-effectiveness before and after the merger will be investigated in this paper. Hence, cost functions will be estimated, in order to forecast simulated values of costs after consolidating these associations. After estimating the costs, changes to economies of scale and scope will be analyzed.

Table 5 shows Translog function of parameter estimates, from which it may be known that significant differences exist in both Y_2 and Y_3 in terms of output variables. Factor prices significantly differ in all aspects.

Table 5

Parameter Estimates

Variables	Coefficients	Standard Error		Variables	Coefficients	Standard Error	
Constants	9.0229	0.6424	***	$\ln Y_2 \times \ln Y_3$	0.0124	0.0115	
$\ln Y_1$	0.0204	0.0865		$\ln Y_2 \times \ln Y_4$	-0.0265	0.0202	
$\ln Y_2$	0.1840	0.0620	**	$\ln Y_3 \times \ln Y_4$	-0.1342	0.0295	***
$\ln Y_3$	0.3986	0.0846	***	$(\ln P_1)^2$	0.0930	0.0077	***
$\ln Y_4$	0.0658	0.1585	***	$(\ln P_2)^2$	0.0337	0.0107	**
$\ln P_1$	0.6088	0.0765	**	$\ln P_1 \times \ln P_2$	-0.0441	0.0062	***
$\ln P_2$	0.2628	0.0983		$\ln Y_1 \times \ln P_1$	-0.0025	0.0033	
$(\ln Y_1)^2$	0.0087	0.0114	**	$\ln Y_1 \times \ln P_2$	-0.0016	0.0032	
$(\ln Y_2)^2$	-0.0369	0.0117	***	$\ln Y_2 \times \ln P_1$	-0.0020	0.0038	
$(\ln Y_3)^2$	0.0489	0.0142	*	$\ln Y_2 \times \ln P_2$	0.0042	0.0037	
$(\ln Y_4)^2$	0.2012	0.0717		$\ln Y_3 \times \ln P_1$	0.0139	0.0048	**
$\ln Y_1 \times \ln Y_2$	-0.0123	0.0111	**	$\ln Y_3 \times \ln P_1$	0.0007	0.0045	
$\ln Y_1 \times \ln Y_3$	0.0172	0.0087		$\ln Y_4 \times \ln P_1$	-0.0022	0.0084	
$\ln Y_1 \times \ln Y_4$	-0.0166	0.0342		$\ln Y_4 \times \ln P_2$	-0.0089	0.0079	

Notes: * at 10% significance level, ** at 5% significance level, *** at 1% significance level.

Cost Savings

According to above empirical models, efficiency estimates after merger may be determined. Cost savings of this study are shown in Table 6. In New Taipei City, farmers' associations have been incorporated into 11 associations, among which costs have declined in 8 associations, and their total costs have been saved after the merger. After consolidation, there are only 4 associations left in Taoyuan County, among which costs have been reduced in 3 associations, in which total costs have been saved. In Hsinchu County, only 6 associations exist after merger, among which there are more associations whose total costs have increased. Costs have merely declined in one association after merger in Miaoli County, but increased in all other four associations. In Taichung City, there are 8 associations left after consolidation, among which total costs have been reduced and saved in 6 associations. After incorporation, costs have risen in 6 out of 11 associations, but declined in 5 associations, so total costs haven't declined after merger. For Nantou County, total costs have declined in 6 associations and thereby saved after merger.

Table 6

Cost Savings of Grassroots Farmers' Associations in Different Counties and Cities

Areas	Total Costs before Merger	Total Costs after Merger	Number of Associations with Increase in Total Costs	Number of Associations with Decrease in Total Costs	Range of Changes to Total Costs
New Taipei City	5.1576	5.1160	3	8	-0.81%

Taoyuan County	4.8925	4.6560	1	3	-4.83%
Hsinchu County	3.8697	3.9731	4	2	2.67%
Miaoli County	4.5550	4.7227	4	1	3.68%
Taichung City	4.9693	4.7167	2	6	-5.08%
Changhua County	4.4829	4.5867	6	5	2.32%
Nantou County	4.8277	4.6464	3	6	-3.76%
Yunlin County	4.9028	4.9562	5	2	1.09%
Chiayi County	4.9532	4.9409	4	3	-0.25%
Tainan City	4.8489	4.9320	6	3	1.71%
Kaohsiung City	4.8110	4.8173	4	4	0.13%
Pingtung County	4.2237	4.4738	7	1	5.92%
Yilan County	4.9102	4.6397	1	4	-5.51%
Hualien County	4.6785	4.7243	3	2	0.98%
Taitung County	4.5026	4.5401	3	2	0.83%
Total	4.7239	4.7211	56	52	-0.06%

In Yunlin County, there are 7 associations left after merger, including 5 associations facing increased costs because of merger. In Chiayi County, costs have increased in 4 farmers' associations, whereas total costs have declined and been saved in 5 associations. In Tainan City, total costs have increased in 6 associations, and fallen in 3 associations after merger. After merger, there are still 8 associations, with an increase and decrease in total costs in the same amount of these associations. Only 8 associations are remained after merger in Pingtung County, where costs have been only lowered in a single association and increased in all of the left after merger. In Yilan County, there has been a decrease in costs after merger and increase in a single association, so the total costs have been saved. In both Hualien County and Taitung County, there are 5 associations remained after merger, including 3 and 2 associations with an increase and decrease in total costs respectively.

In New Taipei County, Taoyuan County, Taichung County, Nantou County, Chiayi City and Yilan County, total costs have been saved after merger. In spite of no cost-effectiveness in other counties and cities, it may be inferred from grassroots farmers' associations across Taiwan that costs may be saved after merger.

Economies of Scale and Scope

According to estimates of Table 7, the mean of farmers' associations after merger (3.2662) has economies of scale compared with the mean before merger (1.9116). This means in case of persistent increase in outputs of associations after merger, the mean costs will be lowered. The economies of scope are better indicated from the mean after merger (0.6465) than that before merger (0.4986). This indicates that, if a farmers' association simultaneously produces four outputs, the total costs will be lower than separate output. As shown in the table, the efficiency is higher after merger (0.7604) than that before merger (0.7488). This reveals that operations of farmers' associations may be improved by merger.

Table 7

A comparison of economies of scale and scope before and after merger

Scenario	Cost Efficiency		Economies of Scale		Economies of Scope	
	Mean	P	Mean	P	Mean	P

Before	0.7388	(0.1059)	**	1.9112	(0.5505)	***	0.8130	(0.4986)	***
After	0.7604	(0.1159)		3.2662	(1.1195)		1.5257	(0.6464)	

Notes: * at 10% significance level, ** at 5% significance level, ***at 1% significance level; ( ) standard deviation (SD).

In Table 8, cost-effectiveness, economies of scale and scope of farmers' associations in different counties and cities before and after merger are compared. After merger, cost-effectiveness has only slightly declined in Taoyuan County, Taichung City, Nantou County, Chiayi County and Yilan County, but improved in all other counties and cities. It significantly differs before and after merger in Hsinchu County, Miaoli County, Changhua County, Nantou County, Tainan County and Pingtung County.

Economies of scale are more evident and significantly differ after merger in all counties and cities across Taiwan. Economies of scale are only not obvious n Yilan County after merger i, and just have no significant differences in Miaoli County, Yilan County and Hualien County. Nevertheless, the economies of scale are more evident in the remained 12 counties and cities because of merger.

Conclusion

This paper expects to find out the optimal combinations for merging farmers' associations through simulation and measure economic benefits. Combinations are selected from farmers' associations of different counties and cities based on their efficiency and standard deviation. There are 266 grassroots farmers' associations in Taiwan. These associations are merged in separate counties and cities by choosing adjacent ones based on the principle that no more than five associations are consolidated in each merger. Measurements are made according to efficiency and standard deviation. Once combinations are confirmed for a merger, pertinent cost functions will be estimated to determine and evaluate economic benefits.

As nonprofit organizations with more extensive businesses, many inputs and outputs, farmers' associations mainly have four departments. However, their business performances are poor because all departments shall be liable for many businesses. According to the draft of future plan for national lands of Taiwan, administrative regions would be further divided in the future. The organization of farmers' associations is restricted by the Farmers' Association Act that material changes will happen to service scope of these associations in case of re-dividing the administrative regions. To improve situation of farmers' associations and conform to future plans for national lands, it is inevitably necessary to improve operations of such associations by merger.

Table 8

A Comparison of Economies of Scale and Scope in All Counties and Cities before and after Merger

Areas	Scenario	Cost Efficiency			Economies of Scale			Economies of Scope		
		Mean		P	Mean		P	Mean		P
New Taipei City	Before	0.7286	(0.1234)		1.9266	(0.6289)	***	0.7862	(0.6662)	***
	After	0.7412	(0.1170)		2.5275	(0.4621)		1.2600	(0.4566)	
Taoyuan County	Before	0.7051	(0.0645)		1.8570	(0.3564)	**	0.5697	(0.2915)	***
	After	0.6707	(0.1089)		3.9164	(1.5112)		1.9447	(0.6025)	
Hsinchu County	Before	0.6694	(0.0947)	***	1.7300	(0.3014)	**	0.6943	(0.4414)	***
	After	0.8039	(0.0762)		2.3840	(0.7488)		1.4740	(0.7200)	
Miaoli County	Before	0.7282	(0.0949)	**	2.0192	(0.3174)	***	1.1144	(0.4598)	
	After	0.8317	(0.0485)		2.8628	(0.6640)		1.2057	(0.1327)	

Taichung City	Before	0.7035	(0.1220)		2.0046	(0.5823)	***	1.1096	(0.6965)	**
	After	0.6576	(0.1453)		3.1817	(0.9752)		1.4837	(0.6288)	
Changhua County	Before	0.7119	(0.0996)	***	1.8023	(0.2945)	***	0.7920	(0.3823)	***
	After	0.8084	(0.0647)		3.6881	(1.3188)		1.4477	(0.5348)	
Nantou County	Before	0.7897	(0.0870)	**	1.7281	(0.2241)	***	0.6979	(0.3525)	***
	After	0.6905	(0.1239)		2.8208	(0.9728)		1.3257	(0.3732)	
Yunlin County	Before	0.7797	(0.0814)		1.7643	(0.2668)	***	0.5314	(0.3652)	***
	After	0.7920	(0.0611)		4.4793	(1.2875)		2.4828	(1.2281)	
Chiayi County	Before	0.8086	(0.0524)		1.6984	(0.2783)	***	0.4495	(0.3309)	***
	After	0.7625	(0.1202)		3.1767	(0.8282)		1.9342	(0.3893)	
Tainan County	Before	0.7454	(0.0899)	**	1.7680	(0.4609)	***	0.6609	(0.3362)	***
	After	0.7992	(0.0730)		3.6220	(0.7386)		1.7646	(0.4243)	
Kaohsiung City	Before	0.7321	(0.1041)		2.1737	(1.0863)	**	0.9481	(0.4860)	**
	After	0.7667	(0.1032)		3.0935	(1.1073)		1.4277	(0.4701)	
Pingtung County	Before	0.7356	(0.1337)	**	2.1620	(0.5620)	**	1.0102	(0.3889)	**
	After	0.8387	(0.0832)		3.5780	(1.3344)		1.6595	(0.6675)	
Yilan County	Before	0.7502	(0.1214)		2.2655	(0.6324)	**	1.2811	(0.4482)	
	After	0.6549	(0.1522)		2.9209	(0.5768)		1.1638	(0.2746)	
Hualien County	Before	0.7503	(0.1393)		1.9704	(0.3979)	***	0.8924	(0.4973)	
	After	0.7858	(0.0780)		3.8158	(0.7971)		0.9961	(0.2046)	
Taitung County	Before	0.7615	(0.0512)		1.7473	(0.1607)	***	0.6761	(0.1890)	***
	After	0.7639	(0.1504)		3.2023	(1.2995)		0.7862	(0.6662)	

Notes: * at 10% significance level, ** at 5% significance level, *** at 1% significance level; ( ) standard

Previous studies about farmers' associations were mostly conducted in light of operations of their credit departments, but neglected departments of promotion, supply & marketing, and insurance. There had been no research on overall situation of farmers' associations until 2005 when a minority of studies had begun to be carried out in this respect. Nevertheless, in literature about consolidation of farmers' associations, only their credit departments are analyzed at present, while no research about overall merger situation of these associations is conducted. In the past, farmers thought these associations didn't perform their due duties and thus led to fights after

their merger. Hence, this paper analyzes the optimal combinations for merging these associations and measures post-merger economic benefits pursuant to the data of four departments indicated on the yearbook of these associations from 2012 to 2013, in order to completely analyze the consolidation of these associations and thereby provide references for future mergers.

According to results of this study, efficiency differences of grassroots farmers' associations in all counties and cities are evident. Besides, these associations are selected for optimal combinations. 266 farmers' associations have been integrated into 108 associations, which only account for 40% of original associations. Based on previous experience of consolidating Japanese agricultural cooperative associations, only 51% associations are left after 10 years of consolidation. In this paper, such percentage is higher than 51% merely in four counties and cities. There had been only 18% associations left in 2012 after 25 years' merger and acquisition since 1987. In this study, combinations of merging Taiwan farmers' associations are evaluated. Provided that about 50% still exists after merger as the situation in Japan after initial consolidation. In this paper, this percentage is about 40% after simulations, which suggests that nearly half of farmers' associations will be consolidated if in the initial stage.

In this paper, cost effectiveness and economic benefits before and after merger are estimated based on cost functions. The results suggest that cost effectiveness has been improved in six counties and cities. Although grassroots farmers' associations only account for 40% of all associations in all counties and cities of Taiwan, their total costs have been saved by 0.06% after merger. Their cost effectiveness has been slightly improved, while their economies of scale and scope have become more evident. Significant differences exist regardless of cost effectiveness, economies of scale and scope. In 10 counties and cities out of all, the cost effectiveness is higher after merger. The economies of scale are more evident in all counties and cities after merger. The economies of scope are only more evident in Yilan County before merger, whereas the situation is just the opposite in other 14 counties and cities. This indicates that improvements may be made in economies of scale/scope and cost effectiveness by simulated optimal combinations.

Pursuant to previous literature on merger of farmers' associations, despite that only their credit departments are consolidated, the benefits are higher after merger, and the results of this study are better than past research. In addition, to integrate any farmers' associations, it has been stipulated in the Farmers' Associations Act that pertinent proposals shall be put forward for consolidation, which shall include feasibility analysis of consolidation method and evaluation of economic benefits. In this study, optimal combinations are simulated for integrating farmers' associations of all counties and cities. Their economic benefits before and after merger are evaluated. Hence, the results of this paper may provide references for consolidating farmers' associations in the future.

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