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Feasibility Research for Improving Chicken Husbandry Using Brown Gibson Method: Case Study of Chicken Farms in Blitar, Indonesia

Sugiono and Dewi Hardiningtyas
Department of Industrial Engineering, University of Brawijaya (UB), Indonesia

Abstract: The Southern part of Blitar region in East Java, Indonesia is not suitable for agriculture due to hot temperatures and difficulty in watering. However, each sub-district has the unique technical and non-technical potential in livestock and business, especially for chicken farm. Therefore, the aim of the study is mapping the location of each potential sub-districts in South Blitar region for selecting the best poultry farm location. The research is started with a literature review on the theory of a Brown-Gibson Method and knowledge of how to develop chicken farm. The next step is continued with questioner survey and interviews of chicken farm in the some target areas of South Blitar. The results of the questioners and interviews are used as an input material for objective factors and as input material for subjective factors in the Brown-Gibson Method. Finally, this research has successfully demonstrated the advantages of each region according to the respective weight of objective and subjective factors. As a result, the poultry businesses can easily select the area of livestock development in feasible and optimal solution.

Key words: Chicken farm, brown-gibson method, blitar, chicken farm, Indonesia

INTRODUCTION

Small business communities are the important part of the Indonesia's economic in situation of recession economic. They employed >50 million people with contribution around 30-53% of the national GDP total (Hartarto and Muhajir, 2013). During the crisis, Small Medium Enterprises (SMEs) are able to respond more quickly and flexibly than their larger counterparts to sudden shocks (Berry *et al*., 2010). In line with the Strategic Plan of the MCSME (2010) as well as the Strategic Plan of the Ministry of Industry and Commerce 2010-2014 and also master plan for the acceleration and expansion of Indonesia's economic development coordinated by the Ministry of Economic Affairs in 2011-2025, the SMEs is a strategic objective for the three ministries in facing global economic challenges.

In 2012, 54% of animal husbandry in Indonesia is still classified as a small business. Whereas, the Indonesian economic growth boosted the main foods consumption, e.g., chicken egg, chicken meat, milk, fruits, vegetables, etc. This research focuses on compliance of chicken meat and chicken egg to meet a big demand in the national or regional requirements. Blitar City is one of the chicken region which net supply the chicken meat and egg for national demand. According to the real topography, Blitar region is divided into two parts for North and South region. Both areas are separated by the Brantas River which is the biggest and the longest river in Java Island. The condition of the North Blitar is a highland with a lot of rivers, hence the land is very fertile and important for agriculture business. Unfortunately, the North area is used for chickened farm expansion that will reduce significantly the agriculture production. In contradiction, the South Blitar Area has fairly critical dry land which is not potential place for agriculture. Based on the research before (Sugiono *et al*., 2014), the total benefit for doing business of chicken farm in South Blitar was not significant different with the Northern region. By the reason of optimization the potential land, the researcher selects the South region as place for development the chicken farm.

The Brown-Gibson Method is employed to select a location that will be used as a development center for poultry. This method combines the consideration of subjective factors and objective factors in specific weight ratio (Brown and Gibson, 1972). The examples of the subjective factors are the attitude of the community, supporting from local officials, working culture and so forth. While the objective factors are labor costs, distribution costs and so forth. Therefore, the purposes of this research are explained as follows:

- Identify the potential areas/villages from the 7 districts in the South Blitar based on the combination of objective factors and subjective factors in the development of the chicken coop
- Able to convert the data (questioner/interview) at points 1 to be used as input in Brown-Gibson Method

Corresponding Author: Sugiono, Department of Industrial Engineering, University of Brawijaya (UB), Indonesia

- Complete the calculation of the Brown-Gibson Method to select the area/village which has the highest potential in the development of poultry
- Researchers were able to estimate the technical and non-technical characteristics on the development of chickens farm in the selected area

MATERIALS AND METHODS

Brown-Gibson Method was developed in by Brown and Gibson (1972). The method integrated the subjective factors and the objective factors as a measurement tool for supporting a decision, allowing decision makers recognize the importance of the criteria in a decision process. The advantage of this method compared with the other methods is more realistic in decision process because of involving subjective and objective/ technical factors. The input data is possible in qualitative or quantitative information. Moreover, the user knows the sensitive behavior of the goal regarding weigh ratio of subjective and objective factors.

The Brown-Gibson methods is used to analyze and to evaluate the alternative locations based on the concept of preference of measurement that combines objective factors (quantitative) and subjective (qualitative). The objective factor is associated with a value or size and subjective factors is associated with the comparison criteria which do not have the size in numerical form. The algorithm of using the Brown-Gibson method is written as follows (Brown and Gibson, 1972):

- Eliminate any alternative site locations that are not feasible for selected. As example, no energy supply, higher land price, higher tax, etc.
- Determine the performance measurement of the objective factors for every locations alternative:

$$OF_i = \left[C_i \sum \left(\frac{1}{C_i} \right) \right]_{-1} \quad (1)$$

- Define the subjective factor that will significantly effect the decision
- Assign a rating factor (W_{ij}) for every subjective factor by using pairwise comparison

The assessment is as follows:

- Point = 1, means "better"
- Point = 0, means "worse"
- Points are both zero or one means "the same"
- Make ranking by pairwise comparison based on subjective factors defined for each alternative location. Ranking is denoted as R_{ij} ($0 \leq 1$ and $\Sigma R_{ij}\ R_{ij} = 1$).
- Define the score of the Subjective Factor (SFI) by combining the following:

$$SFI = W_1 \times W_2 \times R_{I2} R_{i1} + \ldots + W_n \times R_{in} \quad (2)$$

- Combine the objective and subjective factors by weight ratio (weight = 1-k). This calculation will produce a Location Preference Measures (LPM) for each alternative locations exist:

$$LPM_i = k\ (OF_i) + (1-k)(SF_i) \quad (3)$$

- Select the location based on the highest LPM score

The selected location is depended on many factors, precise determination of the location relates to the success of investment in plant establishment. The most difficult part in the process is determining the criteria in order to produce the best alternative.

According to the material of Brown-Gibson, the research is started with a literature review and a preliminary survey in several places in the southern part of Blitar. The observation is divided into 2 parts of factor subjective and factor objective. There are some tools used in the observation as:

- Sound Pressure Level (SPL) for measuring noise near the alternative locations of chicken husbandry
- Thermometer
- Aerometer for measuring air speed and relative humidity near the alternative locations of chicken husbandry

The questioner data contents of:

- Demography data for respondents
- Cost for rent/buy the land
- Availability of land unused, water, electric and employers
- Cost for wages
- Wind speed average, temperature and level of noise
- Local government policy about chicken business
- Level of acceptable from community about chicken husbandry
- Feasibility of transportation
- Complaints and expectation of chicken livestock to government, business partnership in increasing their benefit

RESULTS AND DISCUSSION

There are some basic technical considerations that must be met by all alternative locations before going on stage of calculation the Brown-Gibson Method. The basic factor should be available for building chicken livestock are land, electric and water. Table 1 shows the comparison of feasibility factors for each alternative location for Binangun, Panggungrejo, Kademangan, Wates, Sutojayan, Bakung and Wonotirto region. According to the Table, there are 4 alternative locations that will be used in Brown-Gibson method which are have all technical factors (Binangun, Panggungrejo, Kademangan and Bakung).

The next step is identified the technical factors that will support businessman to select the best area for doing chicken breed. Based on the experience from interview and observation, the technical factors cover employer availability, temperature and climatic factor. The explanation of each each factor is as follows.

Employer factor: Employer factor is identified as total of the people ready to be a worker for breed chicken. There is not need special requirement for the position, mental and physical healthy are the main think to do the best job. Availability of workers is very important for future expansion of chicken husbandry. According to the questioner report, it is divided into 5 scales. There are:

- Scale 1: workers>100
- Scale 2: 50<worker≤100
- Scale 3: 25<worker≤50
- Scale 4: 10<worker≤25
- Scale 5: worker≤10

Temperature factor: Temperature factor is very important in breed chicken. It will influence in stress level of chicken, food consumption, productivity, growth, etc. According to the observation, the researcher clustered the temperature factor into 5 scales for:

- Scale 1: Temperature<20
- Scale 2: 20<Temperature≤25
- Scale 3: 25<Temperature≤27
- Scale 4: 27<Temperature≤30
- Scale 5: Temperature≤30

Climatic factors: Climate factor is one of technical factor in chicken husbandry which described the average of wind speed occurred per year in every alternative locations. The value of wind speed will influence on the chicken livestock and on the chicken healthy. Noise from the wind speed also can influence in the level stress of the chicken. To compare the quality of wind speed for every alternative, it can be categorized into 5 scale for:

- Scale 1: Number of occurred≤2
- Scale 2: 2<Number of occurred≤5
- Scale 3: 5<Number of occurred≤10
- Scale 4: 10<Number of occurred≤15
- Scale 5: Number of occurred≥15

Table 1: Feasibility of basic factors for all alternative locations

	Technical feasibility		
No. of districts	Land	Water	Electric
Binangun	√	√	√
Panggungrejo	√	√	√
Kademangan	√	√	√
Wates	√	-	√
Sutojayan	√	-	√
Bakung	√	√	√
Wonotirto	√	-	-

Table 2: Score comparison in objective factor for every alternative locations

	Objectif factor (scala 1-5)		
Regions	Emp.	Temp.	Climate
District Binangun	3	4	1
District Panggungrejo	5	3	3
District Kademangan	2	4	2
District Bakung	5	4	4

The comparison of objective factors based on 3 approaching in each area alternative can be seen in Table 2. From the table, it can be seen that Panggungrejo district and Bakung District are very good in employer availability. In contrast, Panggugrejo Distric is not enough good in temperature factor and Binangun District is bad in climate factor.

The next step is determine performance measurement (OFi) for factor objective as explained in Table 3. From the table, it can be read that Panggungrejo District and Bakung district have the highest score of Ci to influence in decision making of best location for chicken livestock. According to Table 3 and the objective factor for each alternative location is written as follow:

$$F(1) = [C1\ (\Sigma(1/C1)]^{-1}$$
$$= [8 \times 0.418\ ]^{-1} = 0.299$$
$$F(2) = [C2\ (\Sigma(1/C2)]^{-1}$$
$$= [11 \times 0.418\ ]^{-1} = 0.218$$
$$F(3) = [C3\ (\Sigma(1/C3)]^{-1}$$
$$= [8 \times 0.418\ ]^{-1} = 0.299$$
$$F(4) = [C4\ (\Sigma(1/C4)]^{-1}$$
$$= [13 \times 0.418\ ]^{-1} = 0.184$$
$$\text{Total } \Sigma Fi = 1.000$$

Table 3: Category weight of subjective Factor (OF_i) for each alternative location

Regions	Objective factor (scale 1 s/d 5) Emp.	Temp.	Climate	Total C_i	$1/C_i$
District Binangun	3.000	4	1	8	0.125
District Panggungrejo	5.000	3	3	11	0.091
District Kademangan	2.000	4	2	8	0.125
District Bakung	5.000	4	4	13	0.077
Total ($\Sigma(1/C_i)$	-	-	-	-	0.418

Table 4: Relative importance index for every subjective factors

Subjective factors	Pairwise comparison 1	2	3	No. of preference	Relative importance index
Community acceptance	1	1	2	2	2/4 = 0.50
Commitment from the government	0	1	1	1	1/4 = 0.25
Infrastructure		0	1	1	1/4 = 0.25
Total	-	-	-	4	1.00

The next step after finishing the objective factor is determining the influence of subjective factor in selecting the best option. Factor subjective is more emphasize in perception condition (qualitative) for building chicken livestock. The subjective factor for the problem is:

- Acceptance level from community to build a new chicken livestock
- Commitment from the government to support the breeder in doing chicken business
- Infrastructure index to support in chicken meat/eggs distribution

To do comparison of subjective factor for all alternative location, the forced choice pairwise comparison is employed. The comparison produced important index for subjective factor (W_j) and Ranking (R_{ij}). Based on the interviews and from the questioner, the relative importance index for every alternative location is presented in Table 4.

On the other side, it is important to calculate the site ranking for all subjective factor conducting to all region. Table 5 explained the site ranking score for community acceptance level in 4 alternative regions. It can be seen that Pagungrejo District and Bakung District are good in this aspect with site ranking value = 0.333. On the otherhand, Kademangan District has the lowest score of site Ranking (R1) = 0.111.

Table 6 explained the site ranking score for commitment from the government to support the chicken business in 4 alternative regions. It can be seen that Bakung District is the best performance in this aspect with site ranking value = 0.428. On the otherhand, Kademangan and Panggungrejo District have the lowest score of site Ranking (R2) = 0.148.

Table 5: Site ranking for community acceptance level

Sites	Pairwise compasirson responds 1	2	3	4	5	6	Site ranking (R1)
District Binangun	1	1	0	-	-	-	2/9 = 0.222
District Panggungrejo	1	-	-	1	1		3/9 = 0.333
District Kademangan	-	0	-	1	-	0	1/9 = 0.111
District Bakung	-	-	1	-	1	1	3/9 = 0.333
Total	-	-	-	-	-	-	1.00

Table 6: Site ranking for commitment from the government

Sites	Pairwise comparison responds 1	2	3	4	5	6	Site Ranking (R2)
District Binangun	1	0	1	-	-	-	2/7 = 0.285
District Panggungrejo	0	-	-	1	0		1/7 = 0.143
District Kademangan	-	0	-	1	-	0	1/7 = 0.143
District Bakung	-	-	1	-	1	1	3/7 = 0.428
Total	-	-	-	-	-	-	1.00

Table 7: Site ranking for infrastructure factor

Sites	Pairwise compasirson responds 1	2	3	4	5	6	Site Ranking (Ri)
District Binangun	0	0	1	-	-	-	1/7 = 0.143
District Panggungrejo	1	-	-	0	1		2/7 = 0.285
District Kademangan	-	1	-	1	-	1	3/7 = 0.428
District Bakung	-	-	0	1	-	0	1/7 = 0.143
Total	-	-	-	-	-	-	1.00

Table 8: Summary of site ranking for subjective factor

Factors	Pairwise compasirson respond 1	2	3	4	Site Ranking (Ri)
Sikap Masyarakat	0.222	0.333	0.111	0.333	0.50
Pemerinth	0.285	0.143	0.143	0.428	0.25
Infrastructure	0.143	0.285	0.428	0.143	0.25
Total	-	-	-	-	1.00

Table 7 explained the site ranking score for infrastructure factor to support the chicken business in 4 alternative regions. It can be seen that Kademangan District is the best performance in this aspect with site ranking value = 0.428. On the otherhand, Bakung and Binangun District have the lowest score of site Ranking (R2) = 0.148.

The determining of site ranking for all subjective factors correlated to the region is following by summary of the pairwise comparison respond as shown in Table 8. From the table, it can be explained that community acceptance has the highest score of site ranking for 0.50. Whereas, the commitment of the government and infrastructure factors have the same value in the site ranking with score for 0.25. It indicated that community commitment in developing the chicken livestock is more important aspect than government commitment and infrastructure.

Based on Table 5-7 for pairwaise comparison responds and Table 8 for summary of site ranking, the value of subjective factor can be determined by using formula 2. The result of the subjective values are shown below:

Table 9: LPM comparison for all alternative locations

Region alternative	Objective Factors (OF_i)	Subjective Factors (SF_i)	LPM_i
District Binangun	0.1196	0.1308	0.250
District Panggungrejo	0.0872	0.1638	0.251
District Kademangan	0.1196	0.1188	0.238
District Bakung	0.0736	0.1854	0.259

$$SF_{(District\ Binangun)} = 0.222\times0.50+0.285\times 0.25+0.143\times0.25 = 0.218$$

$$SF_{(District\ Panggungrejo)} = 0.333\times0.50+0.143\times 0.25+0.285\times0.25 = 0.273$$

$$SF_{(District\ Kademangan)} = 0.111\times0.50+0.143\times 0.25+0.428\times0.25 = 0.198$$

$$SF_{(District\ Bakung)} = 0.333\times0.50+0.428\times 0.25+0.143\times0.25 = 0.309$$

The final step of employing the Brown-Gibson Method is calculating the Location Preference Measure (LPM) as shown in formula 3. To use the formula 3, the factor of weigh between objective and subjective factor (k) should be determined before. Based on the observation and from the discussion with breeder, government and chicken business, the k factor was agreed for 0.4. It means that the coefficient of objective factor is 0.4 and the subjective factor is 0.6 linked to formula 3. In sort, the research shows that subjective factor was more dominant than the objective factor in developing the new chicken livestock. According to the value of objective factor and subjective factor, the LPM can be written as in Table 9. The table explained that the best alternative for the problem of selecting location for developing new chicken livestock at sout of Blitar is district Bakung with Preference Measure (LPM) = 0.259 (≈26%). Overall there are good option for 3 region of Distric Binangun, Panggungrejo and Bakung with total = 77%.

One of the other advantage of Brown-Gibson Method is adapting with canging of subjective and objective weight in periode time. It is possible for future condition that the k factor is to be >0.4 becouse of any alterations. To do so, the sensitivity analysis is employed to predict the best choice of alternatif call LPM_i sensitivity. Figure 1 presents the sensitivity analysis for all aternative location based on Subjective factor and Objective factor. It can be concluded that with k<0.4, the Bakung District is cofidenlty the best alternative. In contarst, if k value is >0.6, the best options are District Binangun and Panggungrejo.

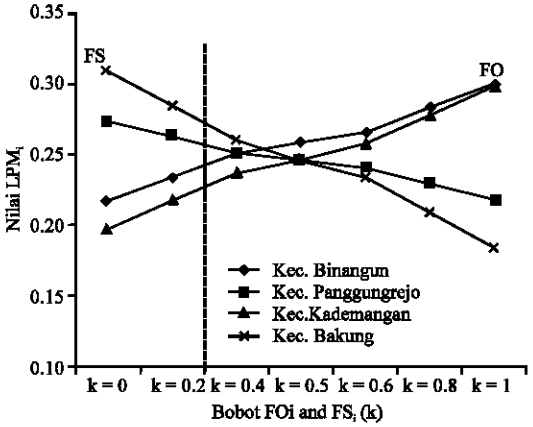

Fig. 1: Sensitivity analysis for all option region based on Subjective and objective weight

CONCLUSION

The research has successfully presented how to employed the Brown-Gibson Method in order to select the best region for developing the chicken livestock in South of Blitar. Following points are the key finding for the research: According to the early survey, there are 4 areas feasible in technical supporting (electric, water and land) to used for developing new chicken livestock. There are District of Kademangan, Bakung, Binangun and Paggungrejo.

Based on the Location Preference Measure (LPM) value with weight comparison k = 0.4 the best alternative is district Bakung. The sensitivity analysis of LPM shows that with k<0.4 (Objective factor dominant) the best option location is Bakung and for k>0.6 the best location are Binangun and Panggungrejo.

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