Selection of Integrators in Malaysia's local broiler industry: Prioritization of critical factors based on Growers' perspectives

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Abstract The Malaysian broiler industry is an integral component of the agriculture sector that generate sustainable food supplies to almost 30 million populations in the country. The industry comprises of conventional and commercial farms for which the latter is more sustainable with contract farming schemes and involvement of major integrators and growers. The survival of local growers as one of the important players within broiler's supply chain hierarchy is largely depending on the integrators. Hence, this study aims to identify critical factors that local growers consider when selecting their integrators. Specifically, the objective is to prioritize integrators' selection factors and to determine the critical ranking of each factor. Analytical Hierarchy Process (AHP) approach is employed to evaluate and rank the importance of the said factors based on inputs from selected broilers' representatives. Five main criteria are identified and considered in the AHP analysis that include relationships, reliability, logistics, input and price. The result indicates that reliability had been given the highest priority, followed by pricing factor, input criteria, relationships with the integrator, and finally the logistics facility. For overall sub-criteria, supplied quantity had been ranked number one, followed by price of raw materials, availability of day-old chick, quality conformance, technology sharing, and in-house logistics facility. In the end, how this study impacted local broiler industry is explained. Certain issues and future direction of this study are also discussed.

Keywords Broiler industry, supply chain, Analytical Hierarchy Process (AHP), pairwise comparison, contract farming

1 Introduction

The Malaysian broiler industry is an important part of the agriculture sector providing employment and producing useful animal protein food for the population, estimated at 25 million people and also to about 4 million people in Singapore. According to [1], Malaysia has one of the highest per capita consumption of chicken in the world. Broiler industry in Malaysia comprises of commercial farms and conventional farms; commercial farms that run business on contract farming basis with integrator and conventional farms that belong to independent entrepreneurs. According to [2], the contracting scheme is therefore more likely to sustain. In 2009 there were 3,300 farms in operation carrying a standing population of nearly 186 million broiler chickens. Of these farms, 22.9% are large farms with more than 50,000 broilers per cycle. According to [3], the states of Johor, Sarawak and Perak were the major producers of broiler which constituted 52% of total national production. In the industry, broiler contracting involves the use of improved technology and production practices. Main players normally have a vertically integrated supply chain and operating as an integrated producer. There are two parties in a typical contract farming arrangement: the grower and the company (Integrator). Integrators recruit large farms (growers) to rear broiler chickens for meat according to contractual guidelines. Farming contracts can also help growers mitigate risks posed by fluctuations of input prices and provide a secure market outlet for their product. Most integrators in Malaysia participated contract farming with growers for broiler production. Consequently, the integrators are always involved in every stage of production. While the important role of integrators is well documented, empirical evidence suggesting which factor to consider when selecting integrators remain limited and inconclusive. The need to identify and to prioritize

integrators' selection factors is timely to both growers and integrators. It is a high time for relevant parties such as the integrators to understand the 'survival' need of the growers and to seek further improvement. Hence, the objective of this study is to determine factors that are critical when selecting potential integrators. In particular, the study aims to prioritize and rank the criteria (selection factors) using the Analytical Hierarchy Process (AHP) method. The remaining part of this paper is organized as follows: Section 2 discusses the AHP method followed by determination of the main criteria and sub-criteria in Section 3. Section 4 discloses the computational works in which the results and sensitivity analysis are discussed. Finally, Section 5 concludes the paper with discussion and recommendation of the study.

2 The AHP method

The Analytical Hierarchy Process (AHP) is a multi-criteria decision making method developed by Thomas L. Saaty in 1970s. One can refer to many of his previous studies on hierarchies, prioritization of decision making factors and the AHP method [4],[5],[6],[7] and [8]. The method has been used extensively in many different sectors such as government, manufacturing, services, engineering and management [9]. According to [10], AHP has been widely employed to decision making in areas such as resource allocation planning. It was also pointed out by [11] that manufacturing sector had been the biggest user of the AHP method. The applications of AHP method in agribusiness was illustrated by [12] in which the method had been used to rank the commodities in terms of the feasibility prospects with the intention of introducing milk futures contracts in Brazil. Study by [13] investigated the usage of AHP for selecting the most suitable bedding material for broiler production in Brazil. In Indonesia, [14] had examined supply chain competitiveness in local food industry using a combination of the AHP and ANP methods. In the meantime, [15] had used AHP method to determine importance ratings and overall index of sustainability of food supply chains. Hitherto, there had been very limited applications of the AHP-related methods in livestock or poultry industry. The AHP method is based on three key steps in which are (1) decomposition, (2) comparative judgement, and (3) synthesis of priorities [16]. This research utilized both primary and secondary data collection methods to get insight into the broiler industry. Primary data were gathered from interviews with four key senior officers from local growers with positions ranging from Managing director to chief business officer. The pairwise comparisons were developed based on key information in the secondary data and input from an experienced chief business officer of a local grower. Special briefing to all selected respondents had been conducted prior to the fulfillment of the questionnaire.

3 Determination of main and sub-criteria

Two approaches had been employed to determine main and sub-criteria that growers consider when selecting local integrators. First, secondary data gathering from relevant articles and journals were carried out in which relevant factors for selection of integrators had been identified. Then, an interview with a chief business officer from a local grower establishment had been conducted to further verify the aforementioned factors and to determine important criteria and the sub-criteria. The following Fig.1 illustrates the main and sub-criteria. Table 2 defines the operational definition for each criteria and sub-criteria. Table 1 depicts the measurement scale that is used in this study and is adopted from [7].
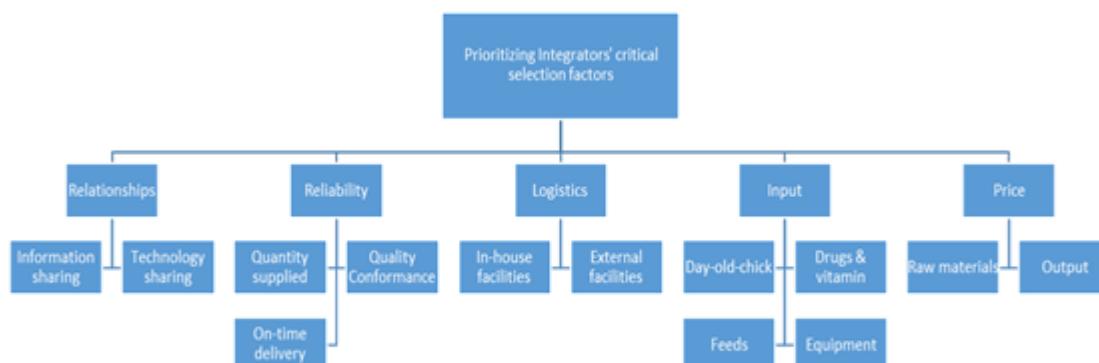
Figure 1 The hierarchy

Table 1 Measurement scales of the level of importance

Importance Level	Denotation	Definition
1	Equally preferred	Both factors in consideration are of equal importance
3	Moderately more preferred	Experience and judgement shows a slightly more preference of one factor than the other
5	Strongly more preferred	Experience and judgement strongly favour one factor over another
7	Very strongly more preferred	An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Extremely more preferred	The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	When compromise is needed. Judgments can reveal an evenly matched preference between the levels of importance

Source: [7]

Table 2 Definitions of the criteria and the sub-criteria

No	Criteria/Sub-criteria	Definition
1	Relationships	The extent of which integrator is willing to foster closer relationships with the grower in terms of sharing of information and technology
2	Reliability	Measured by how reliable is the integrator in terms of quality conformance, accuracy of quantity order fulfillment and on-time delivery
3	Logistics	Refer to whether Integrator has available in-house logistics facilities or external 3rd party logistics (3PL)
4	Input	Relevant input factors of which are offered in the form of chicks, drugs and vitamin, type of feeds, and equipments.
5	Price	Price of the raw materials (input from integrator) and output (buyback price)
6	Information sharing	Willingness of the integrator to share relevant information with the grower
7	Technology sharing	Willingness of the integrator to share the technology and assist the grower how to use them
8	Quantity supplied	Ability of the integrator to supply to grower's demand in terms of quantity
9	Quality conformance	Ability of the integrator to supply quality inputs based on predetermined standards
10	On-time delivery	Ability of the integrator to deliver grower's orders on-time
11	In-house facilities	Capability of the integrator to provide in-house logistics support and facilities to the grower
12	External facilities	Integrator favors the usage of a 3rd party logistics provider to deliver grower's orders
13	Day-old chick	Ability of the integrator to supply 'a day-old chick' to the grower
14	Drugs & vitamins	Types of drugs and vitamins that the integrator use to breed chicks
15	Feeds	Integrator's types of feeds given to the chicks
16	Equipment	Types of equipment and technology that integrator used to breed chicks
17	Raw materials price	The price of chicks and other relevant raw materials the grower has to pay
18	Output price	The buyback price the integrator is willing to pay to the grower

4 The Computational Works

The analysis had been conducted using decision making software, the Expert Choice. For the pairwise comparisons, input from four (4) important respondents were gathered and analyzed. Geometric means were then calculated to determine group judgement. At the end of the analysis, consistency test was carried out.

Table 3 Weights and priorities of each criteria

	Weight of each main criteria with respect to the Goal					
	P1	P2	P3	P4	average	**Rank**
Relationships	0.468	0.044	0.045	0.061	0.098	**4**
Reliability	0.222	0.458	0.441	0.358	0.406	**1**
Input	0.147	0.127	0.186	0.140	0.168	**3**
Price	0.075	0.291	0.246	0.351	0.232	**2**
Logistics	0.089	0.079	0.083	0.091	0.096	**5**

The result in Table 3 indicate that reliability had been given the highest priority, followed by pricing factor, input criteria, relationships with the integrator, and finally the logistics facility. Both reliability and pricing factors were dominantly important, accountable for 63.8% from overall weight with respect to the goal. The least important factor was the logistics. For the overall sub-criteria, Table 4 show

that reliability in terms of supplied quantity had been ranked number one, followed by price of raw materials, availability of day-old chick, quality conformance, technology sharing, and in-house logistics facility. The bottom half of the ranking saw on-time delivery made it as the seventh important sub-criteria, followed by type of feeds, buyback price, information sharing, drugs and vitamins, the equipment used, and finally the 3rd party logistics provider. The results show that reliability in terms of quantity supplied, the price of raw materials, and availability of day-old chick are the top three most important factors that growers consider when selecting integrators. Quality conformance, technology sharing and in-house logistics facility made up the next three high prioritized factors. At the other end, external 3rd party logistics provider, type of equipment used, and type of drugs and vitamins had been ranked as the three least important factors by the growers.

Table 4 Synthesized results of sub-criteria with respect to the Goal

	Synthesized results with respect to the Goal					
	P1	P2	P3	P4	Average*	**Rank**
Relationships						
• Information sharing	0.71	0.006	0.007	0.008	0.033	**10**
• Technology sharing	0.10	0.029	0.028	0.041	0.065	**5**
Reliability						
• Quantity supplied	0.296	0.305	0.277	0.239	0.271	**1**
• On-time delivery	0.080	0.067	0.053	0.046	0.058	**7**
• Quality conformance	0.055	0.116	0.121	0.104	0.092	**4**
Input						
• Availability of day-old chick	0.122	0.085	0.117	0.093	0.112	**3**
• Drugs & vitamins	0.048	0.018	0.031	0.027	0.032	**11**
• Type of feeds	0.032	0.049	0.048	0.044	0.047	**8**
• Equipment used	0.017	0.015	0.017	0.014	0.018	**12**
Price						
• Raw materials	0.169	0.194	0.155	0.234	0.154	**2**
• Output (buyback)	0.019	0.049	0.077	0.078	0.040	**9**
Logistics						
• In-house facilities	0.070	0.053	0.052	0.060	0.064	**6**
• External 3PL	0.009	0.013	0.017	0.012	0.014	**13**

*the average is calculated using geometric mean formula

Overall inconsistency for decision maker P1 is 0.08, P2 is 0.07, P3 is 0.08, P4 is 0.09, while for the group judgement (combined geometric mean) the inconsistency is 0.05. Since all inconsistency is less than 10%, then the pairwise comparison is valid. In the meantime, sensitivity analysis had been carried out to measure how changes in certain criteria or decision maker's priority influence the prioritization of other criterion or the alternatives hierarchy. Using the Expert Choice software, both performance and dynamic sensitivity analysis had been performed. Fig.2 and Fig.3 below illustrated the hierarchy and the prioritization order. Fig 2 illustrated the weights and the prioritization order of each sub-criterion with respect to the main criterion. In Fig.3, it is highlighted that technology sharing, quantity supplied, availability of day-old chick, in-house logistics facility, and raw materials prices were given the highest

weights for each main criteria. Nonetheless, the prioritization order may change upon changes in decision makers' preferences. If closer relationships with integrator is given the highest priority (let assumes an increase of 21.3% for the weight of the relationships criteria from 9.8% to 31.1%), then technology sharing becomes a number two alternative closely behind quantity supplied but way ahead of other factors. Technology sharing will become the most important alternative if the weight of the relationships factor increases to more than 32%. Had a decision maker given more priority to the input factor, the prioritization order will change accordingly. For instance, an increase of weight for the input factor from 16.8% to 35.9% will push the availability of day-old chick into the summit of the prioritization order. Performance sensitivity analysis had indicated that when the price factor increases from 23.2% to 40%, the price of raw materials becomes the most important factor in the prioritization ranking, followed by quantity supplied and output prices. However, it is also worth noting that only with substantial changes in one criteria or decision maker's priority can affect the prioritization order.
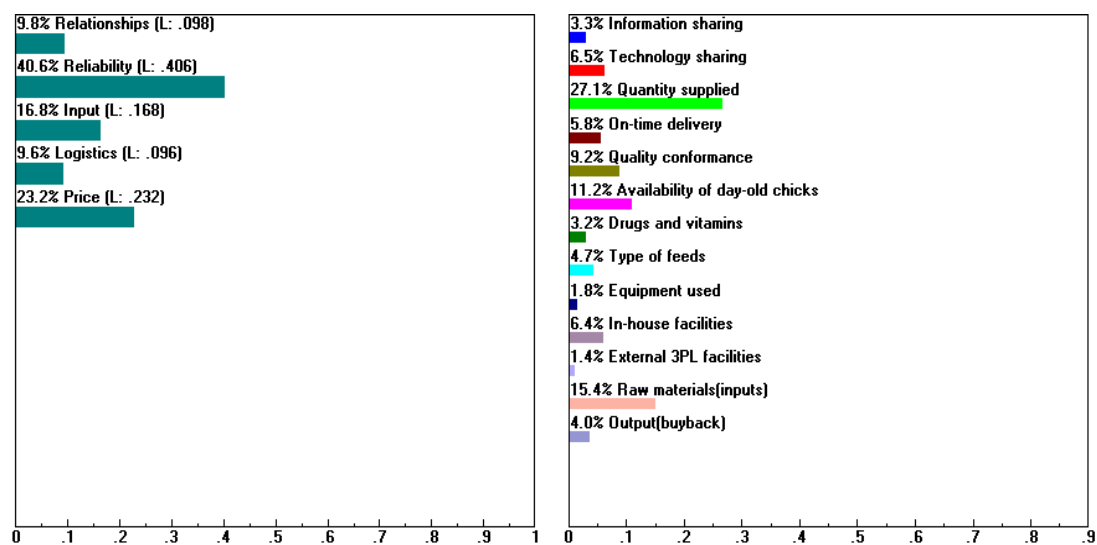

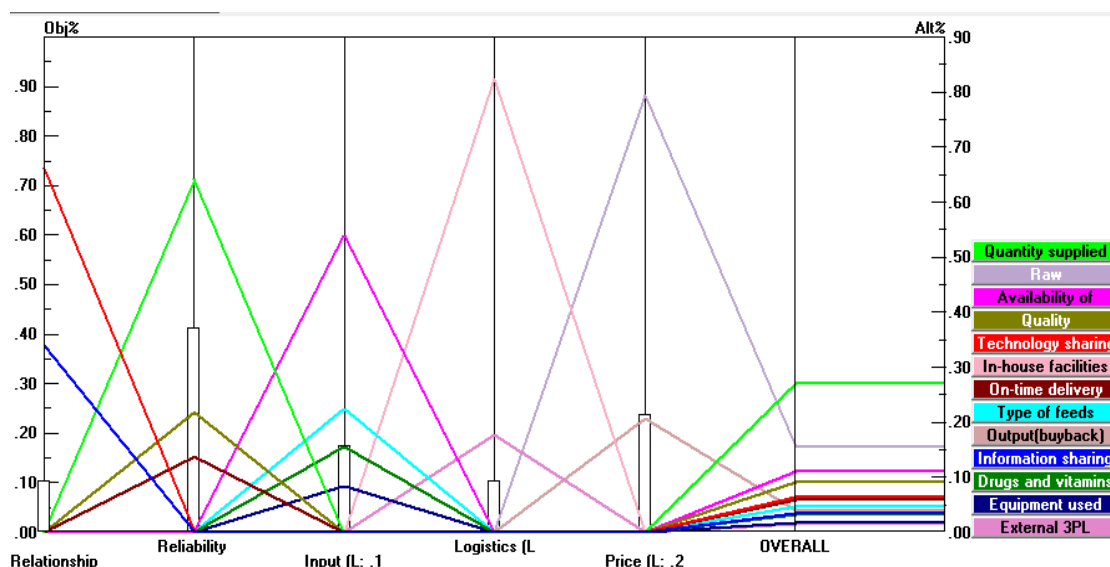**Figure 2 Dynamic sensitivity analysis for the criterion and sub-criterion**

Figure 3 Performance sensitivity analysis for the criterion and sub-criterion

5 Discussion and recommendations

The study aims to facilitate local growers' selection of integrators by determining and prioritizing relevant important factors. Selecting competent and reliable integrators is crucial to the survival of growers in which one is expected to assist the latter in terms of raw materials, equipment and technology, feeding and hatchery, logistics and other support services. The findings show that reliability, followed by price had been given the highest priority when selecting potential integrators. Apparently, having reliable supplies (accuracy in terms of quantity), reasonable and competitive raw materials' prices, and consistent availability of day-old chick had been identified as the top three most important factors. The result, however, may not be generalizable due to small number of respondents. From all four selected respondents, only one stated that relationships was the most important factor when selecting potential integrator. It is therefore concluded that growers prefer a fully integrated partner that has both vertical and horizontal supply chain capabilities. Nonetheless, the extent of which a grower has actually had the luxury to 'select' reliable integrator instead of the integrator choosing its preferable grower remains debatable as the latter has more bargaining power (as well as resources). Hence, avenue for further research may include investigation over integrators' view for grower selection criteria. Potentially, it is an attempt to establish a more holistic supply chain perspectives of Malaysian local broiler industry. The study can also be generalized by getting more respondents from local broiler industry to participate in the survey. This may include key officers from both integrators and growers.

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