Available online at www.sciencedirect.com

ScienceDirect

UMK Procedia 1 (2014) 18 – 25

UMK Procedia

www.elsevier.com/locate/procedia

International Agribusiness Marketing Conference 2013, IAMC 2013, 22-23 October 2013, Kuala Lumpur, Selangor, Malaysia

# Performance of broiler contract farmers: A case study in Perak, Malaysia

Rasak Bin Majid[a] and Sallahuddin Hassan[a,*]

[a]*School of Economics, Finance and Banking, UUM COB, Universiti Utara Malaysia 06000, UUM Sintok, Malaysia*

**Abstract**

Contract broiler farming is one the system used to increase poultry production in Malaysia. Broiler contract farmers (BCF) participate in this system for having some benefits. This paper has evaluated economic performance of the BCFs in Perak. An economic evaluation of 60 BCFs was conducted in Perak to determine the performance of the system using economic performance analysis. Panel regression model was used in the analysis. This model involves price per bird (PRM) as dependent variable and size of farm (SOF), feed conversion rate (FCR), average body weight(ABW), average marketing age (AMA), mortality rate (MOR), and rearing housing system (DU). The results show that all variables, except SOF, are significantly influence the performance of BCF at five percent level of significance.


Peer-review under responsibility of Universiti Malaysia Kelantan.

*Keywords:* Contract broiler farming; economic performance; panel regression model

## 1. Introduction

In Malaysia, poultry is singularly the most important livestock industry and poultry meat has become the staple meat. The production of broiler had increased for the same period due to its ability to meet level of self sufficiency with the technological progress in animal husbandry, nutrition, chicken breed and contract farming

[*]*Corresponding author. Tel.: +0-60125885545; fax: +0-604-9286346.*
*E-mail address: din636@uum.edu.my*


Peer-review under responsibility of Universiti Malaysia Kelantan.
doi:10.1016/j.umkpro.2014.07.003

system that is practised widely (Tapsir, *et al.* 2011). It is estimated that the contract farming system dominate 75 percent of the national broiler production. In that case, shortage of chicken in the market would happen if the broiler contract farming system does not exist in Malaysia. Therefore, it is not surprising that the agenda of ensuring an adequate domestic supply of eggs and poultry is included in the Malaysia's Third National Agricultural Policy (1998-2010). In order to achieve this agenda, an effort to vertically integrate the industry and to stimulate efficiency gains among the small farm sector was singled out as one of the strategies (Sugumar, 2006). As a result, reported by Department of Veterinary Service (DVS) in 2011, broiler production produces 53.2 percent for total livestock production which involve RM10.85 billion in the year 2010, even though Sulaiman *et al.* (2001) estimated that output from contract farming in Malaysia will increase about 55 percent of current broiler production and it is expected to increase further in the future. Meanwhile, broiler consumption per capita had increased from 28 kg in year 2000 to 34 kg in year 2010, an estimated increase of 2.14 percent per year (DVS, 2011).

As of September 2011, there are a total of 3,179 broiler farms in Peninsula Malaysia (see Table 1). The top three broiler-producing states are Kedah, Pulau Pinang and Perak, which account for 60 percent of total broiler population in Peninsular Malaysia. However, the DVS does not come across any information on the commercial parties (i.e. integrators or contract farmers) that operate these broiler farms.

In Perak, particularly, the commercial companies supply all the input production to the contract broiler farms. The companies mostly act as vertically integrators and own the feed mill, parent breeder farms, hatchery, processing plants and marketing division. On average, broiler contract farmer (BCF) manages 10,000-110,000 broiler chickens. BCFs are paid according to the contract agreement between them and integrator based on their broiler performance, particularly final live weight and dressed carcass weight. Therefore, this paper has evaluated economic performance of the BCFs in Perak.

Table 1: Broiler Farms by State (as of September 2011)

| State | Number of farm | Broiler population Number ('000) | % of total |
|---|---|---|---|
| Kedah | 703 | 37,248.5 | 32.1 |
| Pulau Pinang | 592 | 25,663.2 | 22.1 |
| Perak | 335 | 9,928.0 | 8.6 |
| Selangor | 299 | 8,112.3 | 7.0 |
| Negeri Sembilan | 248 | 7,222.8 | 6.2 |
| Melaka | 233 | 6,579.8 | 5.7 |
| Johor | 200 | 6,267.8 | 5.4 |
| Pahang | 187 | 5,915.0 | 5.1 |
| Terengganu | 187 | 5,139.1 | 4.4 |
| Kelantan | 182 | 3,729.5 | 3.2 |
| Perlis | 13 | 180.0 | 0.2 |
| **TOTAL** | **3,179** | **115,986.0** | **100.0** |

Source: DVS

This paper is organized as follows. Section 2 reviews of the determinants of contract farmer system performance are scarce in literature. Follow up with methodology of study in Section 3. Section 4 present result and discussion the impact of size of farm (*SOF*), feed conversion rate (*FCR*), average body weight (*ABW*), mortality rate (*MOR*), average marketing age (*AMA*) and rear housing systems to profit per bird (*PRM*). Lastly, in Section 5 discusses policy implications to improve the BCF performance.

## 2. Literature review

In term of institutional perspective, majority agrees that there are more positive about the potential of contract farming. In principle, contract farming provides significant benefits to those who involve in the system. Glover and Kusterer (1990) and Glover and Ghee (1992) have mentioned that contract farming as an institutional arrangement enables farmers to access markets. While contractual arrangements can vary by crop and by country, contracting is a

form of joint production where the contract farmer's supplies tools, land, labour and management while the integrators supplies technical assistance, some inputs such as seeds or pesticides and undertakes to buy the grower's output at a pre-determined price. From the point of view of the integrators, this arrangement ensures raw material supplies of the desired quality (subject, of course, to production uncertainty). Meanwhile, from the point of view of the contract farmers, such an arrangement provides an assured market and hence reliable income (to the extent permitted by production risks). Without a contract, risks would be too much and few small contract farmers would want to produce these crops. For this reason, Glover (1987) described contract farming as an institutional arrangement that combined the advantages of plantations (quality control, coordination of production and marketing) and of smallholder production (superior incentives, equity considerations).

Glover (1983, 1987) is more positive about the potential of contract farming. Whilst acknowledging the contracts are often exploitive, he also emphasizes that contract farming and out grower schemes have very often led to a significant rise in living standard. His studies have also paid considerable attention to the impact of contract farming on regional development, but he claimed that the issue was not included in the contracts. In addition, Ghee and Dorral (1992) have evaluated the out rower schemes in Malaysia as successful, with a notable success in increasing farmer incomes and national economic returns. The same argument has been given by Miyata *et al.* (2009). Contract farming system is estimated to dominate 75 percent of the Malaysia's chicken meat production through efficient integrated production. However, there are issues shackling this system particularly relating to contract agreement, deposit, marketing freedom, effectiveness of extension services, prices of input-output, risk of losses, technical performance, and impact on farmer life's well-being (Tapsir *et al*., 2011).

Survival of broiler contract farmers actually depends to their performance and profitability. According to D'Silva (2009), contract farming has tremendous potential to boost the agricultural sector in Malaysia to be on par with other sectors that exist in an economy. The survival of this industry depends very much on three major factors namely its effectiveness, ability to withstand obstacles in the competitive market and the competitiveness of those who run this business. Shaikh and Zala (2011) mentioned that to examine and evaluate production performance, the average *FCR*, liveability percentage, *ABW* and *AMA* need to be worked out. Greg (2012) found that feed is typically the most costly expense in broiler production. As a result, feed efficiency or *FCR* is typically the primary tool by which a flock is evaluated. Sharma (2003) mentioned that mortality in broiler flocks represents lost income to growers and integrators alike. According to Samarokoon and Samarasinghe (2012), even though mortality is an everyday part of broiler production, growers should tailor management programs to reduce its overall effect on flock performance. Embrapa (2008) stated that the cycle length or *AMA* is also an important factor when the annual return from the broiler businesses considered. Extending cycle length will increase the return per bird, whereas, shortening the grow-out time will increase the number of harvests per year. According to Genda (2012), efficient feed conversion and excellent growth rate assist in the broiler grower's goal of achieving a targeted weight with competitive advantage of lowest cost.

## 3. Methodology

This study employed panel data. Data in 2012 were collected using survey. Data were collected from the first two rearing cycles in that year for each BCF. In sampling, sixty BCFs were randomly chosen from approximately 335 farmers in three locations in Perak, namely Manjong, Sungai Siput, and Taiping. According to Perak's DVS, there are 70 percent of broiler farms located in district of Manjung. Therefore, ninety percent of respondents were mainly selected from Manjung's district.

For each BCF, the data of price per bird (*PRM*), size of farms (*SOF*), *FCR*, *ABW*, mortality rate (*MOR*), and *AMA* were collected. The *PRM*, as dependent variable, measures the BCFs' performance. This is considered as a major indicator success of the BCF. Other variables are considered as independent variables. In addition, a dummy variable (*DU*) has also been included in the analysis to take into account the effect of rear housing systems, Closed House System (CHS) or Opened House System (OHS), to the BCFs' performance. The dummy variable were given

score 0 for OHS and 1 for CHS.

In particular, panel analysis was employed to perform the evaluation of the economic performance of the BCF system. The panel analysis of the BCF is shown by the following Equation.

$$PRM_{it} = \beta_1 + \beta_1 SOF_{it} + \beta_2 ABW_{it} + \beta_3 MOR_{it} + \beta_4 FCR_{it} + \beta_5 AMA_{it} + \beta_6 DU + \varepsilon_{it};$$
$$i = 1,2,...60,\ t = 1,\ 2$$

where:

| | | |
|---|---|---|
| *PRM* | = | Price per bird (RM) |
| *SOF* | = | Size of farms (number of birds) |
| *ABW* | = | Average body weight (kg) |
| *MOR* | = | Mortality rate (%)* |
| *FCR* | = | Feed conversion ratio |
| *AMA* | = | Average marketing age (days) |
| *DU* | = | Dummy |
| $\beta_i$ | = | Coefficients ($i$ = 1,2,...,6) |

## 4. Results and discussion

Table 2 shows the results of estimation. All coefficients, except coefficient of *SOF*, are statistically significant at five percent level of significance. It means that *ABW*, *FCR*, *AMA*, *MOR*, and *DU* variables are highly significantly affect the performance of the BCF in Perak. For instance, increase one kilogram of *ABW* causes increase *PRM* by RM0.91. This finding is in line with the results of the study by Kleyn (2012). He argued that the most important aspect of broiler production in terms of feed efficiency and growth is to ensure that the birds consume adequate amounts of feed and maximizing technical efficiency. This will improve the *ABW* and automatically will increase the profit per birds.

Furthermore, the table also shows that increases one unit of *FCR*, *PRM* declines by RM1.75 per bird. The effect of *FCR* on *PRM* is considered as the largest compare to other independents. This evidence is supported by Bandara and Dassanayake (2006). They stated that *FCR* is the important factor contributing to the profitability of broiler production. The effect of *FCR* increases with the increasing age of birds on marketing in both sexes is also stated by Samarokoon and Samarasinghe (2012).

---

* MOR is computed using the following formula.

$$MOR = \frac{Size\ of\ \ farm - Number\ of\ \ Livebility}{Size\ of\ \ farm} \times 100$$

Table 2: Estimation Results

Dependent Variable: *PRM*

| Variable | Coefficient | Std. Error | *t*-Statistic | Prob. |
|---|---|---|---|---|
| *C* | 3.407 | 0.328 | 10.399 | 0.000* |
| *SOF* | 3.21E-07 | 4.40E-07 | 0.730 | 0.467 |
| *ABW* | 0.913 | 0.081 | 11.230 | 0.000* |
| *FCR* | -1.749 | 0.195 | -8.950 | 0.000* |
| *AMA* | -0.023 | 0.009 | -2.512 | 0.013* |
| *MOR* | -0.047 | 0.005 | -9.120 | 0.000* |
| *DU* | 0.075 | 0.031 | -2.447 | 0.016* |
| $R^2 = 0.889$ | | | | |
| Adj. $R^2 = 0.883$ | | | | |
| *F*- stat = 150.239 | | | | |
| *D-W* stat = 1.733 | | | | |

The results also indicate that *AMA* and *MOR* are important factors that contribute to *PRM*. If *AMA* increases by one day and *MOR* increases by one percent, *PRM* will decline by RM0.02 and RM0.05, respectively. As stated by Farooq *et al*. (2001), higher market age and smaller flock size would narrow the margin between total gross income and net profit per broiler. It is well-known fact that the FCR increases as the bird gets old (Lesson, 2000). Park and Joeng (1990) and Holsheimer and Veerkamp (1992) from their study also reported better overall performance of broilers marketed at the age of six weeks than at the age of seven through nine weeks. In terms of *MOR*, our findings are similar to the result of the study by Kitsopanidis and Manos (1991). They found that if *MOR* increases by one percent, *PRM* reduces by 2.5 to 10 percent.

The house system chosen by the BCF in rearing broiler significantly affect *PRM*. Since the coefficient *DU* is statistically significant, the study proves that CHS contribute to increase the performance of the BCF. This finding is relevant to Cunningham (2004) statement. According to him, closed houses system provides greater control over the birds' environment. Economic benefits of closed housing include fewer condemnations and downgrades will improve feed conversion, and better livability. Furthermore, he argued that even though the closed housing costs more to build and operate than conventional curtain-sided housing, but economic benefits achieved through improved performances generally offset the additional costs.

The $R^2$ value shows that 88.3% variation of the dependent variable is explained simultaneously by all independent variables. So, it reassures the precession of the model and data gathered.

## 5. Policy implication and conclusion

Since the coefficient magnitudes of *ABW* and *FCR* are higher than other independent variables, these variables are considered to have the highest impact on the *PRM.*

*FCR* is a measure of how well a flock converts feed intake into live weight and provides an indicator of BCF performance at any given feed cost. Increase in *FCR* which is due to many factors that result in an over-estimation or artificial increase in feed usage or an under-estimation of live weight causes decline in *PRM*. Shahvali and Moeinizadeh (2009) in their studied found those factors which can led to high *FCR* were lack of official authority for operation, usage of mash feed, feed supplied by non-official providers, incorrect usage of some technology for hygiene and ventilating, careless the time between two rearing periods, rearing period numbers in the year, chick numbers for a rearing period, early sale of produce, lack of knowledge about feed wastages standard, excessive feeding and incorrect mode of feeding. Therefore, to solve or preventing *FCR* problems, both good planning and good management is requires and in place throughout the brooding until marketing stages.

As discussed in the previous section, we significantly found that increase the *PRM* is mainly due to increase *ABW*. Therefore, BCFs need to improve their broilers' *ABW* to improve the *PRM* value. As concluded by Waine (2002) in his study, a few factors can increase the *ABW*. Those factors are type of breeds which carrying the genetic potential to an attainable goal, quality products or good raw materials, proper feed design, enough water supply, good housing and equipment where chicken to compensate for its surroundings, management in term of the utilization of available resources in order to achieve the maximum performance from the investment, fully support by technical services team and veterinary products and fast action in trouble shooting.

*AMA* significantly affects the *PRM*. Increasing in *AMA* will decrease the *PRM* value. Samarokoon and Samarasinghe (2012) found males should be slaughtered at day 36 to get the optimum return. Depending to size of market, day 40 can be considered as the optimum grows out time for male broilers. Further researches are needed to find out the optimum grow-out period of females. Sex-separate growing can be recommended to broiler operations as male and female broilers since had different optimum grow-out periods when assessing the same parameter of performance to avoid marketing at age which will result of decrease of *PRM* value.

Increase percentage of *MOR* will significantly decrease the *PRM* value. According to Emine (2013), age of the producer, number of family members involve in the production, the budget for producing terms, good management, heating system, coop relaxation time, curtain opening time, weight of the chicks in the broiler and the transportation distance have been found statistically significantly affect *MOR*. She stated the broilers need a certain budget provides for their expenditures such as heating, lightening and work-labour. In her research area, it has been observed that the more the budget increases, the less the death rates become. The broiler farms with the automatic heating system the death rate is relatively less in comparison to the other farms. This is the reason of the necessity for building modern coops with automatic closed heating systems in Turkey.

Since contract farming contributes 70 percent of national broiler production, the government should consider playing part intensively to improve performance of contract farmers. This can be done by providing more technical supports especially the veterinarian to teach and to train BCFs and technicians of integrators the latest technologies in broiler farming. The government should do more research about diseases, birds genetic and raw material quality to improve the production of broilers. Furthermore, BCFs should aware about the important of *FCR, ABW, AMA,* and *MOR* which significantly affects the *PRM*. Based on our results, we would suggest to the government to encourage the integrators to recruit more BCFs with closed house system since the CHS significantly affect the BCFs' performance. The government should also encourage BCFs to convert their present rearing housing system from OHS to CHS by providing special scheme.

Finally, the poultry industry in Malaysia has undergone significant change in the recent past due to vertical coordination in the contract farming system initiated by private companies. The system needs to be reinforced particularly in the aspects of *FCR, ABW, AMA, MOR* and rearing housing system transmission in order to ensure efficiency, effectiveness and sustainability of poultry production through contract farming in Malaysia.

## References

Allen, D.W. & Lueck, D (1995). Risk preferences and the economics of contract. *The American Economics Review*, *85*(2), 447-451.

Agarwal, I., Priya, S., & Bhuvaneswai, S. (2005). Contract farming venture in cotton: A case study in Tamilnadu. *Indian Journal of Agricultural Marketing*, *19*(2), 153-161.

Bandara R.M.A.S. & Dassanayake D.M.W.K. (2006). A quantitative analysis on factors affecting profitability of small scale broiler production, *The Journal of Agricultural Sciences*, *2*(3), 45-50.

Binswanger, H.P. & Rosenzweig, M.R. (1986). Behavioural and material determinants of production relations in agriculture. *Journal of Development Studies*, *22*(**3**), 503-539.

Bisant, K, Fatimah, M.A. & Tan, H.B. (2010). Spatial integration in the broiler market in Peninsular Malaysia, *Journal of International Food & Agribusiness Marketing*, 22, 94-107.

Carstensen, P. (2003). The roles of antitrust and market regulation law in markets for agricultural products, *The Antitrust Bulletin*, *53*(2), 271.

Dileep, B.K., Grover, R.K., & Rai, K.N. (2002). Contract farming in tomato: An economic analysis. *Indian Journal of Agricultural Economics*, *57*(2), 197-210.

Cunningham, D. (2004). Contract Broiler Production: Questions and answers at http://www.thepoultrysite.com/articles/147/contract-broiler-production-questions-and-answers.

D'Silva J.L., Bahaman A.S., & Hayrol, A.M.S. (2012). The March to sustainability of agriculture through contract farming – how will the youth fare? *OIDA International Journal of Sustainable Development*, *3*(11), 59-66.

D'Silva, J. L., Mohamad Shaffril, H. A., Uli, J., & Abu Samah, B. (2009). A review of contract farming and factors that impinge youths acceptance to contract farming. *European Journal of Social Sciences*, *11*(2), 328-338.

Emine I.T. (2013). The Effects of Factors on Death Rate in the Broiler Farms**,** *Journal of Kafkas Univ Vet Fak Derg*, *19*(5), 815-820.

Farooq M., Mian M.A. & Asghar A.(2001). Factors affecting cost of production and net profit per broiler in the subtropics. Livestock research for rural development. 13(1). http://www.cipav.org.co/lrrd/lrrd13/1/

Glover, D. (1983). Contract farming and smallholder outgrower schemes in less developed countries. *World Development*, *12*, 1143-1157.

Glover, D. (1987). Increasing the benefits to smallholders from contract farming: Problems for farmers organization and policy makers. *World Development*, *15*(4), 441-448.

Glover, D. & Kusterer, K. (1990). *Small farmers, big business: Contract farming and rural development*. New York: St. Martin's Press.

Goodhue, R. (2000). Broiler production contract as a multi-agent problem: Common risk, incentives, and heterogeneity. *American Journal of Agricultural Economics*, *82*(3), 602-622.

Government of Malaysia (2012). *Livestock Statistics 2011*, Putrajaya: Department of Veterinary Services (DVS), Ministry of Agriculture and Agro-Based Industry Malaysia.

Government of Malaysia (2012). *Agrofood Statistics 2011*. Putrajaya: Ministry of Agriculture and Agro-Based Industry Malaysia.

Ghee, L.T. & Dorral, R. (1992). Contract farming in Malaysia: With special reference to FELDA scheme in Glover, D. and Ghee, L.T. *Contract farming in Southest Asia: Three country case studies*, Kuala Lumpur: Universiti Malaya.

Gulati, A. (2008). Fragmenting bottom and consolidating top: India's changing food system and implications for small holders in India: Some aspects of economic and social development (eds.) S.Mahendra Dev and K.S. Babu. Academic Foundation, India.

Gray, A.W. and Boehlje, M. (2005). Risk Sharing and Transactions Costs in Producer-Processor Supply Chains, *Choices*, *20*(4), 281-286.

Haque, T. (2000). Contractual arrangement in land and labour market in rural India. Indian *Journal of Agricultural Economics*, *55*(3), 233-252.

Hayrol A.M.S, Jeffrey, L.D., Bahaman A.S., Norsida, M., Jegak, U., and Azmariana, A. (2012). Acceptance towards sustainable agriculture among contract farmers and its impingement factors, *American Journal of Environmental Sciences*, *8*(3), 297-303.

Hennessey, D.A. & Lawrence, J. D. (1999). Contractual relation, control, and quality in the hog sector. *Review of Agricultural Economics*, *21*(1), 52-67.

Key, N. & Runsten, D. (1999). Contract farming, smallholders, and rural development in Latin America: The organization of agroprocessing firms and the scale of outgrower production. *World Development*, 27, 381-401.

Kleyn R. (2012). Feeding broiler chickens for Profit, http://www.spesfeed.co.za/ Feeding_Broiler_Chicken_for_Profit.pdf.

Little, P. D. & Watts, M. J. (1994). Living under contract: Contract farming and agrarian transformation in Sub-Saharan Africa. Madison, WI: University of Wisconsin Press.

MacDonald, J., Ahearn, J. M., Banker, D., Chambers, W., Dimitri,C., Key, N., Nelson,K., & Southard, L. (2004). Contracts, markets, and prices: Organizing the production and use of agricultural commodities. *Agricultural Economic Report* No. 837. United States Department of Agriculture.

Mehta, R., Nambiar, R.G., Delgado C. & Subramanian, S. (2003). Policy, technical and environmental determinants and implications of the scaling-up of broiler and egg production in India. Annex II of the IFPRI-FAO Final Report Livestock Industrialization, Trade and Social-Health-Environmental Impacts in Developing Countries, phase II, International food Policy Research Institute, Washington DC.

Miyata, S., Minot, N., and Hu, D. (2009). Impact of contract farming on income: Linking small farmers, packers, and supermarkets in China. *World Development*, *37*(11), 1781-1790.

Samarakoon S.M.R. & Samarasinghe K., (2012). Strategies to improve the cost effectiveness of broiler production, *Tropical Agricultural Research*, *23*(4), 338-346.

Saran, S., Sasidhar, P.V.K, Sastry, K.V.H., & Singh, R. (2005). Indian poultry industry: Current scenario and future prospects. *Indian Journal of Animal Sciences*, *75*(8), 992- 998.

Perry, J., Banker, D. & Green, R. (1999). Broiler farms: Organization, management, and performance. ERS, USDA: 41.

Shahvali M. & Moeinizadeh H.(2009). Improvement of feed conversion ratio in the broiler farms of Iran by study of effecting factor, Pajouhesh & Sazandegi No 79, 115-127.

Singh, S. (2002). Contracting out solutions: Political economy of contract farming in the India Punjab. *World Development*, 30, 1621-1638.

Singh, S. (2005). Role of the state in contract farming in Thailand: Experience and lessons. *ASEAN Economic Bulletin*, *22*(2), 217-228.

Sugumar S, (2006), Sustainable contract farming for increased competitiveness : case study on poultry sector in Sarawak, Malaysia, http://www.fao.org/ fileadmin/user_upload/ contract_farming/ presentations/ Contract_farming_of_poultry_in_Malaysia_1.pdf.

Tapsir, S. & Sarmin,S. (2008), *Ekonomi pengeluaran dan pemasaran dalam Panduan penternakan ayam pedaging*, Ed. Ke-2, Serdang, Selangor.

Tapsir S., Mokhdzir H.L., Nor Rahim, S. & Jalil, N. (2011), Issue and impact in broiler contract farming in Peninsular Malaysia, *Economic and Technology Management Review*, *6*, 33-57.

Tripathi, R.S., Singh, R. & Singh, S. (2005). Contract farming in potato production: An alternative for managing risk and uncertainty. *Agricultural Economics Research Review*, *18*, 47-60.

Von Braun, J. & Kennedy. E. (1994). Ed. *Agricultural Commercialization, Economic Development, and Nutrition*. Johns Hopkins University Press.

Walne, M. (2002). SAPAInformation/BroilerProduction, http://www.sapoultry.co.za/pdf%20information/ BROILER%20PRODUCTION%20-%20MIKE%20WALNE.pdf.

Wang, H.H., Zhang, Y., & Wu, L. (2011). Is contract farming a risk management instrument for Chinese farmers?: Evidence from a survey of vegetable farmers in Shandong. *China Agricultural Economic Review*, *3*(4), 489-505.