

# Does Poultry Industry Manage Sustainable Production of Chicken Meat? An Empirical Study in Malaysia

K. Jayaraman, Aref Tabandehhaghghi, Sofri Yahya, S. Kiumarsi

**Abstract** – The modern poultry production is an important and diverse component of agriculture and it occurs primarily in enclosed buildings to protect the birds from weather, predators, and the spread of diseases from wild birds. The most favorable agribusiness product in Malaysia after Palm oil and rubber is chicken meat, which is the major source of animal protein and gains importance in the Malaysian diets. Jayaraman et al., (2012) studied the factors that influence consumer attitude towards chicken products in Malaysia. The present study focuses on the maintenance management towards the sustainability of chicken meat production in Malaysia. The findings of the present empirical study reveal that proper management of water and manure inside the poultry, timely disposal of the dead bird, minimum wastages and litter free environment, appropriate nutrition, and accurate vaccination and treatment results in higher chicken production. Further, the results enlighten that the Malaysian poultry may adopt a new technology to be borrowed from the developed countries to safeguard poultry birds which in turn lead to sustainable production.

**Keywords** – Poultry Industry, Litter-Free Environment, Vaccination and Treatment, Sustainable Production, Maintenance Management.

## I. INTRODUCTION

According to the global poultry trends 2013, Asia consumes 40 per cent of world's chicken and is estimated to consume 42.5 million tonnes in the year 2013 while the corresponding figure reported in Asia was 35.4 million tonnes in 2009 of the world total.

The chicken production and consumption in Malaysia is projected to increase by 24% in 2013.

This is due to the increased demand from consumers of higher income group and the perceptions that poultry meat is healthier than other meats (FAO, 2013). Currently, Malaysia faces challenges in increased population growth, competition for land, water resources, industrial and urban growth, climate change, and need to protect the environment. In Malaysia, the term livestock is referred to poultry (broiler and egg) and swine industry. In terms of the yield value, the chicken and swine farming represent undoubtedly the major proportion of the livestock industry. The Malaysian people prefer and consume more chicken meat and the determinants of chicken lovers were studied in Jayaraman et al., (2012).

Although there were many projects conducted on inhibition of the shortage of chicken, it is not surprising that Malaysia's Third National Agricultural Policy (1998-2010) included as one of its objectives, ensuring an adequate domestic supply of poultry products, but it seems that until now these projects and Policies did not reach to success. Johor Agriculture and Agro-based Industry shows that the largest shortage in poultry products which was occurred during July 2013 particularly during the

Ramadan and Aidilfitri, and the Malaysian government decided to import chicken from other countries like Thailand, china, and Indonesia. Thus, to meet the unforeseen circumstances, the sustainability of chicken production is very important, especially for the countries like Malaysia where the citizens are fond of chicken meat. Sustainability is generally defined as the capability to meet existing requirements without compromising the needs of future generations. With the increasing awareness of the consumers on the environmental issues, the private and public industries gradually want to buy more green products which have lesser negative impact on the environment. One of the strategy firms adopt for reducing the negative environmental impact and increased the production was to apply the method of maintenance management in their production strategic plan (Mobley, 1990). The Maintenance Management is a system that operates in parallel to production and can have a major impact on the capacity for production and quality of product produced and then as a result, deserves continuous improvement in industrial environment. Malaysia has around 4.06 million hectares of agricultural land distributed throughout 13 states and two Federal territories, agriculture is only the third force of growth for Malaysia. About 75% of the land is cultivated with primary crops such as palm oil, rubber, cocoa, coconut and pepper, the remaining portion is dedicated to agro-food production but still Malaysia is expected to remain highly dependent on imports on many agricultural products, including beef, dairy products, sheep meat, to a lesser extent rice and sometimes poultry products.

It is estimated that Malaysia Population in the next five years may increase from 29.96 million in the year 2013 to 32.60 million in 2018, and due to this, the country needs more production of chicken meat to cater the needs of the consumers. The contamination of natural resources and the limited availability of natural resources, particularly clean water and soil is the most limiting factor to overcome food insecurity in the region. Using the right maintenance management in Poultry industry, one can optimize the level of energy towards controlling all wastage aspect of energy (Albert & Tsang 2002). Interestingly, the neighbouring country Singapore also has the limited production of agricultural products and imports food (Tey et al., 2009). Thus, the present study is focussed to determine the significant factors that influence the sustainability of chicken production in poultry industry in Malaysia in the context of maintenance management.

## II. LITERATURE REVIEW

The sustainable production is defined as a system of production that integrates concerns for the long-term

viability of the environment, health and safety of product as well as to the welfare of the consumers. Sustainable production is a system that unifies typically fragmented components of environmental and occupational health and safety and uses their interdependence to the advantage of each of the areas of concern (Geiser & Moure-Eraso, 1998). It is understandable that if the company has to be sustainable in the market, it has to ensure in manufacturing products without creating environmental damage or disobeying social standards (Seuring, 2004). The commercial benefits of environmental improvement may be realized by the companies as motivating drivers to initiate sustainable products production (Hansmann & Kroger, 2001). Sustainability plays a significant role to solve many environmental problems and help to increase production without contamination and destroy the natural resources, (Sharma, 2010). Due to the rising importance of environmental sustainability across the world, sustainability is becoming a more important value, which affects all areas of agribusiness (Moffett, 2008). Agribusiness industries must be practiced with the least possible damaging effect to the natural resource base, yet meet the highest health and quality standards. The sustainable farming approach is a new thing in Malaysia and Eco-friendly farming has its own niche market and is rapidly growing (Haji Harron, et al., 2001). The poultry industry is one of the biggest and fastest growing agrobased industries in the world particularly in the area of poultry meat and egg products. There are many challenges in poultry industry like large-scale accumulation of wastes consist of, manure and litter which may pose disposal and pollution problems unless the sustainable management technologies regarding to the environmental and economical are evolved (Power & Dick, 2000).

The broiler industry in Malaysia is progressing steadily towards one million ton production of chicken meat in the year 2012, while the total chicken meat output may come close to 1.5 million tons in 2013, based on the FAO stats, (GPT 2012). However, the sustainability of this trend of chicken meat production in the future is questionable and therefore proper maintenance management has to be planned in advance. Basically, the maintenance management system is a process for more effective and efficient planning, organizing, directing, and controlling of maintenance work. It begins with setting specific quantitative work objectives and then follows through the complete management cycle to ensure that actual performance is consistent with the objectives. It is very necessary to educate companies to better understand the advantages and approaches of government policies on sustainable production through maintenance management as an innovative strategy (Xianbing Liu & Jie Yang, 2012). In terms of continuing productivity, profitability, and sustainability in the poultry industry, the formulation of best maintenance management practices is of paramount importance (Moore, et al., 1995, Szogi & Vanotti, 2010). Castellini et al., (2006) postulates the need to further explore sustainable production through maintenance management due to the recent concerns about productivity in poultry industry. Till date, productivity in

poultry industry literature provides little help in understanding sustainable production (Veleva, 2001). There is a gap in academic knowledge to address sustainable production through maintenance management issues in poultry industry and therefore the present study is initiated. However, Marquez et al., (2005), and Kratz, et al., (2004) have discussed on sustainability aspect which are needed for poultry houses or other livestock related companies but these aspects were not tested empirically and have discussed either conceptually or with qualitative methods. Khaleda (2013) described on the location of poultry and mentioned that the wide paved roads make it possible for agents to come up to the farm gate with their large pick-up vans, and thus helps him to make higher profits, as he does not need to carry the eggs by rickshaw van to the pick-up vans, as some of the other farmers need to do, thus incurring a cost for transport owing to their position away from the paved road. Gbotosho and Burt, (2013) investigated on the sources of feed additives commonly used by the farmers, protective equipments, source of water on the farm and local regulations that apply to construction of poultry houses, and environmental and health impacts of waste disposal (air quality, well location and water quality, the type of any respiratory disease prevalent among poultry farmers, and the illnesses commonly encountered during manure disposal and during or after drinking the water on the farm).

### III. CONCEPTUAL FRAMEWORK

The conceptual Framework (Figure 1) shows the layout of sustainable production of chicken meat through maintenance management in poultry industry. The framework has seven independent variables namely location, maintenance external management, maintenance internal management, nutritious, protection, technology, vaccination & treatment and the dependent variable is sustainable production of chicken meat.

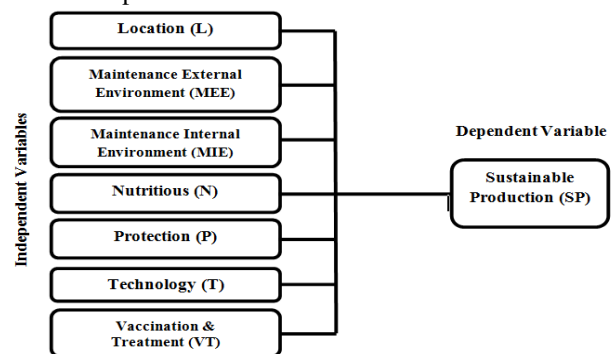


Fig.1. Conceptual Research Framework Hypothesis Development

In accordance to the conceptual framework, hypotheses are developed in order to determine the significance of the relationships among the groups of variables. Based on the utilization of seven types of influencing factors that is, location, maintenance external management, maintenance internal management, nutritious, protection, technology, vaccination and treatment, seven hypotheses were

constructed to examine the direction and magnitude of relationships among these variables.

Prabakaran, (2003) suggested that the profitability in commercial poultry depends not only on efficient production, but also on the proper location of the poultry. Khaleda, (2013) remarked that the most important things, related to the location of the poultry farm, are its flood-free location, as well as its good communication and transportation facilities. These points lead to formulate the hypothesis:

*H1:* Location has a direct positive effect on sustainability in poultry production industry

Mu'azu, Mohamed, and Shamsudin, (2013) employed the structure-conduct-performance paradigm to assess competition in the supply chain of the Malaysian poultry industry. The approach is widely used to analyze competitive conditions in industries by examining how the structure of the industry relates to the market conduct and performance. This lead to formulate:

*H2:* Maintenance External Environment has a direct positive effect on sustainability in poultry production industry

Shamsuddoha and Nasir, (2013) have suggested some processes for the poultry entrepreneurs to utilize their poultry wastes to make economically viable by-products. This type of processes not only utilize poultry wastes but also keep environment intact for future generation with clean hygienic and prevent from common poultry diseases. This leads to formulate:

*H3:* Maintenance Internal Environment has a direct positive effect on sustainability in poultry production industry

Manning, Baines, and Chadd, (2006) have studied the measurable indicators for the effective food safety management which are one of the key issues in the poultry meat industry. It leads to formulate:

*H4:* Nutritious has a direct positive effect on sustainability in poultry production industry

Manning and Baines, (2004) investigated the supply chain aspect of poultry industry like how to manage risk, ensure flexibility and quality of service, become more innovative and interdependent with other partners of the supply chain. It leads to formulate:

*H5:* Protection has a direct positive effect on sustainability in poultry production industry

Sharma, (2010) has studied the hygienic poultry production which pave way to better income and sustainable development. The poultry health management is important due to emergence of highly pathogenic diseases like Highly Pathogenic Avian Influenza (HPAI) in different parts of the world. The latest technological innovations may help adoption of bio-security measures and environment friendly practices in poultry production system. It leads to formulate:

*H6:* Technology has a direct positive effect on sustainability in poultry production industry

Chapman et al., (2002) studied the factors that affect the reproductive efficiency of non-attenuated and attenuated vaccines which are considered as the key role for cyst production to maintain uniform immunity in a flock of

chickens. Flock, Laughlin, and Bentley, (2005) have discussed on the modern poultry industry which have a remarkable record in reducing mortality, applying a combination of effective disease control, adequate nutrition, good husbandry and genetic selection. This leads to formulate:

*H7:* Vaccination & Treatment has a direct positive effect on sustainability in poultry production industry.

## **IV. RESEARCH METHODOLOGY**

The present study is a cross sectional study in which the primary data were gathered twice. The pilot study was carried out first with 14 respondents. The final survey was carried out with 73 respondents over a period of 8 weeks. The study was confined to willing farms respondents in Malaysia as some poultry did not like to share information. The unit of analysis is one among the managers, supervisors, animal keeper or veterinarian who works and has an adequate knowledge and experience on the poultry maintenance and with the cycle of production. The research site for the study is farms, and broiler companies which are in the process of producing chickens and poultry meats in Malaysia. A total of 179 questionnaires were administered to the respondents holding different positions in the poultry industry. Out of 179 questionnaires, 73(40.8%) have responded positively after repeated visits to poultry industry located in different places of Malaysia. Fortunately, all the 73 questionnaires were useful for the purpose of data analysis (Table 3, Appendix) in which 80.8% of the respondents were males and 19.2% were females. The majority of the respondents between 31 to 40 years accounted for 34.2% of the total respondents and followed by 30.1% of the respondents between 41 to 50 years, 23.3% of the respondents between 21 to 30 years old. About 49.3% of the respondents have educational level at under-graduate degree, while 41.1% have diploma, and the rest have postgraduate degree. Those respondents having managerial position in the poultry industry constitute 42.5% followed by 30.1% in supervisory position, 23.3 were animal keeper and 4.1% in veterinarian position. With regard to disposal of dead bird, more than 40% opted for bury method, 6% opted for burn method, 2.7% were thrown in the rubbish pile and 5.5% were thrown the dead bird to the river. About 58.9% opted for composed method and use disposed dead birds for manure and fertilizer (Table 4, Appendix).

The collected data were analyzed through VB-SEM using smart PLS 2.0 version. The first step in PLS is to establish the reliability and validity of the measurement model. In PLS, the composite reliability is preferred over Cronbach alpha, due to its supposition of equal weightings of items; a better estimate can be gained using the composite reliability formula (Chin, 1998). Table 1 presented below illustrates the measurement model. The main loading for all the indicators is above 0.5, the composite reliability (CR) ranges from 0.721 to 0.84 and the average variance extracted (AVE) is above 0.5 for all latent variables. Hence, the convergent validity of the measurement model was established (Gefen et al., 2000).

Table 1: Measurement model of PLS Analysis

Latent Variable	Factor Loadings	CR	AVE
Location (L)	0.858	0.830	0.623
	0.841		
	0.652		
Maintenance External Environment (MEE)	0.999	0.741	0.616
	0.484		
Maintenance External Environment (MIE)	0.695	0.825	0.543
	0.740		
	0.838		
	0.662		
Nutritious (N)	0.648	0.721	0.567
	0.845		
Protection (P)	0.864	0.811	0.682
	0.787		
Sustainable Production (SP)	0.787	0.840	0.570
	0.830		
	0.651		
	0.739		
Technology (T)	0.743	0.775	0.633
	0.846		
Vaccination and Treatment (VT)	0.512	0.807	0.520
	0.644		
	0.868		
	0.806		

The discriminant validity (Table 2) refers to the extent to which a specific construct is different from other constructs. One criterion of discriminant validity is that a construct should share more variance with its measures than with other constructs. Following Tsang (2002), we measured the square root of the AVE for each construct to

assess discriminant validity. These square roots were greater than the correlations between constructs, which measures discriminant validity. Each latent variable loaded more on the construct than on any other constructs. Thus, the discriminant validity criteria have been verified for all latent variables.

Table 2: Discriminant validity

	L	MEE	MIE	N	P	SP	T	VT
L	<b>0.789</b>							
MEE	0.148	<b>0.785</b>						
MIE	0.431	0.063	<b>0.737</b>					
N	0.118	-0.080	0.192	<b>0.753</b>				
P	-0.285	0.272	-0.158	0.297	<b>0.826</b>			
SP	0.169	0.330	0.234	0.301	0.209	<b>0.755</b>		
T	-0.039	0.140	0.353	0.170	0.259	0.200	<b>0.796</b>	
VT	0.368	-0.038	0.160	0.173	0.241	0.320	0.055	<b>0.751</b>

\*The bold number in the diagonal row is the square root of the average variance extracted.

The beta values and the R-squared value (Figure 2) in PLS, can be read in a manner alike to multiple regressions, (i.e. the standardized coefficients designate the relative strength of the statistical relationships and R-squared value contributes for explainable variation). In the second step of PLS, we conducted a test of significance for all paths using 5000 iterations of the bootstrap re-sampling procedure and a one-tailed t-test (Figure 3).

The results of the analysis are shown in Table 5. The coefficient of determination  $R^2 = 0.429$  and is highly

significant. There is no multi-collinearity issue among the independent variables as the variation inflation factor (VIF) is less than 5. Out of the seven direct effects (path coefficients), three direct effects were found to be significant namely the location of the poultry ( $t = 2.168$ ,  $p < 0.05$ ), maintenance internal environment ( $t = 2.331$ ,  $p < 0.01$ ), and the vaccination and treatment ( $t = 2.430$ ,  $p < 0.01$ ) on the sustainable production of chickens. Thus, the hypotheses H1, H3 and H7 were all supported.

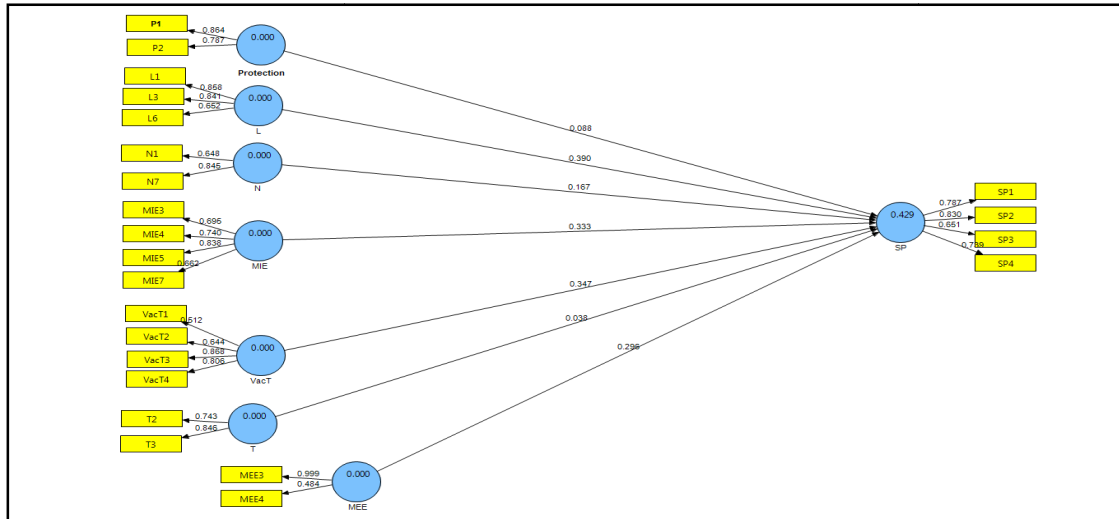


Fig.2. PLS- Path diagram of beta values and R-squared values (n=73)

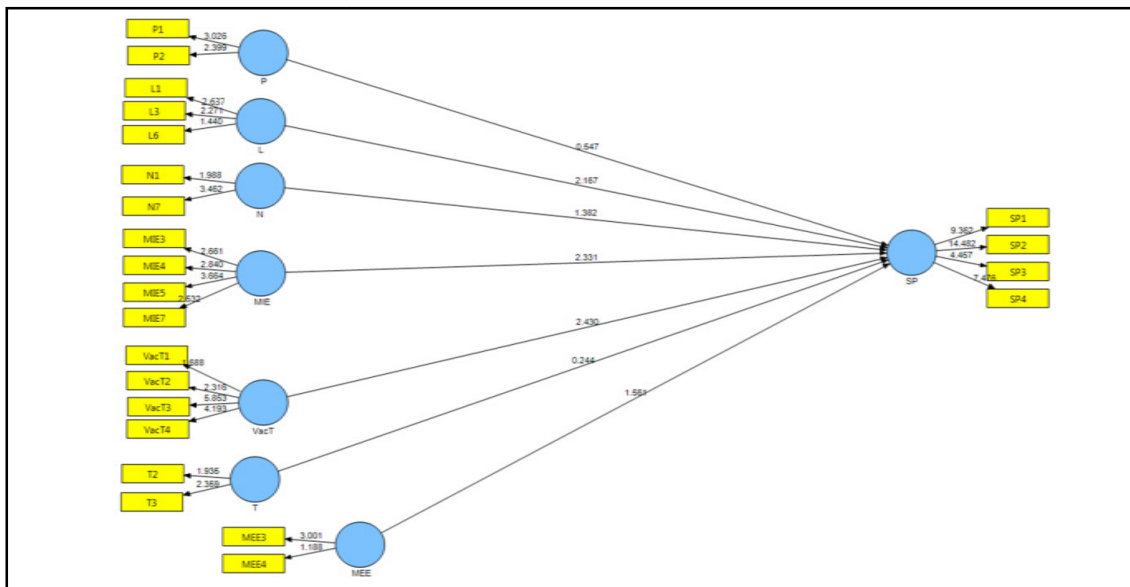


Fig.3. PLS-Path diagram of bootstrap analysis with t-values (n=73)

Table 5: Summary of PLS analysis and Predictive Inference

	Relationship	Path Coefficient	Std-error	t-value	Decision
H1	L -> SP	0.390	0.180	2.168*	Supported
H2	MEE -> SP	0.296	0.190	1.561	Not Supported
H3	MIE -> SP	0.334	0.143	2.331**	Supported
H4	N -> SP	0.167	0.121	1.382	Not Supported
H5	P -> SP	0.088	0.161	0.547	Not Supported
H6	T -> SP	0.038	0.156	0.244	Not Supported
H7	VT -> SP	0.347	0.143	2.430**	Supported

Note: \*p<0.05, \*\*p<0.01

## V. DISCUSSIONS AND CONCLUSION

The variance based structural equation model of PLS results reveal that Location of poultry industry has a positive effect on sustainability in poultry production and this result is consistent with (Goan, 2001, Henderson, 2005). Prabakaran (2003) commented on the location of

the poultry which includes proper planning in choosing the location, proper design of the poultry houses, arranging for quality inputs such as chicks and feed, adopting appropriate rearing techniques, and taking adequate disease-control measures, to ensure high efficiency and productivity. Further, the appropriate location of poultry may reduce complains from residential quarters which may lead to serious consequences. The maintenance

internal environment (MIE) is positively influencing on sustainable production in poultry industry. This proves that managing the internal situation of the poultry houses is very essential and important to improve sustainable production performance of chickens. The proper management of water and high quality usage of manure in the poultry results in higher productivity and less harm to the environment (Bolan, 2010). The poultry wastes create a major problem like occupying space, creating bad smell and polluting the major chunk of the poultry. It is worthwhile to mention that the poultry wastes may be converted in to economically viable by-products (Shamsuddoha and Nasir, 2013). One of the most important factors which can continuously keep the poultry in healthy and productive may be due to accurate vaccination and treatment, (Ram & Khan, 2010). The process of vaccination and treatment may be carried out in periodic intervals in order to have check and balances for preventing any unforeseen epidemic diseases. The poultry may be considered in the order if it provides healthy disease-free chickens without the heavy use chemical medications, (Linares, 2013). Malaysian government has implemented a complex plans for vaccination and fast treatment especially for poultry industry to prevent epidemic diseases.

With regard to maintenance external environment (MEE), urban air quality, river water quality, deforestation, household and industry wastages and hazardous wastes are some of the challenges on environmental issues faced by Malaysia. However, the factor MEE does not show any influence on sustainable production of chicken in poultry industry. This is because of the regular environmental monitoring includes regular analysis of manure samples, maintaining accurate records of all activities in the farm, and regular soil and drainage water sampling and their analysis for nutrients and other contaminants. In addition, the poultry industry in Malaysia maintains litter-free zones and disposes contamination stuff in an effective manner. Animal products like beef, pork, lamb, chicken, and fish contain high levels of nutrient metals, such as iron and zinc. Poultry meats are also rich sources of protein and substances that counteract the negative effects of anti-nutrients found in many staple plant foods, thereby promoting the bioavailability of iron, zinc and other micronutrients in mixed diets (Graham & Welch, 1996, Welch & House, 1995). One of the major problems in the tropical country is the weather conditions in which poultry industry is worst affected. The heat stress compromises performance and productivity through reduction in feed intake, decrease in nutrient utilization, and decline in growth rate & egg production, leads to massive losses in poultry production. In terms of reducing the negative effects of environmental stress on poultry production, antioxidants are used in poultry feed because of the reported benefits of these supplements, including their anti-heat stress effects (Sahin et al., 2012). Odetallah et al., (2003) discussed on the effect of supplementary diet on broiler starter feed with protease or keratinase which showed significant improvements in growth of chickens. However, the factor Nutritious does not show any

influence on sustainable production of chickens in Malaysian poultry industry. The basic level of protection has been always maintained in Malaysian poultry industry and therefore the factor protection was not significantly influencing the production of chickens. To protect the birds from theft, poultry in Malaysia engages strong dogs in the poultry house which works well to discourage predators and unwanted visitors.

Indeed, history confirms that technology has been vital to agricultural and agro base products' productivity, current breakthroughs in technology confirm that the discovery and development of new technologies is a sustainable endeavour, and common sense directs us to the conclusion that technology enables sustainable agriculture, (Hutchins, 2004). One of the new technology poultry houses in Europe engages is Compact fluorescent lights (CFL). CFL is currently available in sufficient voltage and a standard CFL does not have dimming capabilities. Because of their spiral design, dust and dirt can accumulate on CFLs in the poultry environment. CFLs are also more fragile to clean than a standard bulb. Still Malaysia is far from using these applications and technology in their poultry farms and the factor technology have no significant influence on the sustainable production in Malaysian poultry houses.

In the past, Malaysia was self-sufficient with regard to the most favorable chicken meat, but now due to the above stated reasons there is stagnation on chicken growth rate during the years 2012-13. Malaysian poultry industries need to strategize their maintenance management on a long-term basis keeping the objective of sustainable production. Most of the respondents of the study feel that to strengthen the sustainable production of chickens, the Malaysian poultry industries require significant increase in capital investment, education and training of poultry's managers and personnel who want to adapt to newer technology. On the contrary, applying technology and tools like machinery, tools with low consumption and high efficiency, CCTV technology and renewable energy may involve huge investment to the industry.

## ACKNOWLEDGEMENTS

The authors are thankful to the two reviewers for their valuable suggestions and comments in improving the quality of the paper.

## REFERENCES

- [1] Albert H.C.& Tsang. (2002). Strategic dimensions of maintenance management. *Journal of Quality in Maintenance Engineering*, 8(1),7 – 39.
- [2] Bolan, N.S., A.A. Szogi, T. Chuasavathi, B. Seshadri, M.J. Rothrock, Jr., and P. Panneerselvam. 2010. Uses and Management of Poultry Litter. *World's Poultry Science Journal* 66:673-698.
- [3] Castellini, C., Bastianoni, S., Granai, C., Bosco, A. D., & Brunetti, M. (2006). Sustainability of poultry production using the emergy approach: Comparison of conventional and organic rearing systems. *Agriculture, ecosystems & environment*, 114(2), 343-350.
- [4] Chapman, H., Cherry, T., Danforth, H., Richards, G., Shirley, M., & Williams, R. (2002). Sustainable coccidiosis control in

- poultry production: the role of live vaccines. *International journal for parasitology*, 32(5), 617-629.
- [5] Chin, W. W. (1998). Issues and opinion on structural equation modeling.
- [6] Flock, D., Laughlin, K., & Bentley, J. (2005). Minimizing losses in poultry breeding and production: how breeding companies contribute to poultry welfare. *World's Poultry Science Journal*, 61(2), 227-237.
- [7] Gbotosho, O., & Burt, P. J. (2013). Environmental and health impacts of poultry manure disposal methods: a case study of Lagelu and Egbeda local government areas in Oyo State, Nigeria. *International Journal of Agricultural Sustainability*, 11(1), 38-51.
- [8] Gefen, D., Straub, D., & Boudreau, M. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems*, 27 (1), 1-78.
- [9] Goan, Ch. (2001). Site Selection Factors for New Poultry Facilities. The University of Tennessee Agricultural Extension Service, SP592-1M-11/ 01 E12-4415-00-005-02.
- [10] Graham, R.D., Welch, R.M. (1996). Breeding for staple-food crops with high micronutrient density. *Agricultural Strategies for Micronutrients. Working Paper 3. International Food Policy Research Institute, Washington, D.C.*
- [11] Hansmann, K.W., & Kroger, C. (2001). Environmental management policies. In: Sarkis, J. (Ed.), *Green Manufacturing and Operations: From Design to Delivery and Back*. Greenleaf Publishing, Sheffield, UK, pp. 192e204.
- [12] Harron, M.H, Shamsudin, M.N., and Abd Latif, I. (2001). Agribusiness Management towards Strengthening Agricultural Development and Trade. *International Symposium. Chiang Mai University National Chung Hsing University The Ministry of Agriculture and Cooperatives.*
- [13] Henderson, S.R. (2005). Managing land-use conflict around urban centres: Australian poultry farmer attitudes towards relocation. *Applied Geography*, 25(2), 97-119.
- [14] Hutchins., Scott, H. (2004). The Role of Technology in Sustainable Agriculture. *Radcliffe's IPM World. Textbook. University of Minnesota, 1 Jan. 2004. Web. 22 Apr. 2012. <http://ipmworld.umn.edu/chapters/hutchins3.htm>.*
- [15] Jayaraman, K., Munira, H., Chowdhury, D., & Iranmanesh, M. (2012). The preference and consumption of chicken lovers with race as a moderator An empirical study in Malaysia. *International Food Research Journal* 20(1): 165-174.
- [16] Khaleda, S. (2013). The poultry value chain and sustainable development of poultry microenterprises that utilize homestead lands: A case study in Gazipur, Bangladesh. *Land Use Policy*, 30(1), 642-651.
- [17] Kratz, S., Halle, I., Rogasik, J., Schnug, E., 2004a. Nutrient balance indicators for sustainability of broiler production systems. *Brit. Poultry Sci.* 2, 149-157.
- [18] Linares J.A. (2013). Chicken Diseases and Prevention Tips. Popular farming series chickens. Retrieved from <http://www.hobbyfarms.com/livestock-and-pets/chicken-disease-prevention-basics.aspx>.
- [19] Liu, X., Yang, J., Qu, S., Wang, L., Shishime, T. and Bao, C. (2012). Sustainable Production: Practices and Determinant Factors of Green Supply Chain Management of Chinese Companies. *Bus. Strat. Env.*, 21: 1-16. doi: 10.1002/bse.705
- [20] Manning, L., & Baines, R. (2004). Globalisation: a study of the poultry-meat supply chain. *British Food Journal*, 106(10/11), 819-836.
- [21] Manning, L., Baines, R., & Chadd, S. (2006). Food safety management in broiler meat production. *British Food Journal*, 108(8), 605-621.
- [22] Marquez, E., Bracho, M., Archile, A., Rangel, L., & Benitez, B. (2005). Proteins, isoleucine, lysine and methionine content of bovine, porcine and poultry blood and their fractions. *Food Chem.* 93:503-505.
- [23] Mobley, R.K. (1990). *An Introduction to Predictive Maintenance*. USA: the british library caraloguing in- publication data.Elsevier Science.
- [24] Moffett, G.M. (2008). *Agribusiness, the Central Global Business Summit. Harvard Business School, October 13, 2008. Boston, Massachusetts, United States. Cenetr of Agriculture and Business.*
- [25] Moore, P.A., Jr., Daniel, T.C., Sharpley, A.N., & Wood, C.W. (1995). Poultry manure management: Environmentally sound options. *Journal of Soil and Water Conservation* 50(3):321-327
- [26] Mu'azu, A. U., Mohamed, Z., & Shamsudin, M. N. (2013). Structure-Conduct-Performance of the Malaysian Poultry Industry. *Australian Journal of Basic & Applied Sciences*, 7(8).
- [27] Odetallah, N. H., Wang, J.J., Garlich, J.D., & Shih, J.C. (2003). Keratinase in starter diets improves growth of broiler chicks. *Poult. Sci.* 82, 664-670.
- [28] Prabakaran, R. 2003. Good Practices in Planning and Management of Integrated Commercial
- [29] Quinn, M., Kriebel, D., Geiser, Ken., and Moure-Eraso, R. (1998). Sustainable Production: A Proposed Strategy for the Work Environment. *American Journal of Industrial Medicine*, 34,297-304.
- [30] Ram, P., Khanh, L.M., Hai Ninh, P.H. (2010). Poultry Producer Survey. Gathering Evidence for a Transitional Strategy (GETS) for HPAI HPN1 Vaccination in Vietnam. Public and Social Research, TNS Vietnam.
- [31] Sahin, K., Orhan, C., Smith, MO., & Sahin, N. (2012). Reducing heat stress cell by cell. *The World's Poultry Science Association's Journal. Journal: Practice and Research*, 69 (01), 99-112.
- [32] Seuring S. (2004). Integrated chain management and supply chain management e comparative analysis and illustrative cases. *Journal of Cleaner Production*; 12(8).
- [33] Shamsuddoha, M., & Nasir, T. (2013). Poultry Reverse Supply Chain Process Conveys Environmental Sustainability. *Ecoforum Journal*, 2(1).
- [34] Sharma, B. (2010). Poultry production, management and bio-security measures. *Journal of Agriculture and Environment*, 11, 120-125.
- [35] Tey, Y. S., Suryani, D., Emmy, F.A., & Illisriyani, I. (2009). Food consumption and expenditures in Singapore: implications to Malaysia's agricultural exports. *International Food Research Journal* 16, 119-126
- [36] Tsang, A. H. (2002). Strategic dimensions of maintenance management. *Journal of Quality in Maintenance Engineering*, 8(1), 7-39.
- [37] Tsang, E. W. (2002). Acquiring knowledge by foreign partners for international joint ventures in a transition economy: Learning by doing and learning myopia. *Strategic Management Journal* , 23 (9), 835-854.
- [38] Veleva, V., & Ellenbecker, M. (2001). Indicators of sustainable production: framework and methodology. *Journal of Cleaner Production* 9, 519-549.
- [39] Welch, R.M., House, W.A. (1995). Meat factors in animal products that enhance iron and zinc bioavailability: implications for improving the nutritional quality of seeds and grains. In: *Cornell Nutrition Conference for Feed Manufacturers. Department of Animal Science and Division of Nutrition, Cornell University Agricultural Experiment Station, Ithaca, NY, 148530001, USA.*

## AUTHOR'S PROFILE



### K. Jayaraman

Associate Professor, Graduate School of Business, Universiti Sains Malaysia, 11800 USM,  
 Email: dr\_kjraman@usm.my,  
 Mobile: 006010 375 0868, Fax: 00604 653 7292  
<http://www.gsb.usm.my/index.php/en/faculty-and-research/faculty/61-gsb/academic-staf/297-krishnaswamy-jeyaraman>



### Aref Tabandehhaghghi

Graduate School of Business, Universiti Sains Malaysia, 11800 USM, Penang,  
 Email: sep\_tabandeh@hotmail.com,  
 Mobile: 006014 255 2696, Fax: 00604 653 7292


**Sofri Yahya**

Dean, Associate Professor, Graduate School of Business, Universiti Sains Malaysia, 11800 USM,  
 Email: sofri@usm.my,  
 Mobile: 006019 567 9875, Fax: 00604 653 7292


**S. Kiumarsi**

is a Ph.D candidate in the graduate school of business (GSB), at the Universiti Sains Malaysia, 11800 USM, Penang. His research interests include Innovation Business IT, Service Innovation and Marketing. kiumarsi78@gmail.com, Mobile: 006017 499 4018

**APPENDIX**

Table 3: Profile of the Respondents

Background Information	Description	No. of Respondents	Percent (%)
Position	Managers	31	42.5
	Supervisors	22	30.1
	Animal Keeper	17	23.3
	Veterinarian	03	4.1
Gender	Male	59	80.8
	Female	14	19.2
Age	21 – 30	17	23.3
	31 - 40	25	34.2
	41 – 50	22	30.1
	Above 51 years	09	12.3
Education	Diploma	30	41.1
	Degree	36	49.3
	Postgraduate	07	09.6
Experience in poultry	Less than 5 years	14	19.2
	5 - 10 years	27	37.0
	More than 10 years	32	43.8
Poultry size	Large-scale farm	39	53.4
	Medium-scale farm	32	43.8
	Small-scale farm	02	2.7
Average Number of Chickens Produced	Below 1000 chickens	02	2.7
	1000 - 3000 chickens	06	8.2
	3001 - 5000 chickens	14	19.2
	Above 5000 chickens	51	69.9

Table 4: General Practices in poultry farm

General Practices in poultry farm	Description	No. of Respondents	Percent (%)
Dispose of dead birds in the farm	Bury	32	43.8
	Burn	5	6.8
	Throw in the rubbish pile	2	2.7
	Throw into a river	4	5.5
	Compose and use for manure and fertilizer.	43	58.9
Who do they report for bird losses?	Do not report	64	89
	Village animal health worker (AHW)	4	5.5
	Commune chief animal health worker (CAHW)	5	6.8
Use of the present HPAI vaccination program	Yes	37	50.7
	No	36	49.3
If Yes, because...	Free	20	27.4
	Credible	12	16.4
	Effective	3	4.1
	Compulsory	1	1.4
Experienced Avian influenza in your own flock	Yes	2	2.7
	No	71	97.3
Public information ever seen and heard about HPAI	Epidemic announcements	62	84.9
	Prevention methods and poultry care	22	30.1
	Human health care after handling sick	5	6.8
	Vaccination program	28	38.4