A CROSS-SECTIONAL STUDY ON THE ASSOCIATION BETWEEN FARMERS' AWARENESS AND COMPLIANCE ON HERD HEALTH PROGRAM AMONG FIVE SELECTED DAIRY CATTLE FARMS IN SELANGOR AND NEGERI SEMBILAN STATES, MALAYSIA

FAEZ FIRDAUS JESSE ABDULLAH[1,6]*, MUHAMMAD ABUBAKAR SADIQ[2,3], YUSUF ABBA[2,5], ABDUL MUHAIMIN ROPIE[1], KONTO MOHAMMED[1,4], ERIC LIM TEIK CHUNG[1], ASINAMAI ATHLIAMAI BITRUS[2], NOOR HANANI BT MAT ISA[1], MOHD AZMI MOHD LILA[1], ABDUL WAHID HARON[1,6] AND ABDUL AZIZ SAHAREE[1]

1 Department of Veterinary Clinical Studies, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

2 Department of Veterinary Pathology and Microbiology, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

3 Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Maiduguri, PMB1069, Borno State, Nigeria.

4 Department of Veterinary Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Maiduguri, PMB1069, Borno State, Nigeria.

5 Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, PMB1069, Borno State, Nigeria.

6 Research Centre for Ruminant Diseases, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

* Corresponding author: jessearіasamy@gmail.com

ABSTRACT. A cross-sectional study was designed to determine the level of awareness of selected dairy farmers to herd health program (HHP) and compliance in the Program LadangAngkat (PLA). The study also determined the association between farmers' awareness and compliance in promoting herd health. An open-ended questionnaire was randomly administered to five dairy cattle farms within Selangor and Negeri Sembilan as representative dairy farms enlisted into the PLA of Faculty of Veterinary Medicine, Universiti Putra Malaysia. The mean herd size of the farms was 102.20±20.80, with a range of 30-160 heads of dairy cattle, having an average mean number of milking cows at 29.40±11.22. There was a higher (p<0.05) mean herd health awareness level (72.86±5.78%) among the farmers once compared with the mean compliance level (61.2 ± 4.1%) for 10 out of the 14 HHP components; with the lowest compliances being disease monitoring programme (33.20%) and biosecurity (39.9%). There was a significant (p<0.05), direct, weak positive correlation (r = 0.245; p = 0.042) between farmers' awareness and farmers' compliance to the 14 components of the HHP. This study highlights an appreciable

level of awareness among dairy farmers in the PLA, with a relatively low compliance levels to the HHP components.

Keywords: farmer education, herd health programme, dairy farms, Malaysia, milk production

INTRODUCTION

Over the past years the Malaysian livestock industry has witnessed gradual progress with the non-ruminant (poultry and swine) industry recording remarkable growths, while the ruminant industry lagged behind (Jamaludin *et al*., 2014; Sithambaram and Hassan, 2014). The failure in the ruminant sub-sector of the livestock industry was attributed to several factors that include; the lack of incentives, uneconomic production systems and inadequate marketing strategies (Jalaluddin and Halim, 1998). The tropical climate in Malaysia may have played an unfavourable role in the development of dairy farming as high temperature, humidity and rainfall were believed to cause reduction in both, nutritive value of available forage and cow's comfort (Moran, 2013). Even with these unfavourable conditions, the Malaysian dairy sector has recorded some appreciable levels of growth as in the Department of Veterinary Services (DVS) report of 2013 which showed progress in milk production from 38.7 million litres in 2004 to 79.35 million litres in 2013. This equates to a self-sufficiency level increase from 2.98% to 9.30%, respectively (DVS, 2013). Although the progress recorded in achieving self-sufficiency in milk production level is not much, a deliberate effort has been put in place by the government to double local milk production in the short term as well as in the long term, resulting to an increased self-sufficiency level (Mohd Karim *et al*., 2014).

Over the past decades, dairy farming has witnessed several changes, which coupled with increasing international competition has led to selective breeding of high yielding dairy cows (Derks *et al*., 2012), consequently resulting in higher susceptibility to disease (De Kruif and Opsomer, 2004). With this development and intensification of dairy farming, many disease and production related constraints were encountered, hence prompting a change in veterinary service delivery to consist of herd approach rather than the classical individual animal approach, and elaboration of health and production management programmes offering integrated services (Brand *et al*., 1996). The constraints in the development of the dairy sector may be due to lack of farmers' knowledge, technical skill, awareness and compliance in herd health management (Moran, 2013). Smallholder farmers with less than 10 milking cows, usually have not been able to develop the skills of efficient milk production as a result of poor extension services and lack of technical knowledge on tropical dairy production (Moran, 2013). Good farm management means to supply sufficient farm inputs for a desired level of production of farm outputs, this means setting milk

production targets, and determining the necessary farm requirements to achieve these targets(Moran, 2012).

Healthy, productive and fertile dairy cows and their necessary feed nutrients supplied in forages and concentrates, are the major requirement for achieving the goals for a sustainable milk production in any dairy system (Moran, 2012). Certain diseases and production constraints can be expected in dairy farms as in any livestock production system, on the basis of accumulated experience. To minimize the potential adverse effects of these anticipated constraints and to protect against unexpected ones, herd health management and preventive medicine programs or herd health program (HHP) are designed with the objective to assist the farmers in reaching their farm performance goals. (Pugh and Baird, 2012; Derks *et al*., 2014). Green and Green (2012) defined 'herd health management' or HHP as 'a method to optimize health, welfare and production in a population of dairy cows through the systematic analysis of relevant data and through regular objective observations of the cows and their environment, such that informed, timely decisions are made to adjust and improve herd management over time'. This concept of herd health program (HHP) that integrates herd health, animal welfare, public health and food quality assurance has been shown to be effective in improving farm productivity in the past and also at present (Derks *et al*., 2014).

Herd health management programs are designed to support farmers in changing their focus from curative to preventive health management practices, which are necessitated by increased herd sizes and meeting quality standards in dairy farming (Derks *et al*., 2013). Dairy cattle farmers in the Netherlands who participated in veterinary herd health management were shown to have produced 336 kg more of milk per cow per year, lower age at first calving (less than 12 days), lower repeat breeder after artificial insemination (less than 3.34%), better milk quality with decreased milk somatic cell count (8340 cells/mL) as compared to farmers who did not participate in the program (Derks *et al*., 2014). Previously, (Abdullah *et al*., 2015) conducted a survey to study farmers' compliance on HHP practiced among goat farms in Malaysia. From the results obtained, there seemed to be dearth of information by farmers' to awareness on herd health program, implementation and compliance in Malaysians.Based on this, the Faculty of Veterinary Medicine (FVM), Universiti Putra Malaysia (UPM) introduced an initiative called 'Program Ladang Angkat' (PLA) in September 2011, to the ruminant farmers with the aim of assisting in solving issues associated with low productivity among the dairy farmer. Ruminant farmers within the vicinity of 40 km from the faculty were invited to join PLA, where participating farmers where given free consultation, diagnosis, treatment and education on aspects related to livestock herd health management. The implementation of HHP of Ladang Angkat was designed to be in several stages with

emphasis on observation, implementation, followed by a systematic analysis of the impact and comparison with set out targets of the participating farmers. This study was designed to determine HHP awareness and compliance level among selected dairy cattle farmers participating in the PLA and to determine the association between farmers' awareness and compliance with the HHP. It is believed that the results of this study will give an insight into the effectiveness of the PLA herd health programme implementation in all the participating dairy farms.

MATERIALS AND METHODS

Study design

The survey was conducted in the form of a simple closed-ended questionnaire which was administered to all the five randomly selected (by balloting) dairy cattle farms (n=5) that were enlisted into the Program Ladang Angkat of FVM, UPM located in Selangor and Negeri Sembilan. The questionnaires were designed using simple and common words in both English and Malay languages in order to ensure proper comprehension by the participating farmers to respond accurately. The questionnaire comprised of 2 sections; section A (farm profile) and section B (farmer compliance with HHP). Section A was adapted from the farm profile of Malaysian Good Agriculture Practice (MyGAP) evaluation form sourced from the Department of Veterinary Services (http://www.moa.gov.my/documents/10157/1683433), which consisted of the types of management, roofing and flooring, milking facilities, animal performance, sales per month and medication. Section B consists of questions concerning the farmer's knowledge, awareness and compliance on each of the 14 components of the herd health programs such as (a) housing condition, (b) feed and feeding management, (c) deworming program, (d) vaccination program, (e) farm biosecurity, (f) waste disposal management, (g) fly, pest and odour control, (h) milking management, (i) reproductive management, (j) calf management, (k) cow management, (l) animal identification, (m) drug management and lastly (n) disease monitoring program. Farmers were interviewed for section A, and filled out the responses for section B farmers by themselves or interviewed by the researcher depending on the farmer's preference. Visual examination of the farm environment was also done.

Data Collection

Questionnaire

90% of the questions in the questionnaires were structured to have dichotomous answers (yes and no). Detailed questions about each component as "yes" and "no" type of questions were used to determine the level of farmers' awareness and compliance on each HHP component. The questionnaires were collected on the same day after completion.

Data Analysis

All the respondents' data were entered into Microsoft Office Excel 2010 and analysed in IBM SPSS statistical software version 20. Data were analysed to obtain descriptive statistics, mean, standard error of mean and percentages. Spearman's rho correlation was used to determine linear correlationbetween farmers' awareness and farmers' compliance on the 14 components of HHP at alpha (α) level of 0.05 according to Corder and Foreman (2014).

RESULTS

General information on farm management and herd population

All the dairy cattle farms (n=5) accepted to participate and with all the questionnaires (100%) were returned. The mean herd size was 102.20±20.80 with a range from 30 to 160 heads of dairy cattle. Among these herds the average number of milking cows was 29.40±11.22 cows with range from 5 cows to 70 cows. There were a total of 78 calves in all the five herds with a mean of 15.60±4.34. Two of the farms reported the use of traditional hand milking method (Table 1).

Farmers' herd health program (HHP) awareness

From the five farms, two farmers responded to having knowledge on what HHP is, however only one was able to define HHP, while the other 3 farmers had never heard of the word before getting enlisted into the PLA. Following enrolment into the PLA, four out of five farmers;mean ± SE (72.86±5.78%) learnt about the HHP from Program Ladang Angkat and by discussing with other fellow farmers, while 3 out of 5 learnt about it from courses offered by the Department of Veterinary Services of Malaysia.

Table 1. Data on farm management and herd population structure

Farm	Production system	Milking facilities	Total herd	Milking Cow	Non milking and heifer	Calf	Bull
A	Semi intensive	Herringbone parlour	30	17 (57%)	0	13 (43%)	0
B	Semi intensive	Portable machine	106	70 (66%)	30 (28%)	5 (5%)	1 (1%)
C	Semi intensive	Portable machine	160	35 (22%)	113 (71%)	10 (6%)	2 (1%)
D	Semi intensive	Hand milking	111	5 (4%)	85 (77%)	20 (18%)	1 (1%)
E	Semi intensive	Hand milking	104	20 (19%)	50 (48%)	30 (29%)	4 (4%)
		Total	**511**	**147**	**278**	**78**	**8**
		Mean±SE	**102.20±20.80**	**29.40±11.22**	**55.60±19.92**	**15.60±4.34**	**1.6±0.68**

Level of farmer compliance on 14 components of HHP

Figure 1 shows the distribution level of participating farmers' compliance (%) based on each component of HHP with mean ± SE (61.2 ± 4.1%). The lowest farmer compliance was recorded in disease monitoring program (33.20%), followed by farm biosecurity (39.9%). Other measures such as cow management, reproductive management, feed and feeding management, animal identification; fly, pest and odour control, milking management, calf management, housing condition were recorded in varying levels, ranging from 50% to 70%,respectively. These were followed by drug management and parasite control program recorded in over 70% of farms. The highest was waste disposal management and vaccination program with 86.8% and 83.2%, respectively.

Association between farmer awareness and compliance on 14 components in HHP

There was an appreciable awareness of farmers (72.86 ± 44.79) to the HHP components among the dairy cattle farmers; however, this did not necessarily correlate to the farmers' compliance (61.18 ± 25.26) on each component of the HHP. Based on Figure 2, a clustered bar graph revealed two distinct scenarios, where blue and brown colour bars represent the

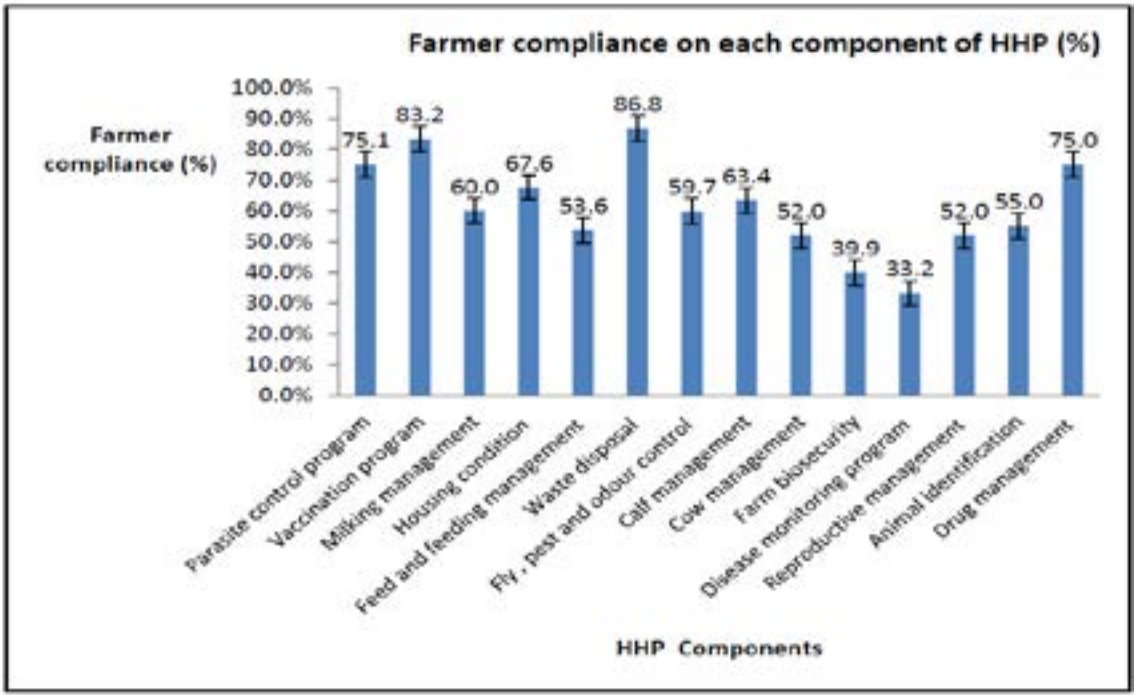

Figure 1. Bar chart of farmer compliance on each component of HHP (%)

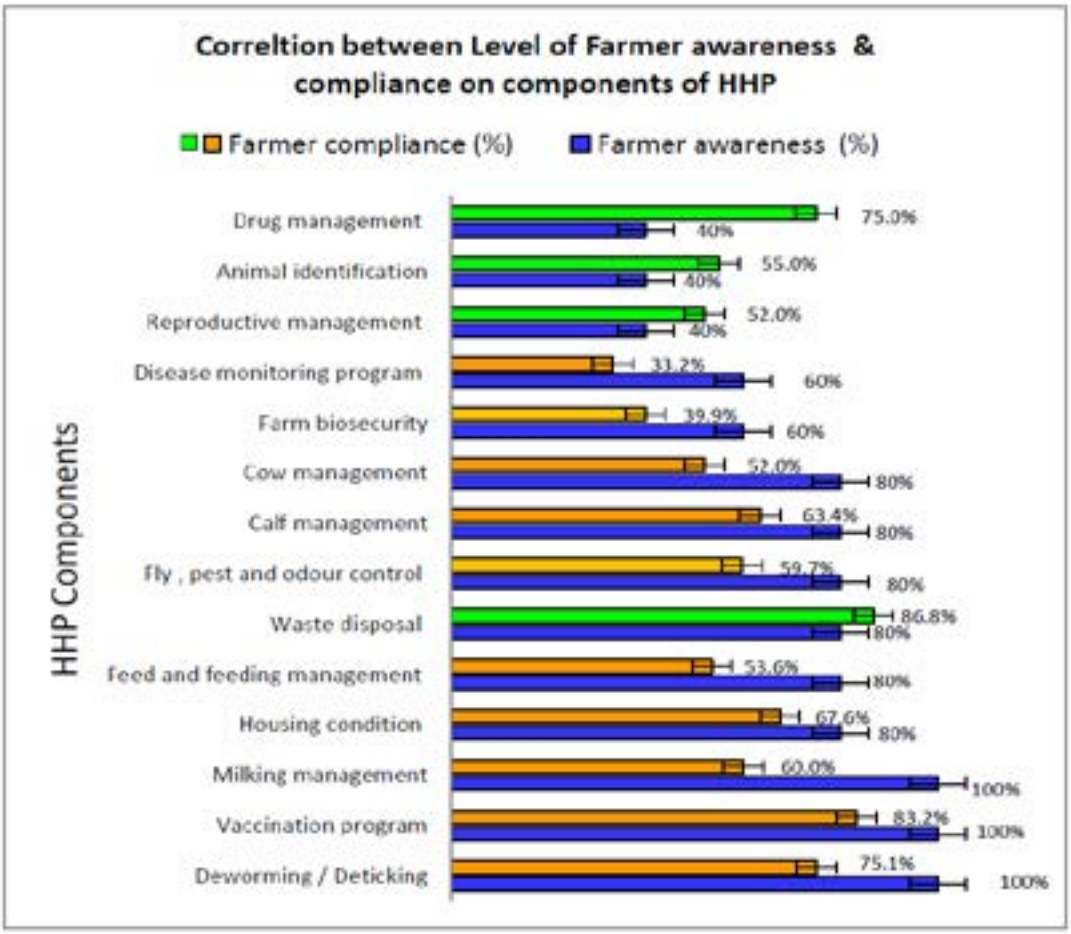

Figure 2. Clustered Bar chart of Correlation between farmers' compliance on each of the 14 component of HHP (%)

first scenario in which farmers' awareness percentage was higher than farmers' compliance percentage whereas in the second scenario, components such as waste disposal management, reproductive management, animal identification and drug management (blue and green colour bar) had farmers' compliance percentages recorded as higher than farmers' awareness percentages, which may be due to the presence of bias element in responding to the questions asked.Shapiro Wilk test for normality showed that the data of farmers' awareness was not normally distributed, since p (0.028) < α (0.05), whereas data for farmers' compliance was normally distributed since p (0.910) > α (0.05). Thus, a non-parametric, Spearman's rho was chosen to determine the correlation between both variables since one of the

variables was a non-parametricvariable. There was a significant low positive correlation between the farmers' awareness and farmers' compliance on the 14 components of HHP; $r = 0.245$ and $p = 0.042$

DISCUSSION

Historically agriculture has been the mainstay of Malaysia's economy and the livestock industry has progressed gradually over the years, however, the ruminant sector of this industry is lagging behind. The livestock sector in Malaysia produce 2,025,000 metric tonnes of food in 2010, accounting for 27% of the total domestic food production. This in economic terms translates to RM10,870 million in total ex-farm value of livestock products in 2010 (Jamaludin *et al*., 2014). Among the many constrains militating against the development of the dairy industry is that many of the small holder dairy farmers have not been able to develop their skills for efficient milk production (Moran, 2013). Some of the major aims of the HHP in dairy production are to optimize health, welfare and production in a population of dairy cows in order to assist the farmers in reaching their farm performance goals.

In this study all (100%) farmers that participated responded to the questionnaire, which was expected based on the previous study by Dillman and Bowker (2001), which stated that participants in a survey who were interested in the topic are usually willing to answer the questionnaires administered. The average herd size obtained in this study was higher compared to the average herd size of 2.46 and 4.29±0.864 reported by Wanjala and Njehia (2014) and Atuhaire *et al*. (2014), in Kenya and Uganda, respectively.The difference in the herd sizes could be as a result of differences in herd characteristics, where dairy cattle sampled were those from household smallholder farms, while in this study, the participating farms were commercial farms which were relatively larger. The proportion of 28.77% and 54.40% were recorded for lactating and non-lactating/heifers in the sampled herds. This finding was in contrast with Wanjala and Njehia (2014), who reported proportions of 36.4% and 15% for lactating cows and heifers, respectively. The discrepancy seen between lactating and non-lactating heifers in this study was an indication of lack of efficiency in milk production from lactating cows in the herds.

Varying degree of compliance was recorded, with lowest from disease monitoring program and farm biosecurity. These are very vital in improving and sustaining productivity of the dairy animals, which could also be another reason for the wide gap between the proportion of lactating and non-lactating/heifers. Diseases are known to reduce milk yield, fertility and conception rate in dairy cattle ultimately resulting to an increased number of non-lactating mature cows in the farm. This agrees with the assertion of Gröhn and Rajala-Schultz (2000), who observed that diseases and reproductive

disorders are responsible for decreased milk yield, delayed insemination and conception rate in dairy cows, which may often result in increased the risk of culling in such farms.

The farmers' compliance with components of the HHP; waste disposal, reproductive management, animal identification and drug management recorded higher levels than the farms' awareness in this study. This could be attributed to response bias by the farmers in order to avoid a bad impression about their farm. Derks *et al.* (2014) reported a similar finding, where out of ten variables only two were seen to have significantly different results than the other eight variables due to bias in responses.Another reason for this bias may be the fact that questionnaires were sometimes not filled by the farmers themselves but their children or workers. In this study, two of the five questionnaires were filled by the farmer's son and a farm worker, who may not have all the relevant information requested. The other ten components in this study showed that farmers' awareness were higher than the farmers' compliance level. Moran (2013) identified several key constrains militating against increased milk production in tropical Asia, which indirectly affected farmers' compliance on HHP. These limiting factors have been categorised into institutional factors, such as lack of skill or training from extension services and socio-economic factors, such as the farmer's education and traditional beliefs (Moran, 2013). Previously, Devendra (2000) identified other constraint factors such as availability of species and breeds, feed resources and feeding, breeding, production and animal health, marketing and market outlets. In this study, there were two putative constraint factors militating against farmers' compliance; not all farmers participated in the seminar (Hari Bersama Penternak) and practical training organised by Faculty of Veterinary Medicine, under the PLA. Thus such farmers have lost the opportunity of acquiring valuable lessons that could be applied to improve their farm productivity. The examples of lessons given during such contacts with experts include: theory and practical sessions on the use of anthelmintic for treatment and prophylaxis of different gastrointestinal worms and pasture management techniques aimed at reducing survivability of parasites by interrupting their the life cycle. This would help farmers to reduce worm burden in their livestock. There are a number of farm procedures that could be taught as well, for example procedures to prevent and control mastitis in dairy farms and many other disease preventive measures.

The second factor affecting farmers' compliance on HHP was socio-economic factors such as level of farmer education and traditional beliefs (Moran, 2013). Even though the Faculty of Veterinary Medicine, UPM had conducted training either on the farm or during the seminar's practical, about dairy farm practice lessons, some farmers still did not put it into practice because they kept their traditional beliefs

and experiences in running the farm. Such farmers will not be able to save production costs and improve the farm productivity. Individual farmer's attitude and level of education also affects the acceptance of the lesson or advice given. Farmers' decision making has been shown to be a complex process which involves many factors like intention to change, social environment and attitude towards the area of change (Bergevoet *et al*., 2004; Ellis-Iversen *et al*., 2010). Cost is among one of the many factors limiting the implementation of HHP as most of the dairy cattle farms in the PLA tend to practice animal naming system instead of number tagging, because they thought tagging was more costly. Similar cost constraints and inadequate knowledge and skill have also been identified as factors militating against HHP compliance among goat farms in Malaysia (Abdullah *et al*., 2015). Farmers will appreciate HHP if the cost of implementing does not exceed the total profit gained from a cow per year (Derks *et al*., 2014).

Success in the implementation of HHP and optimal farmers' compliance could be difficult to achieve due to poor communication between veterinarians and farmers. Thus effort to discuss topics related to herd health management, animal performance and farm productivity such as mastitis control, herd fertility programme, disease prevention programme and nutrition are not effectively done. This observation agrees with Derks *et al*. (2012) and Derks *et al*. (2014), who also observed that optimal communication between farmer and veterinarian is not always achieved thereby resulting in communication gap between the veterinarian advice and the dairy farmers' needs and targeted production goals. The way information is communicated to the farmer and the priority of the information for the farmer may influence the level of farmers' compliance in dairy HHP (Derks *et al*., 2012).

CONCLUSION

It can therefore be concluded that this study has found a higher level of awareness with a corresponding lower level of compliance in 10 out of the 14 HHP components among farmers under the PLA. Lower level of farmers' compliance was seen in vital components such as disease monitoring and prevention programme, farm biosecurity, reproductive programme, feed and feeding managementand animal identification. This is due to lack of knowledge, constraints in finance, influence of their traditional belief and poor ineffective communication between veterinarian and farmers. There is a need to encourage farmers to participate in disease surveillance programmes of the Department of Veterinary Services Malaysia for routine endemic disease screening such as Brucellosis and Food and Mouth Disease. There is also a need to help the dairy farmers in the form of training and guidance via extension services given by institution such as Department of Veterinary Service and Faculty of Veterinary Medicine, Universiti

Putra Malaysia through PLA. Further cross-sectional studies comparing between dairy cattle farms participating and non-participating in the herd health programme will provide invaluable information on the impact of HHP on farm productivity.

REFERENCE

1. Abdullah F.F.J., Rofie A.M.B., Tijjani A., Lim E., Chung T., Mohammed K., Sadiq M.A., Saharee A.A. and Abba Y. (2015). Survey of Goat Farmers' Compliance on Proper Herd Health Program Practices. *Int. J. Livestock Res.,* **5(11),** 8-14.
2. Atuhaire A.M., Mugerwa S., Kabirizi J., Okello S. and Kabi F. (2014). Production Characteristics of Smallholder Dairy Farming in the Lake Victoria Agro-ecological Zone, Uganda. *Front. Sci,* **4(1),** 12-19.
3. Bergevoet R.H., Ondersteijn C., Saatkamp H., Van Woerkum C. and Huirne R. (2004). Entrepreneurial behaviour of Dutch dairy farmers under a milk quota system: goals, objectives and attitudes. *Agric Sys.,* **80(1):** 1-21.
4. Brand A., Noordhuizen J.P.T.M. and Schukken Y.H. (1996). *Herd health and production management in dairy practice*: Wageningen Pers.
5. Corder G.W. and Foreman D.I. (2014). *Nonparametric statistics: a step-by-step approach*. John Wiley and Sons.
6. De Kruif A. and Opsomer G. (2004). Integrated dairy herd health management as the basis for prevention. *Vlaams Diergeneeskundig Tijdschrift,* **73(1)**: 44-52.
7. Marjolein Derks, Lindsay M.A. van de Ven, Tine van Werven, Wim D.J. Kremer and Hank Hogeveen (2012). The perception of veterinary herd health management by Dutch dairy farmers and its current status in the Netherlands: A survey. *Prev. Vet. Med.,* **104(3)**: 207-215.
8. Marjolein Derks, Tine van Werven, Hank Hogeveen and Wim D.J. Kremer (2013). Veterinary herd health management programs on dairy farms in the Netherlands: Use, execution, and relations to farmer characteristics. *J.Dairy Sci.,* **96(3)**: 1623-1637.
9. Marjolein Derks, Tine van Werven, Hank Hogeveen and Wim D.J. Kremer (2014). Associations between farmer participation in veterinary herd health management programs and farm performance. *J. Dairy Sci,* **97(3)**: 1336-1347.
10. Devendra C. (2000). Smallholder dairy production systems in developing countries: characteristics, potential and opportunities for improvement. *Asian Australasian J.Anim. Sc.,* **14(1)**: 104-113.
11. Dillman D.A. and Bowker D.K. (2001). The web questionnaire challenge to survey methodologists. In: *Bemad Batinic, Ulf-Dietrich Reips, Michael Bosnjak and Andreas Werner: Online Social Sciences. Seattle: Hogrefe and Huber*, 53-71.
12. DVS. (2013). *Annual Report*. Malaysia: Department of Veterinary Services (DVS)
13. Ellis-Iversen J., Cook A.J., Watson E., Nielen M., Larkin L., Wooldridge M. and Hogeveen H. (2010). Perceptions, circumstances and motivators that influence implementation of zoonotic control programs on cattle farms. *Prev. Vet. Med.,* **93(4):** 276-285.
14. Green M. and Green M.J. (2012). *Dairy Herd Health*: CABI.
15. Gröhn Y. and Rajala-Schultz P. (2000). Epidemiology of reproductive performance in dairy cows. *Anim. Rep. Sci.,* **60**: 605-614.
16. Jalaluddin S. and Halim R.A. (1998). Development of the Livestock Industry in Malaysia. In: *Proceedings of the Regional Workshop on Area-Wide Integration of Crop-Livestock Activities*, Bangkok Thailand.
17. Jamaludin M., Hassan M., Md Ruhul Amin and Zulhisyam A. (2014). The Future of the Malaysian Beef Industry. *J. Trop. Res. Sustain. Sci.,* **2(1)**: 23-29.
18. Mohd Karim Z., Arumugam N., Nguang S.I. and Baba A.R. (2014). Determinants for Sustainability in the Dairy Industry in Malaysia. In: *National Postgraduate Symposium on Sustainable Agriculture 2014.*
19. Moran J. (2012). Feeding Management of the Milking Herd. *Malaysian Farm Management Note* **7**: 1-9.
20. Moran J. (2013). Addressing the key constraints to increasing milk production from smallholder dairy farms in tropical Asia. *Int. J. Agric. Biosci.,* **2(3)**: 90-98.
21. Pugh D.G. and Baird N.N. (2012). *Sheep and goat medicine*: Elsevier Health Sciences.
22. Sithambaram S. and Hassan Q.N. (2014). Country report – Malaysia. *Asian-australasian dairy goat network*, 57.
23. Wanjala S. and Njehia K. (2014). Herd Characteristics on Smallholder Dairy Farms in Western Kenya. *J. Anim. Sci. Adv.,* **4(8)**: 996-1003.

ACKNOWLEDGEMENT. The authors wish to acknowledge Mohd Jefri Norsidin, members of staff of the Large Animal Clinic, University Veterinary hospital (UVH), andFaculty of Veterinary Medicine Universiti Putra Malaysia for their technical assistance.

CONFLICT OF INTEREST. The authors declare no conflict of interest.