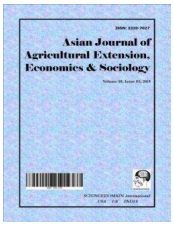

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Enhancing Sustainable Stingless Beekeeping Production through Technology Transfer and Human Resource Development in Relationship with Extension Agents Work Performance among Malaysian Beekeepers

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Authors' contributions

This work was carried out in collaboration between all authors. Author IAI designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors OO, MMI and SH managed the analyses of the study. Authors OO, SH and NM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Stingless beekeeping is not only a profitable activity to Malaysian beekeepers but also to Malaysian economy. However, natural honey has faced some difficulties which resulted to low production due to lack of information on improved technology as well as capacity and potential building of stingless beekeeping farmers which depend mostly on information received from the extension agents. Hence, it is the responsibility of the extension agents to give useful information on the available technology and develop the capacity of the farmers to take right decision that will

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improve their level of production. This study assessed how technology transfer and human resource development skills influences work performance of the extension agents towards sustainable beekeeping production among beekeepers. The study sought to establish the role of relevant technology transfer and human resource development skills in effective performance. The research design was descriptive and quantitative survey of stingless beekeepers on technology transfer and human resource development by the extension agent. Data was obtained from 54 beekeeping farmers and was analyzed using descriptive and inferential statistics. The results revealed that technology skill, technology dissemination skill, technology evaluation skill, Decision making process skill, Leadership development skill and work performance were rated moderate by stingless beekeeping farmers while Social skill was rated high. Significant and positive correlation (P<0.01) existed between all variables and performance. Regression results showed that leadership development skill, Decision making process skill, and social skill are significant (P = .05), while technology skill, technology dissemination skill, technology evaluation skill are not significant. The highest contributing factor is social skill (β=.446). Beekeeping is a profitable project in Malaysia and can be sustained if the extension services and programmes are well carried out by competent extension agents and relevant agricultural government agency.

Keywords: Sustainable; beekeeping; technology transfer; human resource development; extension agents; work performance.

1. INTRODUCTION

Stingless bee farming which is referred to as Meliponiculture was initially practiced culturally in the communities of country with regional and traditional understanding. Stingless bee production and marketing has expanded in country like Australia but recorded less than 100kg in terms of total annual production. Due to high potential of beekeeping development, the wholesale price of honey product was marketed at Australian Dollar $50/kg [1]. Therefore, stingless beekeeping was kept for purposes of pollination as recorded in South East Asia countries like Malaysia, Indonesia, Thailand and the Philippines [2]. Beekeeping business has high growth potentials especially in Malaysia that include state of Kelantan, which commercialized honey products like honey, bee bread and propolis. These products were marketed at RM35/300g, RM30/200g and RM25/10ml respectively according to demand [3]. The economic value of stingless bee and its features of external nest are yet to be explored [1].

Malaysia happened to be a forest dominated area with indigenous honeybees' species and abundant nectar and pollen sources, this show a good direction for beekeeping industry to prosper rapidly since the demand for local natural honey is far outweigh the supply in the country. About 50 species of stingless bees were found today in the country and Heterotrigona species were selected in order to obtain good colony such as pest tolerant strains [1]. The five common bees are *Trigona (Geniotrigona) thoracic*, *Trigona (Heterotrigona) itama, Trigona (Lepidotrigona) terminata, Trigona (Lisotrigona) scintillans and Trigona (Tetragonula) laeviceps. Heterotrigona* specie was farmer's best choice because it covered about 83.2% of Malaysian farms [8]. Furthermore, low production of local natural honey has been reported in a research conducted by [4] where he revealed the production trends of natural honey in Malaysia, indicating insufficient production at local level right from year 2000 up to 2010 compared to consumption as shown in Table 1 Similarly, [5] reported an increase of honey production from 2011 to 2015 to meet up with the demand of domestic consumption but the productivity was still below the quantity consumed and that there can be a lot of improvement if beekeeping farmers have access to the right technology which may have sustainable effect on the economy of the country.

However, the major function of agricultural extension is to facilitate diffusion and adoption of innovative technologies and practices through effective technology transfer from innovation producers (research institutes and universities) to its users or clientele such as rural farmers [6]. It also aims to develop and empower its clientele through availing them with information and enabling their decision-making process for enhanced livelihood using the human resource development approach [7]. These aspects of extension have not been academically assessed in the context of stingless beekeeping in Malaysia, thereby leaving a knowledge gap needed to be filled. Furthermore, there is need to

understand the competencies of extension agents in technology transfer and human resource development to determine which of the two is most important in determining their work performance.

Conversely, there has not been comprehensive study in this area that provides evidence for extension interventions targeted at enhancing the delivery capacity and work performance of extension agents [8]. Moreover, the contribution of extension agents' is considered crucial in transferring technology to the farmers. Traditionally, extension has been closely associated with the field of agriculture and rural development. In fact, it was the single most important strategy employed to promote the growth and development of small scale agriculture and agricultural-related enterprises in Malaysia [9,10]. Competent extension agents delivering appropriate technologies and development advisory services are required to empower stingless beekeepers towards enhanced productivity, higher income and improved livelihood [11]. The low production of natural honey could be due to inadequate information on improved technology and lack of capacity and potential development of stingless bee farmers.

The main objective of this study is to determine how sustainable stingless beekeeping production could be enhanced through extension agents' technology transfer and human resource development in Malaysia. The specific objective was to; (1) to examine the level of transfer of technology skills, human resource development skills and extension agents work performance; (2) to find out the relationship between transfer of technology skills, human resource development skills and work performance of extension agent and (3) to identify the highest contributing factors to work performance of the extension agents in the study area.

1.1 Theoretical Background

A work performance model-central and surface competency was the theoretical basis used to evaluate work performance from competency perspective in this study. The model was developed basically to assess characteristics of an individual employee as criteria for effective and superior performance in every work situation [12]. The model was generally acknowledged and used widely by competencies and work performance researches [13,14,15,16,17,18]. The model was based upon identification of five different characteristics of competency. The word competencies have as a meaning the skills or knowledge that results to high performance. They are learned ability of employee that allows them to perform specified actions appropriately or some task. Competency reveals the quality of being able to perform which permits or facilitates achievement or accomplishment of a given task. The aim of this study is to determine the level of extension agents' work performance through technology transfer and human resource development on sustainable beekeeping production among beekeepers in Malaysia.

Table 1. Total natural honey produced and consumed in Malaysia, 2000-2015

Year	Production (MT)	Import Quantity (MT)	Quantity Consumed (MT)
2000	98	2294	2283
2001	60	1940	1981
2002	60	2432	1153
2003	60	4940	1135
2004	60	2319	2057
2005	60	2194	2172
2006	63	2483	2307
2007	90	4927	2835
2008	1228	6749	3008
2009	2120	8233	2970
2010	8548	7915	3011
2011	9403	3,160	10,054
2012	10343	2,207	10,971
2013	11377	1,784	12,465
2014	12515	3,157	14,870
2015	13767	4,913	15,159

Source: (Ismail, 2014; Ismail & Ismail, 2016)

Spencer LM and Spencer SM [12] divided competency into visible and hidden components. The visible component of competency is the knowledge and skills, while the concealed aspects are motives, traits and self-concept. [12] give attention to the component that are capable of being seen since it can easily be changed over time so as to be complete for more usage and productive relatively to cost. The aspect that is open to easy view out of the component is the skill and it is the area concentrated on in this study. The aspect was divided into technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill and social skill since they are related to characteristics which enable extension agents to perform their duties as it is related to technology transfer and human resource development within a specific function of their job [19]. If extension agents possess these six components of skills their duties can be perform in an effective way as it is required by the schedule of their job [13].

A skill gives way for individual ability to perform activities in a competent manner. All the above mentioned components are habitual behaviours by which extension agents can make difference in their work during technology transfer and human resource development. A skill is the learned ability on how and what to do about a particular task through energetic or mental capacity. The knowledge and skills learned or retained by individual have a tendency to be developed easily and at the same time capable of being seen, while training can serves as a complement to achieve best possible result in a cost-effective manner with others serving as an essential component for utilization of skills.

In this context, an agricultural extension agent should consider expanding their competencies on technology transfer and human resource development which will serve as the basis on which clientele and organization can change and improved their performance. [20] identified more than two grounds why extension agent should be encouraged to consider expanding their competencies. Firstly, competency development between individual performance and organization performance should focus on demonstrating quality performance that thrusts itself into attention by an individual, team or work group links to decisions that are very strategic. The second reason is that an extension agent should be able to recognize the needed skills, knowledge, and the behaviour to achieve maximum result in addition to ineffective functional skills. The third and the most important for an agricultural extension agencies worldwide are to consider skills and knowledge competencies in the competency models as powerful decision-making tools in making the right human resource decisions which can serves as basis to decide selection criteria for employee, the nature of training and professional development needed, professional methods of appraising their performance and successive planning.

2. MATERIALS AND METHODS

This research is a descriptive correlational study, which was employed to examine a relationship between the predetermined predictor variables and work performance of the extension agents among beekeepers. Data were collected from the sample states of the population through 'drop and pick' method of administering a set of questionnaire within six months from the months of September 2017 to February 2018. The instrument for data collection was developed, pilot tested and validated by academic experts to ensure quality of the data sourced.

The study was conducted in Malaysia which made up of islands that covered 130,598sq/km (50,424 sq. miles). The location shared border with Thailand in the north, Singapore to the south. The population of the study comprised of 717 commercialize Stingless bee farmers from Malaysia. Multi-stage sampling method was used for sample size selection. In the first stage, ten states were purposively selected from the thirteen states in Malaysia based on their involvements in honey production activities. The ten states are Kedah, Perlis, Kelantan, Terengganu, Pahang, Negeri Sembilan, Melaka, Selangor, Johor and Sarawak as shown in Fig. 1.

In the second stage, one honey production town communities from each of the ten states were obtained from Department of Agriculture in Malaysia giving a total of ten town communities. In the third stage, a list of beekeeping farmers was obtained from Department of Agriculture in Malaysia. From the list provided by DOA (Department of Agriculture), the respondents were selected based on experience, educational qualification and business records using Slovin's formula of [21] to determine the total sample size:

$$n = \frac{N}{1+NE^2}$$

Where,

n = Sample size
N = Population size
E = Desired margin of error (10%)

As shown below,

$$n = \frac{717}{1+717(0.10)^2}$$

$$n = \frac{717}{1 + 717(0.01)}$$

$$n = \frac{717}{8.17}$$

$$n = 87.7$$

Approximately, the sample size is eighty-eight farmers (n = 88).

A total sample of 88 was identified. However, only 54 representing 62% questionnaires were retained for analysis due to error in filling and presence of outliers. The IBM SPSS Version 23 was used to analyze the data using descriptive statistics for the demographic profile and level of technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill, social skill and work performance. The relationship that exist between technical skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill, social skill and work performance were determined by the use of correlation coefficient. The extent of technical skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill, social skill contribution to work performance were evaluated by using multiple linear regressions.

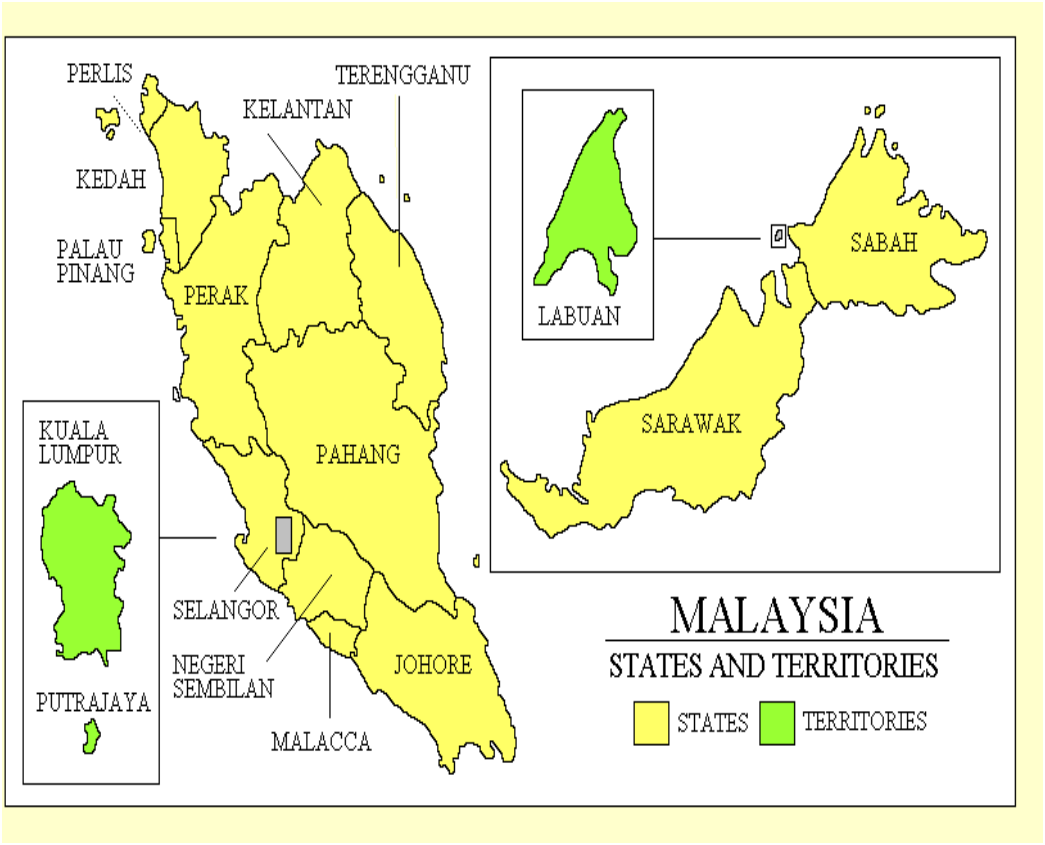

Fig. 1. Malaysian map showing the location of study area from each state

3. RESULTS AND DISCUSSION

3.1 Demographic Profile

The result of the study according to Table 1 show that close to half of the respondents is within the age range of 51 and greater than 60 years (40.8%), 33.3% are within the age range of 31-40 years, while 16.7% falls to the age range of 41-50 year and 9.3% were found to be within the age range of 20-30 years of age. Most of the respondents are male (77.8%) while female constituted 22.2%. The marital status shows that most of the respondents (77.8%) are married, 18.5% are single, while only 3.7% are widowed. More than half (59.3%) of the respondents have a family size of 4-7. The respondents' educational level reveals that 46.3% have secondary education, 31.5% possessed university education, and about 14.8% had primary education, while only 7.4% were educated at college level. Also, 70.4% of the respondents took beekeeping practice as full time job, while 29.6% undertake beekeeping practice as a part time job. Nearly half (44.4%) of the beekeepers indicates 1-3 years of experience, followed by 3.7% as having less than 9 years experience, while less than 1 year and 4-6 years of experience recorded 25.9% each. When beekeepers were asked about being a member of beekeeping association, only 37% were said to be a member of beekeeping association while almost 64% were not member of beekeeping association.

3.2 Levels of Work Performance, Technology Skill, Technology Dissemination Skill, Technology Evaluation Skill, Leadership Development Skill, Decision Making Process Skill, And Social Skill

As presented in Table 3, the descriptive statistics of the contributions of technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill and social skill to work performance of extension agents among beekeepers. The mean scores and standard deviations of the level of agreement were determined based on the range of (1-2.339) as low, (2.34-3.67) as moderate and (3.68-5.00) is high as indication of measurement for the levels on a five-point likert scale of 5.00. As indicated in Table 3, the mean scores ranged from 2.92 to 3.68. From Table 3, the level of work performance was moderate (M = 2.929; SD = .790). Out of all the factors that contributed to work performance, five showed moderate mean scores being technology skill (M = 3.402; SD = .774), technology dissemination skill (M = 3.362; SD = .862), Technology evaluation skill (M = 3.039; SD = .876), decision making process skill (M =2.855; SD = .898) and leadership development skill (M = 2.865; SD = .845) while social skill showed highest mean score (M = 3.688; SD = .692).

3.3 The Influence of Technology Skill, Technology Dissemination Skill, Technology Evaluation Skill, Decision Making Process Skill, Leadership Development Skill, Social Skill To Work Performance

The relationship between the six factors (technology skill, technology dissemination skill, technology evaluation skill, decision making process skill, leadership development skill, and social skill) contribution to work performance were determined using Pearson correlation coefficients. Exploratory analysis was carried out to ensure that assumptions of normality and linearity were not violated. The result of the correlation analysis showed that all factors were significantly correlated. As indicated in Table 4, very strong, positive and significant relationship was found between social skill and work performance ($r = .928$; $P < .001$); strong, positive and significant relationship between leadership development skill and work performance ($r = .891$; $P < .001$); decision making process skill and work performance ($r = .860$; $P < .001$), technology evaluation skill ($r = .721$; $P < .001$); technology dissemination skill and work performance ($r = .734$; $P < .001$) and a moderate positive and significant relationship between technology skill and work performance ($r = .530$; $P < .001$).

3.4 The Contribution of Transfer of Technology and Human Resource Development Skills to Work Performance of Extension Agents among Beekeepers

In order to identify the effect of transfer of technology and human resource development skills to work performance, Table 5 presents the result of the regression analysis and was based on the contribution of all six independent variables to work performance. The three components of human resource development

(HRD); decision making process skill (β =. 217; P = .006), leadership development skill (β =.203; P = .033) and social skill (β = .446; P = .000) was positive and significantly contributed to work performance. On the other hand, the three components of transfer of technology (ToT); technology skill (β = .008; P = .879), technology dissemination skill (β = .099; P = .110) and technology evaluation skill (β = .086; P = .191) was not statistically significant towards work performance. The summary statistics of the regression analysis show the variables for which the coefficients are statistically significant with $Adj.R^2$ of .575. The work performances were attributed to the three component of HRD with a combined contribution of 57.5% to variance of work performance.

Table 2. Demographic profiles of participant

Demography	Frequency (n = 54)	Percentage (%)
Age		
20-30	5	9.3
31-40	18	33.3
41-50	9	16.7
51-60	11	20.4
>60	11	20.4
Gender		
Male	42	77.8
Female	12	22.2
Marital status		
Single	10	18.5
Married	42	77.8
Widowed	2	3.7
Family size		
1-3	15	27.8
4-7	32	59.3
8-11	6	11.1
>12	1	1.9
Educational levels		
Primary	8	14.8
Secondary	25	46.3
College	4	7.4
University	17	31.5
Beekeeping Practice		
Full time	38	70.4
Part time	16	29.6
Beekeeping Experience		
< 1year	14	25.9
1-3 years	24	44.4
4- 6 years	14	25.9
>9 years	2	3.7
Beekeeping Association		
Yes	20	37.0
No	34	63.0

Source: Computed survey data, 2018

Table 3. Levels of work performance, technology know-how, dissemination of technology, evaluation of technology, leadership development, decision making process, and social skill

Level	Mean	SD
Work performance	2.929	.790
Technology skill	3.402	.774
Technology dissemination skill	3.362	.862
Technology evaluation skill	3.039	.876
Leadership development skill	2.865	.845
Decision making process skill	2.855	.898
Social skill	3.688	.692

Source: Computed survey data, 2018
M=Mean; SD=Standard Deviation

Table 4. Correlation coefficients among technology skill, technology dissemination skill, technology evaluation skill, decision making process skill, leadership development skill, social skill and work performance

Variables	X1	X2	X3	X4	X5	X6	Y
Technology skill (X1)	1	.528**	.638**	504**	.443**	.482**	.530**
Technology dissemination skill (X2)		1	.618**	.658**	.645**	.681**	.734**
Technology evaluation skill (X3)			1	.642**	.623**	.678**	.721**
Decision making process skill (X4)				1	.802**	.797**	.860**
Leadership development skill (X5)					1	.881**	.891**
Social skill (X6)						1	.928**
Work performance (Y)							1

Source: Computed Survey data, 2018
*Significant; **P<.01*

Table 5. Multiple linear regression of technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill, social skill, and work performance

Factors	Unstandardized Coefficients	Std error	Standardized Coefficients	t	Sig.
Constant	-1.139	.380		-2.998	.004
Technology skill	.017	.109	.008	.153	.879
Technology dissemination skill	.140	.086	.099	1.628	.110
Technology evaluation skill	.180	.136	.086	1.327	.191
Decision making process skill	.227	.080	.217	2.853	.006
Leadership development skill	.229	.104	.203	2.192	.033
Social skill	.511	.111	.446	4.608	.000

$P < .001$, $R = .789$, $R^2 = .623$, Adj. $R^2 = .575$, Std. Error of the Estimate = .51575, β = standardized regression coefficient, t value = test statistics of β
Source: Computed Survey data, 2018
*Significant; *P = .05*

4. DISCUSSION

The results of all the factors are consistent with previous research [10,22,23]. The moderate levels of technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill and social skill at high level tend to reflects level of work performance of the extension agents and moderate level of production among the beekeepers, the extension agents need to do more in these areas so as to be able to develop farmers knowledge and skills for sustainable improvement on their production. [24] reported that effective knowledge, skill and positive personal characters are vital tools in influencing outstanding performance among extension agents. Also, in another study by [25], it was revealed that knowledge, skills and preparedness of extension agents assist them in decision making process which has a greater contribution to extension services and enhanced agricultural productivity and food security among beekeepers.

The findings of the study showed that the correlation coefficients of transfer of technology (ToT) components (technology skill, technology dissemination skill and technology evaluation skill), human resource development (HRD) components (decision making process skill, leadership development skill and social skill) are significant and positively related to work performance of the extension agents. While the social skill had the strongest relationship with extension agents work performance. This is in line with the study of [26], which revealed a significant and positive relationship between social skill of agricultural extension agents and their work performance. This is showing how important is social skill as it will enable both extension agents and farmers to form a synergy on social value integration, norms, culture and tradition to enhance beekeeping production which will have a lot of positive influence on their standard of living. Also, developing high level of leadership development skill by the extension agents was said to have transmitted to organising a good leadership strategy among the farmers toward relating with each other, seek for more information on production and this can have high chance of improving sustainable production [27].

Furthermore, previous studies have frequently described association of decision making process skill, technology skill, technology dissemination skill and evaluation skill with work performance [10,23]. Dissemination and decision-making process skill referred that stingless bee farmers need to take the right decision in order to increase and improve their production through the influence of extension agents' delivery methods and decision making abilities. Hence, the process of identifying problems, securing relevant information, developing alternatives courses of action and the readiness to making a decision from the information gathered is vital in enhancing productivity [28]. In addition, extension agents' technology skill and evaluation skill showed a positive relationship to their work performance. Thus, acquiring technical skill and having the ability to evaluate extension programmes through systematic collection of information about the outcome of a programme enables them to make the right judgements about the programme in order to improve its effectiveness and make decision about future programme [29,30].

The findings of this present study on regression analysis showed that leadership development skill, decision making process skill and social skill significantly contributed to work performance of the extension agents. The result (Table 5) shows that the highest contribution is attributed to social skill (β = .446), followed by decision making process skill (β = .217) and leadership development skill (β = .203). This result is in line with the previous study by [10], they found that one of the most important and essential skill that agricultural extension agents must possess is social skill which is directly related to their duties to act as a team with the farmers. Furthermore, extension agents need to be experts and possess a good public relations and networking skills through effective use of extension communication methods [31]. Other studies also confirm that leadership development skill contributed to the success of an extension services and this is subjected to the ability of extension leaders' to optimize human resources. It is commonly accepted that for any organization to be effective, there is need for an effective leadership and that attempt to neglect this aspect will lead to poor performance of the organization [32]. Moreover, [33] recommended that agricultural extension needs to be analyzed and redesigned to provide quality agricultural extension education and capacity-building programmes that will improve skills of extension agents to help them create decision making

environments for farmers to have an improved productivity and performance.

5. LIMITATION AND CONCLUSION

The limitation of this study emanated from the usage of sample meant to be representative of whole population. Even though there is positive relationship between dependent and independent variables, work performance variance of 57.5% give explanation of three significant independent variables. The used of experience, education qualification and business records of beekeepers also serves as limitation in this study due to the fact that it may not be a representative sample of other beekeeping farmers which are new in the industry, they do not have business records and their production is only for their own consumption. There is need for more diverse samples for future research.

The implication of the findings from this study is focusing on the need to designing training programmes and innovations on beekeeping to improve the skills of extension agents on technology transfer and human resource development among beekeepers. Many of the beekeeping related technology were lacking and the one transferred by the extension agents lack required skills for effective delivery such as technology skill, technology dissemination skill, technology evaluation skill, leadership development skill, decision making process skill and social skill. Given the importance of the required skills for technology transfer as well as capacity and potential development of the beekeepers, these six skills should be entrenched in training programmes introduced by agricultural extension service agencies in Malaysia for enhance sustainable production of honey.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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