

EFFECTIVENESS OF EXTENSION AGENT SERVICES IN INFLUENCING THE ADOPTION OF MODERN HIVE IN SUSTAINABLE STINGLESS BEEKEEPING

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Abstract: The role of extension services in the development of agricultural practices is believed to have more significant impact in influencing the adoption of modern technology. This study identifies factors affecting the effectiveness of extension agent services on participants' adoption of modern stingless beekeeping hives. A total of 117 respondents were interviewed with structured questionnaires. Descriptive statistics, factor analysis and regression analysis were employed. The survey revealed that 78 out of 117 beekeepers had adopted modern hives. Of this, 66 were men and 12 were women, with the majority being full-time operators. The factor analysis identified four factors influencing the effectiveness of extension services in the adoption of modern hives, namely guidance and encouragement from extension agent, education, training provided and outcome. However, only education and training provided by extension agents were significantly positive in influencing the effectiveness of extension services. This study suggests that capacity-building and enhancement of extension agents and services through ongoing programs seem to be the most important strategies to ensure that beekeepers understand and acquire knowledge about the advantage of adopting modern hives.

Keywords: Apoidae, meliponiculture, bees, extension service, socio-economy, Malaysia.

Introduction

Meliponiculture, also known as stingless beekeeping, has been practiced for a long time in Malaysia following the demise of the *Apis* species in 2000. Modern beekeeping reportedly began in Malaysia in the 1970s using imported bees from Taiwan (Ismail, 2016). The development of modern beekeeping industry has been remarkable, leading the Malaysian Agricultural Research and Development Institute (MARDI) to launch stingless beekeeping in 2011 because of its huge potential in supplementing honey production in Malaysia. The stingless bee, known as *lebah kelulut*, is indigenous to Malaysia's tropical climate and has emerged as an alternative honey producer besides honeybees. The honey of stingless bees has high medicinal value and was once dubbed as a "super food" due to its high nutrient and antioxidant content,

which is considered good for health. Stingless bees do not only contribute to honey production, but they also play an important role as effective crop pollinators (Azmi *et al.*, 2016; Azmi *et al.*, 2017). More than 38 species of stingless bee species have been identified in Malaysia, but only four are commercially domesticated and they are *Geniotrigona thoracica*, *Heterotrigona itama*, *Lepidotrigona terminate* and *Tetragonula leviceps* (Mustafa *et al.*, 2018). According to a 2017 unpublished data by the Department of Agriculture Malaysia (DoAM), there were 605 stingless beekeepers in Malaysia. However, the number was expected to be higher as it only accounted for those registered under DoAM. In terms of honey production, stingless bees had been recorded to produce 134.2 tonnes of honey in 2017, which was worth more than RM19.27 million. Sarawak contributed almost half of the honey production in 2017 (about 51.5 %).

Presently, the use of modern hives in the stingless beekeeping is still low and does not get much attention from beekeepers. Most still prefer to use traditional methods, such as logs, which is not sustainable. A Turkish study revealed that honey production would increase in tandem with the number of modern hives being used (Vural & Karaman, 2009). One of the obstacles that causes a low adoption rate of modern hives among beekeepers is the perceived failure of extension agents in educating, monitoring and evaluating beekeepers. As stated by Degu (2012), the decision to adopt modern hives in stingless beekeeping could be influenced by the access to information provided by the extension service agents. In addition, poor and inadequate extension services have been observed to affect beekeeping and the adoption of technology in farm management practices (Mujuni *et al.*, 2012).

Extension Agents

Extension, as defined by Akinsorotan (2002), is an informal educational process for rural people that is vital to increase agricultural yield in family farms, thereby raising their standard of living. The agricultural extension service operates mainly to increase productivity and depends primarily upon the acceptance of improved cultural and technological practices at the farm level. Zaria (2001) had defined agricultural extension as the channel for developing rural communities for better health and wealth. If expansion is to perform its most useful role, it must have valid and viable programmes to attract farmers to use improved technologies.

Extension services is an important tool for rural development as it is technically viable and may serve as an effective knowledge-sharing activity in the extension ecosystem. Through extension agents, the extension services play an important role in the farmers' life and their agricultural production. In Malaysia, DoAM has been tasked with the responsibility of providing extension services to farmers, such as consultation and investment, technical support services, crop advice and agricultural training (Samsudin, 2010).

It is undeniable that agriculture extension has a vital role in promoting the adoption of new technologies and innovation (Jamilah *et al.*, 2010). Agriculture extension agents play the role of a middleman in facilitating communication and policy implementations between government agencies and farmers. They should be able to convince farmers to adopt modern farming technologies to increase their yield. However, before persuading farmers to adopt technology, extension agents must be convinced themselves on the importance of using the technologies that they are supposed to promote (Allahyari, 2009). They should be well informed and knowledgeable in disseminating information besides building a rapport with farmers, who will be more receptive to their advice.

Agricultural extension services aim to improve the farmers' attitude, knowledge and skills through education and communication. They do not only help farmers to increase agricultural production and profitability, but also bring changes in agriculture practices using modern technology improved from conventional methods. Technology and agricultural practices are constantly changing and farmers need to be versatile with an open attitude. Extension services provided by the government will ensure that farmers and beekeepers are not left behind in terms of agricultural developments. Various methods should be employed to effectively disseminate information to the farmers.

Zaria (2001) stated that the failure of extension services in beekeeping practices in Nigeria has been caused by the following reasons: Lack of dedication of extension agents; lack of incentives for agents and farmers; wrong concept in attending trainings, which focuses only on the allowance and not knowledge; and, weak government policies that are not geared towards improving the beekeeping industry. Thus, it is crucial for extension service agents in Malaysia to play their role in ensuring that beekeepers are updated with the latest knowledge and thus, adopting new technologies. Furthermore, the effectiveness

of their services will positively influence local stingless beekeepers to use modern hives to create a sustainable beekeeping industry.

Previous studies had shown that the capability of extension agents would affect the efficiency and effectiveness of their delivery. Maoba (2016) found that the production of farmers who had contact with extension agents were low and their practices were not different than those who did not have contact with extension agents. This might be the result of the failure to effectively disseminate information to farmers. Inadequate contact and lack of communication skills were also among the causes of failure and ineffectiveness of extension agents in influencing farmers to adopt technology (Ajayi & Aphunu, 2007). Adesiji *et al.* (2010) indicated that the effectiveness of extension services was influenced by the way the information was delivered. The author recommended different approaches in communicating with farmers because they came from different backgrounds. Baloch & Thapa (2016) found that the lack of knowledge among extension agents was the main problem in the ineffectiveness of their services. That could not develop problem-solving skills among farmers and the problems they faced in their agricultural practices would remain unsolved. That would bring no changes in farm production levels compared to farmers who had no contact with extension agents (Al-Sharafat *et al.*, 2012).

The use of modern hives among stingless beekeepers is still not widely accepted. It is believed that the low adoption rate is related to the low knowledge of beekeepers about its advantages. Thus, to increase and improve the beekeepers' knowledge in using modern hives, it is important to ensure that they have access to dedicated extension agents. According to Anaeto *et al.* (2012), extension agents were responsible for increasing the farmers' knowledge, honing their skills and changing their attitudes (Shah *et al.*, 2013). By providing advisory and consultancy services, the farmers had become educated, full of knowledge and could respond positively to new ideas. The farmers

were beginning to understand the importance of adopting new technologies despite the complexity and technical difficulties.

Although the government has provided extension services to Malaysian beekeepers, there are several factors that may influence their effectiveness. Ismail & Ismail (2018) stated that the lack of these services may adversely affect farm productivity and profits. The purpose of this study is to identify the factors influencing the effectiveness of the extension agents' services in the adoption of modern hives in stingless beekeeping.

Methodology

The study was conducted throughout Peninsular Malaysia, Sabah and Sarawak. Data collection was carried out from October 2017 to March 2018. The samples were collected from various stingless beekeepers nationwide because their farms were dispersed and to ensure that the sampling was conducted randomly. The respondents were gathered in one place with the assistance of DoAM and *Koperasi Pembangunan Desa* (KPD) in Sabah. The stingless beekeepers were active industry players and registered with DoAM and KPD. The beekeepers were contacted by phone email or official letter. However, the selection of respondents was based on their willingness to participate in the study.

Sample Selection and Sampling Technique

The selection of respondents was based on a purposive and random sampling method, including adopters and non-adopters of the modern hive. A list of registered stingless beekeepers was obtained from DoAM in Putrajaya, the federal administrative centre of Malaysia. The list contained the details of 605 beekeepers nationwide until the end of 2017. A total of 125 beekeepers responded to this study and this figure was lower than 254 as suggested by Krejcie & Morgan (1970). Only 117 questionnaires were deemed complete and the incomplete questionnaires were excluded.

Data Collection

The data were collected primarily through a survey using structured questionnaires and a face-to-face interview. Prior to the data collection, a pre-test was conducted to check the appropriateness of the questionnaire. Visits were also carried out to the responding beekeepers' farms to obtain first-hand observation on their practices.

Data Analysis

Data from questionnaires were analysed using IBM SPSS Version 23 (IBM Corporation, Armonk, New York, USA). Descriptive statistics were compiled and subjected to factor analysis. The descriptive statistics described the socio-demographic characteristics of the stingless beekeepers in Malaysia and differentiated between those who adopt and did not adopt modern hives. Factor analysis using the principle component analysis approach with orthogonal rotation (varimax) was used to identify the most important variables in the data set that affected the adoption of modern hives.

Factor Analysis

The exploratory factor analysis was employed to measure the factor influencing the effectiveness of extension agents in the adoption of modern hives in stingless beekeeping practices. Factor analysis was used to determine which items clustered or grouped together to form a "factor".

As there were 117 respondents only, this might give rise to an argument on whether the analyses in this study were valid. Although there were many "rule of thumb" relating to the sample size in factor analysis, this study employed the minimum number of 100 as suggested by Hair *et al.* (2012). A similar recommendation was proposed by Kline (1994) and Gorsuch (1997), where their sampling had at least 100 subjects for factor analysis.

The factor structure was investigated using an exploratory factor analysis with Principle Component Analysis. The factors influencing the effectiveness of extension agents in the

adoption of the modern hive in stingless beekeeping practices were measured using the Likert scale, where 1 (strongly disagreed), 2 (disagreed), 3 (agreed) and 4 (strongly agreed). The questionnaire consisted of three variables, namely decision-making process, leadership and social life and with 32 items. The items considered for factor analysis were subjected to a reliability test to ensure the internal validity.

According to George & Mallery (2003), the value more than 0.8 was considered good, indicating the variable was consistent and reliable. The measure of sampling adequacy was determined by Keiser-Meyer-Olkin (KMO) and its value of at least 0.6 or higher, with Eigenvalue greater than 1 was considered meaningful for factor analysis (Hair *et al.*, 2012). The Bartlett's Test of Sphericity determined the null hypothesis where the correlation matrix was an identity matrix with variables that were uncorrelated. The significant value was defined as $P < 0.05$ and thus, factor analysis was suitable.

Regression analysis

In addition to descriptive and factor analyses, the multiple linear regression was applied to examine the influence of factors affecting the effectiveness of extension agent services in influencing the adoption of modern hives. The score factor values derived through factor analysis were considered as independent variables and the adoption of modern hives was used as the dependent variable. According to Maddala (1992), the multiple linear regression equation could be specified in equation 1.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + u \quad (1)$$

where, Y was the dependent variable measured by the adoption of modern hives, α was the regression constant (intercept), β_1 , β_2 and β_3 were regression coefficients of Factor Score (FS). FS was a score and u were an error term in the model. The coefficient of determination (R^2) was used as an indicator of the quality of the regression model.

Results and Discussion

The demographic profile of respondents is stated in Table 1. The study revealed that majority of the beekeepers were men (81.2 %), with 69 adopters and 29 non-adopters of modern hives. This indicated that the stingless beekeeping in Malaysia was a male-dominated industry, in

line with the observations of Nwaobiala (2017). Around 82.9 % of the respondents were married and their age ranged between 32 and 41. It indicated that for both groups, majority of the adopters and non-adopters of modern hives aged between 31 and 41 years were 33.3 % and 28.2 %, respectively.

Table 1: Socio-demographic of stingless beekeepers in Malaysia

Variables	Adopters (n=78)	Non-adopters (n=39)	Total (n=117)
Gender			
Male	66	29	95(81.2)
Female	12	10	22(18.8)
Marital status			
Single	13	5	18(15.4)
Married	63	34	97(82.9)
Widowed	2	0	2(1.7)
Age			
22 – 31	16	6	22(18.8)
32 – 41	26	11	37(31.6)
42 – 51	10	6	16(13.7)
52 – 61	18	9	27(23.1)
62 – 71	8	7	15(12.8)
Household size			
1 – 4	51	22	73(62.4)
5 – 8	26	16	42(35.9)
9 – 12	1	1	2(1.7)
Educational level			
Primary school	3	7	10(8.5)
Secondary school	28	21	49(41.9)
College	17	5	22(18.8)
University	29	5	34(29.1)
Others	1	1	2(1.7)
Mode of practices			
Full-time	49	29	78(66.7)
Part-time	29	10	39(33.3)
Experience in beekeeping practices	68	35	103(88.0)
1 – 5	8	4	12(10.3)
6 – 10	1	0	1(0.9)
11 – 15	1	0	1(0.9)
16 years and above			
Involvement in beekeeping association	27	12	39(33.3)
Yes	51	27	78(66.7)
No			

The high number of young beekeepers was in line with the government’s attempt to promote and encourage young people to participate in agriculture. This is achieved through the implementation of young entrepreneur programs under the 11th Malaysian Plan that targeted those age between 18 to 40. About 73% of them had a small family of four. Almost 42 % of the respondents had secondary school education. However, among the modern hive adopters, most of them had tertiary education.

This indicated that better educated beekeepers were putting their knowledge to good use and tended to use better techniques such as the modern hives. About 78 (66.7%) of them were full-time beekeepers. Majority of the beekeepers (88%) had less than five years’ experience and only one had been involved for more than 16 years.

Factors Affecting the Effectiveness of Extension Services in Influencing the Adoption of Modern Hives

To obtain the new factors affecting the effectiveness of extension services in

influencing the adoption of modern hives, the exploratory factor analysis was used. Bartlett’s Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used to determine the factorability of the matrix. The result of KMO measurement in Table 2 was 0.939, which was greater than 0.6. This indicated that the sampling was adequate and appropriate to proceed for factor analysis. The Bartlett’s Test of Sphericity should be significant ($p < 0.05$, $p = 0.000$) for factor analysis to be applied.

The factor analysis of the 32 statements was conducted using the principal component method. Four of the identified factors had Eigenvalues greater than one, collectively accounting for 77.27 % of the variation across the sample. The factor loadings were subsequently subjected to the varimax rotation. The result of the factor loading is presented in Table 3. The factor analysis uncovered four broad factors for effectiveness of the extension services in influencing the adoption of modern hives among stingless beekeepers in Malaysia.

Table 2: KMO and Barlett’s Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.939
Bartlett’s Test of Sphericity	Approx. Chi-Square	4561.939
	df	496
	Sig.	.000

Table 3: Factors affecting the effectiveness of extension services in the adoption of the modern hive in stingless beekeeping practices

Items	Factor loading	α
F1 Guidance and encouragement from extension agents		
- There is reinforcement of positive attitudes about beekeeping among clients.	0.504	0.974
- Extension agents can motivate me.	0.543	
- Extension agents train me to work together in beekeeping.	0.650	
- Extension agents teach me to become a commercial beekeeper.	0.660	
- Extension agents have guided me on how to invest my money.	0.597	
- There is improvement in my standard of living and social wellbeing as a result of marketing outlets through extension agents.	0.747	
- I am able to do business with other people far and near with the help of extension agents.	0.762	

- I have established contacts with key community leaders.	0.553	
- Extension agents educate me on the importance of integrating with people's norm, culture and traditions.	0.721	
- Extension agents encourage me to behave and respect the community.	0.749	
- Extension agents have taught me how to liaise with educational institutions, health, social and community leaders.	0.644	
- Extension agents are approachable.	0.614	
- Extension agents have shown me how to demonstrate concern on beekeeping problems and solutions.	0.642	
- Extension agents want me to cooperate with fellow beekeepers.	0.733	
- Working together with beekeeper partners is strongly encouraged by extension agents.	0.539	
- Extension agents have taught me how to communicate effectively with fellow beekeepers to share and adopt improved practices.	0.574	
F2 Education by extension agents		
- Extension agents have shown me how to choose a good farm environment.	0.800	0.963
- Extension agents encourage me to adopt improved and modern technologies.	0.822	
- Extension agents can help me overcome pests and diseases in beekeeping.	0.746	
- Extension agents try to inculcate a good attitude in me so I will regularly supervise my farm.	0.730	
- Extension agents have taught me to give high priority to additional feeding information.	0.770	
- Extension agents have educated me to monitor bee health.	0.681	
- Extension agents have full knowledge in beekeeping technology and management.	0.631	
- Extension agents train me to become an effective decision maker.	0.589	
F3 Training provided by extension agents		
- I receive training regularly from the Department of Agriculture.	0.597	0.897
- Extension agents conduct meetings with me to create awareness on beekeeping products.	0.644	
- There is good leadership approach by extension agents through local cooperatives.	0.658	
- I have received training from extension agents on how to approach banks to finance my beekeeping business.	0.666	
- Cooperatives have provided better marketing outlets to help members expand their business.	0.764	
F4 Outcome of extension agents		
- There is an improvement of farm income through interactions with various parties involved.	0.658	0.914
- A good leadership approach has helped me form networks with many social, health and community leaders.	0.748	
- I feel confident in carrying out my beekeeping business as a result of organized leadership shown by extension agents.	0.685	

Factor 1 — Guidance and encouragement from extension agents: This factor explained 25.13 % of the variation. There were 16 items under this factor. The top five items under Factor 1 seemed to have higher Eigenvalues. Guidance and encouragement from the extension agents were important as they provided moral support and motivation to the beekeepers to adopt modern hives. When the extension agents

frequently contacted and increased their visits to beekeepers, there would be a higher rate of modern hive adoption. Nwaobiala (2017) found that the approaching method employed by extension agents, such as conducting demonstrations and on-farm practices, had yielded a positive result in disseminating information and adoption of modern technology among beekeepers.

Factor 2 — Education by extension agent: The issues that were loaded most heavily on this factor, which explained 23.11 % of the variation, were the ability of extension agents to show beekeepers how to choose a suitable farm environment and efforts to encourage them to adopt new technologies. Adequate knowledge was important because when the beekeepers had specific knowledge, they would know the best actions to take in resolving issues. Providing the right, adequate and valuable information could increase the probability for the adoption of new hives. A study by Lawal *et al.* (2009) stated that the extension agents should ensure that current information on beekeeping should be effectively disseminated among industry players. This would reduce constraints faced by the farmers and increase the adoption of improved practices.

Factor 3 — Training provided by extension agents. The issues that were loaded most heavily on this factor, which explained 16.32 % of the variation, were the role of cooperatives in helping beekeepers to market their honey and guidance by extension agents to seek financing. The training provided by agents was important because it could give knowledge to farmers, including the practical aspects and hands-on practices. The beekeepers could learn a new skill and experience how technology worked. Most of the extension agents provided and disseminated information and knowledge to beekeepers through field visits. However, the extension agents should employ various methods so that the beekeepers could get a clear sight about the technology and ready to adopt it. Kassem (2014) revealed that applying more than one method in learning would increase the farmers' exposure to new technologies.

Factor 4 — Outcome of extension agents. The issues that were loaded most heavily on this factor, which explained 12.72 % of the variation, were better income through networking, the importance of having good leadership skills among extension agents. Basically, before the beekeepers adopted a new technology, they would want to see the results of the new practice

that had been adopted elsewhere. Outcome in terms of monetary and social benefits were found to be one of the factors affecting the effectiveness of extension services in influencing the adoption of modern hive. This factor was not mention in any previous literature because the researcher did not focus on the success of the extension services in transferring new technology.

The Influencing Factors Affecting the Effectiveness of Extension Services in Influencing the Adoption of Modern Hives in Stingless Beekeeping Practices

An attempt was made to examine the influence of factors affecting the effectiveness of extension services in influencing the adoption of modern hives in stingless beekeeping practices using regression analysis. The results are in Table 4.

The coefficient of multiple determination (R^2) and the adjusted R^2 values indicated that the regression model was a good fit. It showed that 72.8 % of the variation in the dependent variable (the adoption of modern hives) was explained by the independent variables (the influence of factors affecting the effectiveness of extension services in influencing the adoption of modern hives). The F-value of 5.869, significant at one per cent, also implied that the regression model fitted the data well.

Further perusal of Table 4 showed that out of four independent variables used to determine the relative influence of each variable in explaining the variation in the dependent variable, there are only two variables that positively and significantly influenced factor affecting the effectiveness of extension services as shown by their significant t values.

Education by extension agents appeared to be one significant factor in influencing the effectiveness of the extension services in influencing the adoption of modern hives. Majority of stingless beekeepers in Malaysia operated in rural areas and lacked access to external information on modern beekeeping practices. Thus, they highly depended on

Table 4: The influence of factors affecting the effectiveness of extension services in influencing the adoption of modern hives in stingless beekeeping practices

Factors affecting the effectiveness of extension services	Regression co-efficiency	t-value	Sign.
Intercept	1.129	3.967	0.011
Guidance and encouragement from extension (X_1)	0.561	3.601	0.710
Education by extension agent (X_2)	0.728	3.315	0.032*
Training provided by extension agents (X_3)	0.692	2.872	0.011**
Outcome of extension agents (X_4)	0.528	2.551	0.521
R ²	0.736		
Adjusted R ²	0.728		
F	5.869		0.000
N	117		

Note: *, **, significant at five per cent and one per cent level, respectively

extension agents to provide information and technical advice. Once the agents visited their farms, it would increase their understanding and build confidence in communicating. Shah *et al.*, (2013) revealed that the roles played by extension agents were important so that they could create awareness and convince beekeepers to innovate their practices.

Besides, the training provided by extension agents had also been revealed to be important factors in providing effective extension services. Basically, beekeepers were always looking forward to receiving training and guidance so they could increase their confidence in running their bee farms. From time to time, they would be trying to get extra knowledge, which later could increase their production. Training, courses and practical demonstrations conducted by the extension agents were important as the beekeepers could attend and experience hands-on practical and learn from the demonstrations how to carry out procedures correctly. As stated by Mujuni *et al.*, (2012), training by extension agents to beekeepers could enhance the skills and knowledge on the art and science of bee farming. Training offered to beekeepers also made beekeeping management more practical, coupled with frequent extension visits and contacts.

Conclusion

Guidance and encouragement from extension agents seemed to be the most important factor in the effectiveness of extension agent services for the adoption of modern hives in stingless beekeeping. The relevant agricultural research institutions, like MARDI and the Department of Agriculture, should enhance the services through ongoing programs to ensure that the beekeepers understood the advantage of using new technology, like the adoption of modern hives. The effectiveness and success of using modern hives could attract non-adopters to use the item. In summary, the extension service agents should understand their roles as agents of change and provide their training effectively.

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