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ASSESSING BEEKEEPING POTENTIAL IN OYO STATE, NIGERIA

Balogun, Taofeek Ayodeji[1*], Dontsop, Nquezet[2], Olawuyi, Seyi Olalekan[3*] and Onomu, Roland[3]

[1] Cooperative Information Network, Obafemi Awolowo University, Ile-Ife, Nigeria
[2] International Institute of Tropical Agriculture, Nigeria
[3] Department of Agricultural Economics and Extension, University of Fort Hare, South Africa
*btaofeekayodeji@yahoo.com, p.dontsop@cgiar.org, *seyidolapo1704@gmail.com, 201411986@ufh.ac.za*

Abstract: This paper investigated the technical efficiency and its correlates as well as the profitability status of honey enterprise in Oyo State, Nigeria. A hundred and twenty respondents were sampled using multiple stage sampling techniques and questionnaire was administered to elicit the needed responses. The non-deterministic nature of producing honey informed the use of stochastic production model to assess beekeepers' technical efficiency while gross margin analysis was adopted to illuminate how profitable honey production is in the area under consideration. The descriptive statistics revealed important socio-economic attributes of beekeepers in relation to beekeeping while the Maximum Likelihood Estimate (MLE) revealed the technical efficiency deciles of beekers within the production possibility frontier. Result revealed that beekeepers are operating close to the frontier of production using the available resources. The elasticity of production was greater than 1, showing an increasing return to scale of production while the budgetary analysis revealed that honey production is profitable. Consequent on the research outcome, beekeeping enterprise has the potential to generate substantial income, generate employment opportunity and meet the nutritional needs of Nigerian populace.

Keywords: Technical efficiency, maximum likelihood estimate, beekeepers, elasticity, gross margin

INTRODUCTION

The consensus world over is that, significant economic growth and sustainable development (Binam *et al.* 2004; Msuya, 2008) is anchored on improving agricultural productivity and attaining adequate nutritional requirements (Oyewo *et al.* 2009). While there are dissenting opinions as to the appropriate ways to improve productivity and the standards of nutrition, a number of approaches, including technological options, have been suggested. The use of innovative technologies in agriculture includes but is not limited to the application of fertilizer, herbicides and pesticides in farming, and the use of advanced equipment. The adoption of technological approaches, according to Oyewo *et al.* (2009), is a necessary but not a sufficient consideration to achieve the needed productivity improvement.

Although, productivity is most times used interchangeably with efficiency, efficiency fundamentally quantifies goods and services that can be turned out from a specified unit of input. According to Farrell (1957), the units of efficiency include the technical, allocative and economic efficiency. Technical efficiency (TE) is the capacity of a producer to maximise output from a stated input given available technology (Yao and Liu, 1998). Allocative efficiency is the optimal allocation of resources considering the cost at which the resources are purchased. And economic efficiency combines the outcome of technical and allocative efficiency and matches it with the unit price of input (Oladebo and Ambe-Lamidi, 2013).

In recent times, researches in respect to TE keep growing with few assessing the TE around renewable resources. A unique attribute of renewable resources is that, they reproduce naturally over a period of time that is comparatively short in human terms (Kirkley *et al.*, 1995; eNote, 2012). Apiary, for instance, offers an enormous opportunity to ameliorate poverty and meet nutritional requirements. The low entry cost associated with setting up an apiary enables farmers who find access to land difficult to be able to earn reasonable income and profit in the first year of operation using their backyards. In addition to honey produced by bees, beeswax, propolis, royal jelly and bee venom are other products that give the beekeeper reasonable proceeds when sold (ICIMOD, 2009). Similarly, bee-based micro-enterprise, hive carpentry, hiring and renting of bee colonies for pollination and honey trading are among off-farm forms of employment associated with beekeeping. Honeybees are pollinators, and as such, their activities in pollination promote production in agriculture, forestry and keeping the natural resource and biodiversity stable.

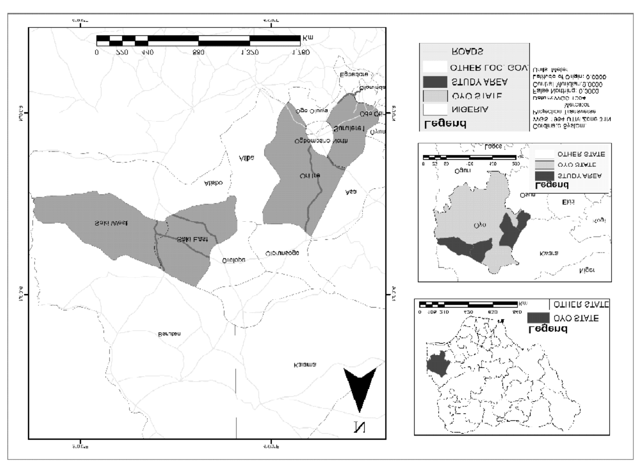
In spite of the enormous potential that beekeeping offers, the application of synthetic chemicals (such as pesticides and herbicides), lack of beekeeping equipment, extension services and good market (Tesfaye *et al.*, 2017) hinders optimal honey production. Most importantly, factors relating to market opportunities and the apparent deficit of technical knowledge needs to be addressed. Much is still left to be understood in respect to the technical efficiency of beekeeping among the few practicing it. Therefore, knowing more is important to sustainably address and scale up honey production from abysmal to lucrative production level.

Notable among beekeeping studies are Amao (2005), Adjare (1990), Armon (1980), Sekumade *et al.* (2005), Rauf *et al.* (2005). Amao (2005) evaluated modern and traditional beekeeping; Adjare in 1990 examined the status of beekeeping in Africa; Armon (1980) examined the use of honey in the treatment of infectious wounds while Sekumade *et al.* (2005) and Rauf *et al.* (2005) attempted the analysis of honey production. These studies leave much to be understood as the technical knowledge required for profitable scale of honey production remains unclear. It should also be noted that, for those that have studied beekeeping, time and location is of the essence in studying technical efficiency.

As a matter of fact, insufficient theoretical information about the technical efficiency of beekeeping and how it should be organised for beekeepers to make profit has hampered appropriate empowerment of existing and prospective beekeepers with the needed technical know-how in Nigeria. The in-road to policy development is fueled by the available information so that more feasible approach to scale-up production would have been considered. Hence, the need to assess the technical efficiency and the profitability of honey production in Oyo state, Nigeria. In this study, emphasis is on the inputs in beekeeping and also the identification of sources of inefficiency in beekeeping along with the enterprise profitability.

RESEARCH METHODOLOGY

Oyo state occupies a land mass of approximately 28454 square kilometers. Oyo State is an inland state in South-West Nigeria. The longitude and latitude is 8°002 N 4°002 E. It is boarded in the south by Ogun State and in the north by Kwara State. In the west, it is partly bounded by Ogun State and partly by the Republic of Benin. Also, it is boarded by Osun state in the East. The National Population Commission reported that the population of Oyo state in 2006 was 5,591,589 (National Bureau of Statistics, 2006). The mean annual rainfall is estimated at between 1,194mm and 1,278mm in the Northern and Southern parts of the State. This amount of rainfall is suitable for beekeeping because it falls within the recommended range (1000-1400mm), (FAO, 1990). The mean temperature is 27^{0}C. Agriculture is a common practice among the indigene of the State. The climate of the State is suitable to grow crops like millet, yam, plantains, maize, cassava, rice, cocoa, palm produce, cashew.



Source: Authors' composition

Sampling technique and sample size

Under the agricultural development project, Oyo state is divided into four agricultural zones namely Ibadan/Ibarapa (9 blocks), Ogbomoso (5 blocks), Oyo (5 blocks) and Saki (9 blocks). The study employed a multi-stage sampling procedure. The first stage of the sampling is the purposive selection of Ogbomoso and Saki Agricultural Development Programme (ADP) zones. The two agricultural zones were selected based on their attributes; which has cultivation of different crops that aid pollen grain gathering by honeybees to produce honey. The second stage had two local governments selected at random from Ogbomoso (Orire and Surulere Local Governments) and Saki (Saki West and East Local Governments) agricultural zones and they have a total of four local governments. In the third stage, a proportionate to size was used to select the sample population from the four local governments selected in the second stage. Thereafter, simple random sampling was then used to select the respondents sampled from the list of the beekeepers provided by the Beekeepers' Association of Nigeria (BAN) in each of the four local governments after using the proportionate to size factor. A hundred and forty respondents were sampled. However, only hundred and twenty was used for this study because other respondents did not complete the questionnaire. This is clearly shown in Table 1 as follows:

Table 1
Breakdown of sampling Procedure

Ogbomoso Agricultural Zone			*Saki Agricultural Zone*		
Local Governments	*Registered Respondents*	*Sampled Respondents*	*Local Governments*	*Registered Respondents*	*Sampled Respondents*
Orire	61	22	Saki West	95	35
Surulere	97	36	Saki East	129	47
Total	158	58		224	82

Source: Field survey, 2009

Source of Data: Primary data used for this study was collected using a well-structured questionnaire which was administered through interview technique. This was made possible with the cooperation of the chairman of BAN who allowed the interview to hold on the day when members have their meeting. This eased and facilitated the collection of the data needed. Relevant information on farmers' socio-economic attributes such as gender, age, marital status, educational status, years of experience, household size, membership of association, occupational status and honey production characteristics; output per hive, type of labour, hours (in man-day), land ownership, benefits derived being a member of BAN where collected.

Analytical techniques: Descriptive statistics such as frequency counts and percentages describe farmers and farm-based characteristics of beekeepers in the study area. The technical efficiency of the beekeepers was estimated using the Stochastic Frontier Analysis model (SFA) while cost and return analysis of beekeepers was estimated using the Gross Margin Analysis approach.

Model specification

The Stochastic Frontier Analysis (SFA) was used to assess the efficiency level of beekeepers. The variability associated with agricultural production formed the premise on which the SFA was chosen. The hazard linked to weather, insect, pest, diseases, physical damage of crops and the lack of proper farm record documentation especially among smallholder farmers are ills which makes SFA suitable for this study. It factors in these ills by concurrently accounting for the random error and inefficiency parameter specific the agricultural sector under consideration

The stochastic frontier also permits simultaneous assessment of individual farmer's technical and allocative efficiencies coupled with their determinants (Battese and Coelli, 1995). Unlike SFA, Data Envelopment Analysis cannot take into account, statistical noise, as the efficiency estimate may be biased because the processes involved in producing honey stochastic in nature. Similarly, with no relationship between input and output, individual farmers maybe being seen as unique and entirely operating at the frontier of production. This situation most times leads to loss of discriminating power (Thiam *et al.*, 2001; Jacinta *et al.* 2012).

The influence of farm and farm specific attributes on the technical efficiency of beekeepers prompted the estimation of the stochastic frontier production model. The functional form is summarized as follows:

$$\ln Y_j = \beta_0 + \sum_{i=1}^{i=3} \beta_i \ln X_{ij} + v_j - u_j$$

Where *ln* designates a natural logarithm and subscripts *i* and *j*, respectively, represent the inputs *i* used by farm *j*. Furthermore:

Y = Output of harvested honey (in Litres)

X_1 = Labour

X_2 = Access to land

X_3 = Number of hives

X_4 = Time spent on beekeeping activities

The random variable which is denoted by v_j, has a zero mean and a variance σ_v^2 that is not known. The non-negative random term denoted by $u_j (u_j \geq 0, \forall_j)$ which represents the technical inefficiency in j^{th} farm production. It is assumed to be independently and identically distributed between observations, and is obtained by truncation at point zero of the normal distribution with mean u_j, and variance σ_v^2, where the mean is defined by the equation:

$$\mu_j = \delta_0 + \delta_1 Gen_j + \delta_2 Ag_j + \delta_3 Exp_j + \delta_4 MBA_j + \delta_5 Hs_j$$

where:

Gen = Gender of respondents

Age = Age of beekeeper; measured in number

Exp =Experience; measured in number of years spent in beekeeping

MBA = Dummy variable indicating if beekeeper is a member of Beekeepers Association of Nigeria (BAN).

Hs = Household size of beekeepers, i.e. number of individuals living within a household

The technical efficiency of farm *j*, written as TEj, is defined according to Battese *et al.* (1988) as:

$$TE_j = \exp(-u_j)$$

TEj assumes values between zero and one. In the event that j^{th} farm assumes a value that is one, it follows that the farm has an absolute technical efficiency level. But when the value is close to zero, it connotes that the farm been assessed is plagued with inefficiency. In essence, *TEj* is an indicator that shows management's efficiency level. It shows farmers ability to accomplish outcome relative to others operating at the frontier of production.

The coefficients β_0, β_j, β_{ik} and δ_0, to δ_{10} and the variance parameters $\sigma^2 = \sigma_v^2 + \sigma_\mu^2$ and $\lambda = \frac{\sigma_\mu}{\sigma_v}$ are simultaneously estimated by MLE, using *Frontier* 4.1 software developed in 1996 by Coelli.

Return to scale (RTS) and elasticity

To assess the RTS in beekeeping enterprise, the α (scale coefficient) should be estimated. Theoretically, RTS is estimated by summing up the partial elasticities of every single input used in production. In doing the same for this study, the average elasticity value of beekeeping output linked each input is assessed by estimating the model stated below:

$$\frac{\partial \ln E(Y_j)}{\partial \ln(X_k)} = \beta_k + 2\beta_{kk} \ln(X_{ki}) + \sum_{j \neq k} \beta_{kj} \ln(X_{ji})$$

Thus, α is estimated by:

$$\alpha = \sum_{k=1}^{n} \left(\frac{\partial \ln E(Y_j)}{\partial \ln(X_k)} \right)$$

The extent of α determines the relative variation in output following a unit proportional rise in the general inputs. An industry experiences increasing return to scale of production when α is more than 1. A constant return to is exhibited when the value of α is unitary while the value of α not up to 1 exhibit decreasing return to scale.

Cost and Return analysis

To show the profitability of the beekeeping enterprise, the cost and return was examined using the gross margin analysis. Gross margin (GM), according to Abdullahi *et al.* (2017), is the financial output minus the variable cost. While GM is applicable to an enterprise with similar attributes and production method, GM gives a useful explanation of production and economic efficiency of the enterprise under review. Furthermore, it serves as a framework to explain the misconception relating to the process of assessing the performance of the food value chain system (Lawrence, 1992). The fact that it gives an overview of the monetary outlay spent on the process of adding value to products along with the market service presents it as a veritable tool in evaluating an enterprise such as beekeeping. GM is stated as follows:

$$GM = TR - TVC$$

$$GM = \sum_{i=1}^{n} p_i q_i - \sum_{i=1}^{m} c_j x_j \quad \text{where:}$$

GM = Farm gross margin, TR = Total revenue, TVC = Total variable cost, TFC = Total fixed cost

p_i = Unit price of output i in the market, q_i = Amount of output i, c_i = Unit cost of variable input j

x_i = Amount of variable input j, m = Number of input used, n = Amount of output produced

And net profit is given by: Π = GM – TFC

RESULTS AND DISCUSSION

The results of the test conducted on the data obtained from the beekeepers in Oyo are presented in this section. The section began with the presentation of the socio-economic and production attributes of beekeepers. The frequency counts and the percentages of the selected variables are presented in Table 1. From the table, it was observed that 80 percent (majority) of beekeepers are male while the remaining (20 percent) were female. This shows male dominance in beekeeping. This may be attributed to the fear of bees as males are likely to show more courage than females in approaching a bee swarm. The domination of male gender in this enterprise agrees with Sekunmade *et al.* (2005); Amao (2005); Raufu *et al.* (2005) and Oluwatusin (2008).

Age factor in traditional agriculture is significant in increased productivity and increased adoption of innovation. The distribution of respondents' age is presented in Table1. The distribution according to the table showed that, the average age of beekeepers was 40 years while the minimum and maximum age of the respondents was 20 years and 68 years, respectively. In addition, 72 percent of beekeepers were not up to 46 years, which also agrees with Rauf *et al.* (2005). Farmers in their economic active age may have high level of efficiency.

According to Ezihe, Agbugba and Lornum (2014), married couples with large family can enjoy the supply of family labour to help cultivate their farm plots. Following these words, the marital status distribution of beekeeper is stated in Table 1. Inferring from Table 1, majority (74.2 percent) of the beekeepers were married, while 25.8 percent were unmarried. The involvement of more married people in beekeeping may be driven by the desire to make more income for the subsistent family. The involvement of more married respondents agrees with Sekunmade *et al.* (2005).

The educational attainment of a farmer raises productivity and improves his/her human resource to comprehend and appraise information in respect innovative technology. The distribution of educational status of beekeepers reveals that 79.2 percent of them acquired a formal tutoring or another which vary from primary to tertiary education. Only 20.8 percent of them had no formal education. This educational status of respondents signals a positive rate of adoption of innovation in beekeeping.

The years farmers spend in the agribusiness could signal the pragmatic knowledge learnt over the period. This may have sizeable effect on production efficiency. The experience ranges between 1-22 years, respectively with the average years of experience being 5.7 years. Majority of the respondents (57.5 percent) had experience of less than 5 years.

Peasant farming is characterised by the utilisation of family members as a source of cheap labour (Adegeye and Dittoh, 1982). The household size of the enumerated respondents ranges between 1 and 11, respectively with an average of 6 members per household. More than 2/3 of the respondents (84.9 percent) fell within the range of those that had between less than or equal to 6 members in their household. This result corroborated the account of Sekunmade *et al.* (2005).

Having 2/3 (81.7 percent) as active members of Beekeepers Association of Nigeria (BAN) suggests that members could have the privilege to enjoy economic and social benefits along with knowledge sharing among other fellow members.

Majority (57.5 percent) of the beekeepers as stated in Table 1 have other occupation. Less than half of the respondents take beekeeping as their only means of livelihood. Other activities that bee farmers use to sustain their life ranges from being a civil servant, tailoring, trading, animal husbandry, general crop cultivation and rendering consultancy services. This statistic might not be unconnected with the fact that majority of the beekeepers are in their active ages (45 years and below) hence, they are still energetic and can engage in various lucrative enterprises.

Honey production characteristics

The average output and number of hives are 11 litres and 20 hives, respectively. The output ranges between 2-25 litres. Majority (34.2%) of the respondents harvested between 6-11 litres of honey/hive. Also, 37.5 percent of the respondents harvested greater than 12 litres of honey per hive while 10 percent harvested less than 5 litres. In the same vein, majority of the beekeepers used family labour. About 61.7 percent used family labour, while 22.5 percent of the bee farmers used both family and hired labour. This result shows the importance of family labour in beekeeping enterprise.

The average man-day is a little above 2, while the maximum man-day of labour in the study area per production season is 41. Table 1 reveals that 2/3 of the respondents representing 80 percent use less than 1.64 man-day of labour. The remaining 20 percent use man-day of labour greater than 1.647 per production season. These show that beekeeping is not labour intensive. Accordingly, 15.8 percent of bee farmers purchased the land on which their hives were placed while majority (38.3 percent) inherited the land they use for beekeeping. The remaining percentage accounts for respondents who either leased the land or "purchased and lease" or "inherited and lease" the lands use as their apiary. The fact that majority of beekeepers leased the land on which their hives are placed suggest the likelihood of beekeepers having the problem of land tenure.

The findings as revealed in Table 1 shows that (63.3 percent) benefit from exchanging ideas and knowledge by being a member of BAN. Diffusion of knowledge includes seminar attendance, training on hatching of queen, identifying diseases, among others. This is likely to give bee farmers a higher level of productivity.

Apart from knowledge acquisition, 19.2 percent of BAN's members enjoy economic benefits, this involves the sales of their produce, marketing assistance, loan disbursement by the Association. All these contribute to better and improved. Finally, 15.8 percent of respondents enjoy social benefits (more recognition, labour assistance, security and produce exhibition) as members of BAN.

Efficiency analysis of honey producers

The MLE of the stochastic frontier model for beekeepers is organised and displayed in Table 2. The log-likelihood function of -0.74, and sigma square of 0.24 which is significant at 1 percent shows that the fitted regression model is good. The production function reveals that number of hives and access to land are significant at 1 and 5 percent, respectively. Of the 4 variables fitted to explaining honey production efficiency. Number of hives and access to land were both positively related to quantity of honey produced. This means that an increase in any one of them leads to an increase in the quantity of honey produced. Labour which is a critical input in general production is not significant in honey production. This illuminates the usefulness of family labour in honey production. Similarly, the time spent on beekeeping activities is not significant. It follows that beekeeping requires short time, relatively. The mean technical

Table 1
Selected socioeconomic and production variables of the respondents

Variables	*Frequency*	*Variable*	*Frequency*
Gender		**Honey Production Characteristics**	
Female	24(20.0)	**Output per Hive**	12(10)
Male	96(80.0)	<5	41(34.2)
Age		6-11	32(26.7)
<35	41(34.2)	12-17	9(7.5)
36-45	45(37.5)	18-23	4(7.5)
46-55	24(20.0)	>23	22(18.3)
>55	10(8.3)	No output/Hive	
Marital Status		**Type of Labour**	
Married	89(74.2)	Family labour	74(61.7)
Single	31(25.8)	Hired labour	19(15.8)
Educational Status		Both	27(22.5)
No formal education	25(20.8)	**Working Hour (in man-day)**	
Primary education	8(6.7)	<1.646	96(80)
Secondary education	18(15)	1.647-3.293	5(4.2)
Tertiary education	69(57.5)	3.294-4.94	2(1.7)
Years of Experience		4.95-6.596	1(0.8)
<5	69(57.5)	>6.596	16(13.3)
6-10	41(34.2)	**Land Ownership**	
11-16	6(5.0)	Inherited and lease	19(15.8)
>16	4(3.3)	Inherited land	46(38.3)
Household Size		Lease land	43(35.8)
<3	11(9.1)	Purchased and lease	7(5.8)
4-6	91(75.8)	Purchased land	5(4.2)
7-9	14(11.6)	**Benefit derived being a member of BAN**	
>9	4(3.3)	Diffusion of knowledge	76(63.3)
Membership of Association		Economic benefit	23(19.2)
Not a member	22(18.3)	Social benefit	19(15.8)
A member	98(81.7)		
Occupational Status			
Other Occupation	69(57.5)		
Honey Production	51(42.5)		

Source: Field Survey (2009)

efficiency was 0.89 meaning that bee farmers are 11 percent inefficient.

Determinant of technical inefficiency of honey producers: Assessing the level of efficiency is paramount but, relying on it to make recommendation for economic policy should not be in absolute terms until the sources of variation in T.E are identified. The inefficiency function as shown in Table 2 revealed that years of experience, membership of BAN and household size contribute significantly in explaining the inefficiency of beekeepers. Years of experience and the size of household are significant at 5 and 10 percent, respectively, and they are negatively related to inefficiency. This outcome reveals that beekeepers who have spent more years keeping bees for its honey and other products are more efficient. Similarly, member of BAN was more efficient. Analogously, household size has a negative and significant value; that is, it emphasizes the importance of family labour in honey production. This means an increase in any one of these will reduce inefficiency.

Table 2
Maximum likelihood estimate of frontier model for honey producers

Variable	*Coefficient*	*Standard Error*	*t-Ratio*
Constant	2.421	0.175	13.804
Labour	-0.024	0.024	-1.00
Access to land	0.073**	0.025	2.96
Number of hives	1.000***	0.055	18.24
Time spent on beekeeping activities	0.039	0.484	0.810
Inefficiency Function			
Constant	0.762	1.138	0.669
Gender	0.498	0.327	1.523
Age	0.216	0.321	0.674
Experience	-0.547**	0.217	-2.526
Member of BAN	-0.907**	0.338	-2.687
Household size	-0.596*	0.302	-1.973
Sigma square	0.237***	0.044	5.423
Gamma	0.203	0.156	1.303

Source: Field Survey, 2009

Log likelihood function=- 0.73581

Mean Technical efficiency=0.893

***Significant at 1 % level **Significant at 5% level *Significant at 10% level

Distribution of T.E of honey producers

The frequency distribution of beekeepers' technical efficiency is stated in Table 3. About 72 percent of the beekeepers had their technical efficiency above 0.9. This is an indication that majority of the beekeepers are operating not too far from the frontier of honey production. This is further corroborated by Figure 1.

Table 3
Technical efficiency distribution of honey producers (Decile range)

Distribution	*Frequency*	*Percent*
<6	4	3.3
0.6-0.7	7	5.8
0.7-0.8	8	6.7
0.8-0.9	15	12.5
0.9-1.0	86	71.7

Source: Field Survey, 2009

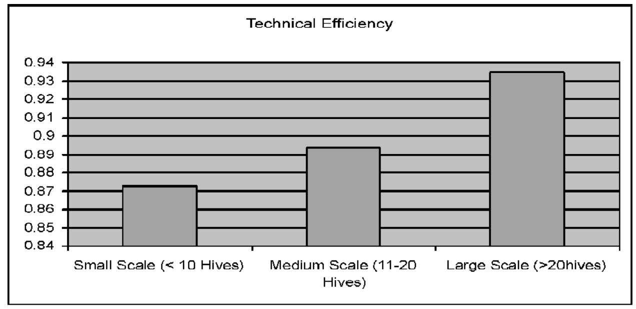


Figure 1: Distribution of the technical efficiency across production scale

Long run production analysis

Partial elasticity of output, in respect to input, permits the assessment of the effect of change in the amount of an input on the output. Since Cobb Douglas model was estimated, it implies that the coefficient can be interpreted as elasticity of production. The value of partial elasticity according to Table 2 indicates the relative significance of resources organised to produce honey. The same table shows that the number of hives is very crucial in honey production, followed by size of the land with labour having a negligible coefficient value.

The concept of return to scale focuses on the rate at which an output changes when all factors of production (inputs) change simultaneously in the same proportion (Olayemi, 2004). It assesses the percentage variation in the amount of an output produced when the quantities of all production inputs used are changed by one percent. It is only in the long run that the entire production inputs are variable, it therefore follows that the concept of returns to scale happens in the long-run when all inputs are variable simultaneously, albeit; in the same proportion (Olayemi, 2004).

The return to scale of production is 1.05. This figure is not less than one, indicative of increasing returns to scale in honey production. By this result, it follows that, a proportionate rise in the entire resources used in production results in more than proportional rise in production.

Cost and return analysis

Cost is important in all activities. It is the summation of the monetary expenses, time and resources committed to an activity. While cost that can be varied changes with variation in the level of output, fixed cost remains unchanged at least for an accounting period. The variable and fixed input costs examined are organised and displayed in Table 4. Empirical evidence from Table 4 shows that the highest transportation cost was incurred by large scale bee farmers while the least cost was incurred by small-scale beekeepers. Consequently, the amount incurred on labour by the three categories (small, medium and large scale) of beekeeper was found to be greatest for large scale bee farmers. This high cost suggests that additional hands were employed in the management of their apiary outside family labour in order to complete the activities done in good time. Employing additional hands to reduce time spent in an apiary may be because more hives are involved.

One would see that the small-scale bee farmers spent the highest amount on containers used in honey production. This high cost incurred by small-scale bee farmers on containers may be associated with entering requirement (i.e. compulsory purchases) when establishing the enterprise. The least variable cost incurred by large scale beekeepers is on containers. This reflects additional cost incurred to purchase additional containers to increase the number of the already existing ones. Of all the variable inputs considered, the bulk of the cost was incurred on labour. This illuminates the potential of beekeeping enterprise to generate employment if adequate attention is paid to scale it up.

Considering the short durability of the fixed input, its cost was computed using a constant amortisation method. Table 4 reveals that the medium scale bee farmer spent the highest amount on bee cloth, but looking at the smoker, the small-scale bee farmer incurred the least cost. This may be as a result of the limited hives (< 10 hives) hence not economically wise to spend more on this input. Of all the fixed input used in producing honey, the least expenses were incurred by the large-scale bee farmer except for the metal stand. No cost was incurred on top-bar and lamp. Also, the highest amount of money as shown in table 4 was expended on the extractor while the least was on hat.

Table 4
Average, variable and fixed inputs cost composition across small, medium and large-scale farmers

Cost Description	*Small Scale (< 10 Hives)*	*Medium Scale (11-20 Hive)*	*Large Scale (>20 Hive)*	*Average Total*
Variable Costs				
Transportation	1454.35	2248.00	3710.71	2471.02
Labour	3514.29	4784.62	9060.00	5786.30
Container	417.44	240.18	126.50	261.37
Fixed Costs				
Bee suite	3300.00	4041.94	3023.08	3455.00
Bee smoker	2078.57	2724.49	2230.00	2344.35
Extractor	43222.22	25000.00	16000.00	28074.07
Rain boot	1761.54	1732.14	1585.71	1693.13
Beehive	7791.88	7606.67	5666.67	7021.74
Cutlass	922.73	541.67	490.00	651.47
Knife	191.88	279.55	106.00	192.48
Gloves	235.56	386.36	305.00	308.97
Top-bar	675.00	616.67		403.56
Brush	228.57	364.17	200.00	264.25
Metal stand	1750.00	1066.67	2000.00	1605.56
Lamp	3000.00	1366.67		1455.56
Hat	128.00	154.44	90.00	124.15
Average Number of Hive				20
Average Output Per Hive				11 LITRES

Source: Field Survey, 2009

Thus, an average beekeeper spent more on labour, followed by transportation and containers. The distribution of variable cost across the scale tells that medium-scale farmers incurred the highest on labour while small-scale farmers incurred the highest cost on container. Also, on the average, famers spent more on labour followed by transportation and containers respectively, regardless of the scale of production. The highest fixed cost was incurred on extractor while the smallest was on hat.

Profitability analysis

The distribution of bee farmers according to their scale of production and their associated cost (TVC, TFC and TC) total revenue, gross margin, profit and technical efficiency is stated in Table 5. The empirical evidence revealed that medium-scale farmers were not doing well looking at their gross margin, profit and total revenue values. Averagely, the overall total revenue was ₦374614.73 in the study area for the production season considered for the study. Also, the distribution across the scale reveals that large-scale bee farmers had highest total revenue (₦867,980), followed by small-scale bee farmers (₦132,808) and medium-scale bee farmers had the lowest total revenue (₦123,056). The same goes for gross margin and profit. Nevertheless, the result still shows the profitability of bee farming enterprise at different scale/level of production (refers: Figure 2).

Table 5
Budgetary analysis of honey production

Scale of Production	*TVC*	*TFC*	*TC*	*TR*	*GM*	*Profit*	*T.E*
Small scale (< 10 Hives)	2,339.53	18,803.37	21,142.91	132,808.19	130,468.65	111,665.28	0.87
Medium scale(11-20 Hives)	2,555.18	18,958.68	21,513.86	123,056.00	120,500.82	101,542.14	0.89
Large scale (>20hives)	4,989.00	8,275.50	13,264.50	867,980.00	862,991.00	854,715.50	0.93
Total average	3294.57	15345.85	18640.42	374614.73	371320.16	355974.31	0.89

Source: Field Survey, 2009

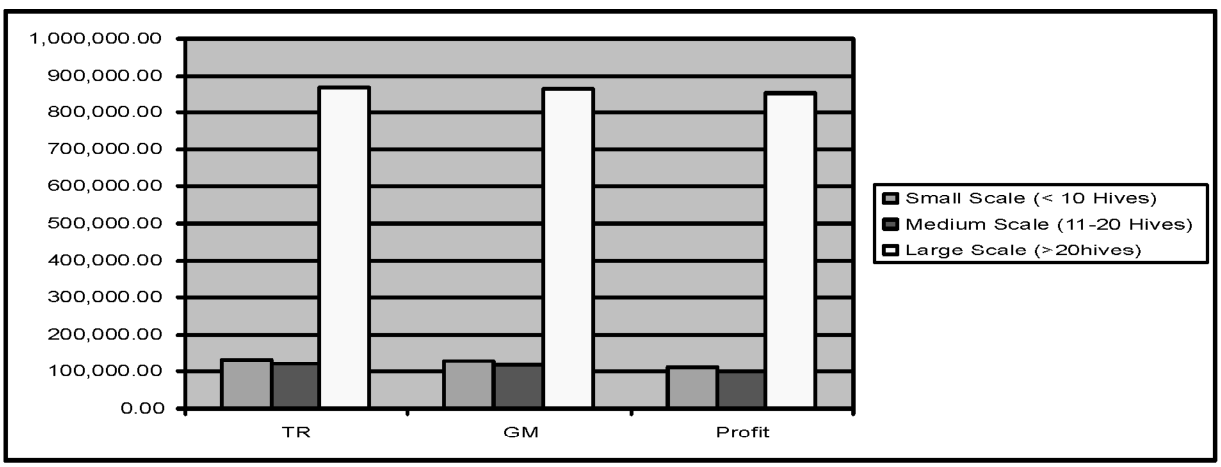


Figure 2: Distributions of TR, GM and profit across production scale

SUMMARY AND RECOMMENDATIONS

This paper reveals the important socioeconomic attributes of beekeepers along with the estimates of technical efficiency, its determinants, return to scale, elasticity of honey production and how profitable beekeeping is in Oyo State, Nigeria. Male dominance was found in honeybee production as this gender constitutes the major work force in honeybee enterprise. Also, majority are literate with varying levels of formal education. In addition, most of the respondents were married, with an average household size of about 6 in these areas. Most of the respondents have experience less than or equal to

5 years. About 81.7 percent are member of the Beekeepers Association of Nigeria (BAN).

The result of the maximum likelihood estimate reveals that beekeepers are 89 percent efficient. Beekeepers' technical efficiency range (0.52-0.98) implies that many beekeepers are close to production frontier. Empirically, experience, membership of Beekeepers Association of Nigeria and household size were found to reduce the technical inefficiency of the bee farmers. The elasticity of honey production is 1.05 which is an increasing return to scale. The budgetary analysis however shows that honey production is profitable with the large-scale bee farmers having the highest profit and most efficient.

From the outcome of this research, it is recommended that:

1. Government at all levels should include beekeeping enterprise in the different empowerment schemes and programmes established to alleviate poverty. By so doing, the population of active age that are unemployed will be gainfully employed if the requisite knowledge required in the enterprise is provided.
2. The study revealed male dominance. Women should be well involved by properly enlightening them on the benefits of beekeeping. This should be radically approached by Extension Officers, and also ensuring that when training and material used in beekeeping enterprise are distributed, it should be done with equity among the genders.
3. There is a positive scope for increasing the present level of technical efficiency of honey production going by the outcome of the study. Also, since the variation in the technical efficiency level is directly and positively related to the number of hives and access to land, policies should be strengthened to ensure that prospective beekeepers have unhindered access to these resources.
4. The outcome of this study revealed the profitability of the beekeeping enterprise. Financial institutions should be regulated to at least include beekeepers among farmers that can access loan.
5. When this enterprise is promoted, more employment will be generated in other enterprises. For example, carpenters will have more hives to fabricate; welders will have more metal stands to fabricate on which the hives could be safely placed, etc.

REFERENCES

"Are honey bees a renewable resource?" *eNotes*, 28 Sep. 2012, *https://www.enotes.com/homework-help/honey-bees-renewable-resource-362953. Accessed 25 Oct. 2017.*

Adegeye A. J. and Ditto, J. S. (1982). Essentials of Agricultural Economics, Centre for Agriculture and rural dev. (CARD), University of Ibadan, pp. 258.

Amao J.O. (2005). Evaluation of Traditional and Modern Managements System of honey production. *An International Journal of Applied and Apicultural Research*. Faculty of Agricultural Science, LAUTECH, Ogbomoso, Nigeria, 2005.

Anyanwu, S. O. (1996). Nigeria Migration Profile and Employment Implications. In towards full Employment Strategy in Nigeria.Umeh (Ed.). Lagos, Nigeria, pp. 16.

Battese, G. E. and H. Sarfraz (1998). "Technical efficiency of cotton farmers in Vehari District of Punjab.

Binam, J.N., J. Tonye, N. Wandji, G. Nyambi, M. Akoa (2004). Factors Affecting the Technical Efficiency among Smallholder Farmers in the Slash and Burn Agriculture Zone of Cameroon. *Food Policy*, 29 (5): 531–45.

Bradbear, A. (2000). Beehives and Equipment for Honey Extraction, Great Britain.

Bwala, M.A., H. S. E. Kokoye and R.N. Yegbemey (2015). Technical Efficiency of Cereal Production in North Central Nigeria: A Case for Maize, Rice and Sorghum Farmers.

Carter, G. (2004). *A Guide to the Better understanding of bees, Their Diseases and the Chemistry of Beekeeping*; Biotech Books, Delhi- 110035.

Deffar, G. (1998). Non-wood Forest Products in Ethiopia. EC-FAO Partnership Programme (1998– 2000), Project GCP/INT/&/)/EC, Data Collection and Analysis.

FAO (1990). Beekeeping in Africa. FAO Agricultural Services Bulletin, 68/69, Rome, Italy.

FAO (1990). Beekeeping in Africa. FAO Agricultural services Bulletin, 68/69, Rome, Italy.

Gurung, M. B. (2005). Improving the Cash Income of Poor Mountain Households through apis Cerana Beekeeping: An experience from Nepal; ICIMOD Newsletter from International Centre for International Mountain Development, Khumaltar, Nepal. No. 48 (Autumn 2005). p.18.

International Center for Integrated Mountain Development (ICIMOD) (2009). Improving Livelihoods through Beekeeping-Knowledge partnerships and value chains for bee products and services in the Himalayas.

Jacinta Lemba, Marijke D'Haese, Luc D'Haese, Aymen Frija & Stijn Speelman (2012). Comparing the technical efficiency of farms benefiting from different agricultural interventions in Kenya's drylands, Development Southern Africa, 29:2, 287- 301, DOI:10.1080/0376835X.2012.675698

James E. Kirkley, Dale Squires and Ivar E. Strand (1995). Assessing Technical Efficiency in Commercial Fisheries: The Mid-Atlantic Sea Scallop Fishery. *American Journal of Agricultural Economics*, Vol. 77, No. 3 (Aug., 1995), pp. 686-697.

Mohammad M. R, H. G. Siew and I. K. Md. (2014). Neurological Effects of Honey: Current and Future Prospects. Evidence-Based Complementary and Alternative Medicine.

Msuya, E. E., (2008). Reconstructing Agrobiotechnologies in Tanzania: smallholder farmers perspective. In: *Reconstructing biotechnologies* (Ed. G. Ruivenkamp, S. Hisano, and J. Jongerden), Wageningen Academic Publishers, 2008.

National Bureau of Statistics (NBS) (2006). Census Figure by States and Local Government Areas, Nigeria.

National Honey Board (NHB) (2002). Longmont, USA. Honey Processed in poultry meal.

Oladebo, J. O. and A. I. Ambe-Lamidi (2013). Gender, Technical Efficiency and Sectoral Analysis of Rural Poverty among Farmers in Nigeria. Research Proposal submitted to African Economic Reserach Consortium (AERC).

Olagunju M. (2002). Beekeeping Techniques. A paper presented at a workshop organised in Plateau State Nigeria pp. 6-10.

Olayemi, J.K. (2004). Principle of Microeconomics. Ibadan: Sico Publisher. Oluwatusin F. M. (2008). Cost and Returns in Modern Beekeeping for Honey Production in Nigeria. Department of Agricultural Economics and Extension, University of Ado-Ekiti, Nigeria.

Onwumere J., F. Onwukwe., C.S. Alamba (2012). Comparative Analyses of Modern and Traditional Beekeeping Entrepreneurships in Abia State, Nigeria. Department of Agribusiness and Management. Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. *Journal of Economics and Sustainable Development*. www.iiste.org ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online) Vol.3, No.13.

Oyewo, L. O., M.O. Rauf, F. Ogunwale and S. O. Balogun (2009). Determinant of maize production among maize farmers in Ogbomoso South Local Government in Oyo State. *Agricultural Journal*; 4(3): 144-149. ISSN: 1816-9155.

Pakistan". Center for Economic Policy Analysis Working Paper No. 8/98. Department of Raufu, M.O., Akinniran T. N., Oloko, O.A. (2005). Profitability of Beekeeping Enterprise. An International Journal of Applied and Apicultural research. Faculty of Agricultural Science, LAUTECH, Ogbomoso, Nigeria.

Seeley, T. D. (1985). Honey bee ecology, Princeton University, New Jersey.

Sekunmade A. B, Akinleye S.O and Olayode G.O. (2005). Economic Analysis of Honey Production. *A Bowen Journal of Agriculture*; Vol.2 (1) March 2005 U.S National Honey Board, 2002.

Tahereh E. and N. Moslem (2013). Tradional and Modern Uses of Natural Honey in Human Diseases: A Review. *Iran Journal of basic Med Sci*. 16(6) 731-742.

Tesfaye, B., D. Begna and M. Eshetu (2017). Beekeeping practices, trends and constraints in Bale, South-eastern Ethiopia. Journal of Agricultural Extension and rural development.

Thiam, A, Bravo-Ureta, BE & Rivers, T.E. (2001). Technical efficiency in developing country agriculture: A meta analysis. *Agricultural Economics*; 25: 235–43.

Vanesa, A, M. Gracia, M. Arruebo and I. Silvia (2015). Smart Dressing Based on Nanostructure Fibers Containing Natural Origin Antimicrobial, Anti-Inflammatory and Regenerative Compounds. Materials 8, 5154-5193.

World Bank Report (2006). Report on Global Warming.

Yehia, M. E, A. E. Ola, H. E. Dalia and M. S. Islam (2011). Immunomodulatory effect of Food. *Egypt Journal Pediatric Allergy Immunology*; 9(1): 3-13.