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An Economic Analysis of Apiculture Practices in Zambia

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Abstract: The study was conducted to investigate the cost of production, net income and creation of employment in apiculture practices in the Central Province of Zambia. The study aims to find out the type of technology used in honey production, cost of honey production, price of honey, net income and income to investment ratio. Further, it aims to know the employment creation potential, employment to investment ratio and income to employment ratio in apiculture practices. The study revealed that the effect of apiculture practices on net income and employment was positive. The imputed value of family labor was higher in total cost of production and the price of honey sold was the only source of revenue. The income to investment ratio was higher and the cost-output ratio was lower. The employment to investment ratio and the income to employment ratio were higher. The study found several challenges to apiculture practices. These include lack of appropriate beekeeping skills, financial and infrastructure constraints. The study suggested for establishing bee farmers' co-operative associations for access to loan, marketing, training the beekeeping farmers in using modern techniques of honey production and get inputs from the government and non-government organizations. The study also suggested for the establishment of an accredited certifying institute for national honey standard to sell at premium price within the country and to export.

Keywords: Apiculture, Beekeeping Skills, Net Income, Employment, Cost-Output Ratio, Financial Constraints

1. Introduction

The apiculture practices are important to the Zambian economy in terms of contribution to the GDP, export earnings, employment creation and poverty reduction. The aim of Revised Sixth National Development Plan (2013-16) in Zambia is to achieve the objectives of Vision 2030, i.e., prosperous middle-income country. The Plan focuses on public capital investments that have a bias to rural development and job creation so as to achieve inclusive growth (Lusaka Times, 2014).

Zambia has potential to earn over US$ 12 million from in excess of 10,000 metric tons of honey exports annually but, need to increase investment in research and technology. The honey sector in Zambia has not been fully developed and is faced with a number of challenges such as limited access to markets and modern technology and limited investment in research and development (Sichinga, 2014). With the export and domestic market potentials for the product, beekeeping is likely to contribute to poverty reduction and develop the rural communities in the country (Ellis, 2014).

Beekeeping work is having one main object, namely to bring more cash in to the pockets of the people living in rural areas in order to enable them to improve their standards of living and hence help to stimulate the whole rural economy (Holmes, 1964). Beekeeping has potential to improve economic, social and health status of rural people if theoretical and practical training will be well conducted (Kumar, et. al., 2010). Beekeeping is one of the best practices that have been recognized to improve livelihood of poor farming communities without much investment cost (Baptist and Punduhewa, 1983). Zambia has thousands of hectares of Brachystegia wood lands, which provide an excellent source of nectar for bees, so that in most seasons bees can be depended upon to give a surplus of honey (Mickels-Kokwe, 2006).

Zambia is a traditional beekeeping country. It has immense potential to increase production. Presently, the national domestic demand alone is between 100-150 tones per annum, which has never been met. It is therefore imperative that the beekeeping industry be developed to levels where the domestic demand is met and surplus produced for export. The domestic demand for bee wax is large though most wax is exported, thus serving as an important source of foreign

exchange for the nation (ZFAP, 1997).

The main markets for bee products continue to be United Kingdom (55%), Germany (35%), and South Africa (5%). Other markets (5%) have been Botswana, Libya, Tanzania and Zimbabwe. Honey and bee wax products have great market potential in Canada, Middle East, Japan and U.S (SNV, 2010).

Despite the conducive environment for beekeeping in Zambia to provide employment opportunities, reduce poverty levels and to earn foreign exchange, the sector is facing a number of problems, such as, poor statistics on the size and structure of the sector; lack of policies and a regulatory frame work to guide stakeholders on forest resource use, management of bees and handling of bee products; lack of national honey standards, lack of competition amongst input providers and traders; poor infrastructure and transport facilities; lack of collaboration between stakeholders and lack of market information and entrepreneur skills (Husselman, 2008).

This paper contains three sections. Section 1 deals with introduction, importance of the study, objectives and methodology. Section 2 addresses model specification and estimation, data analysis and discussion. In section 3 conclusions and suggestions are given.

2. Importance of the Study

Employment creation and income generation are essential for poverty eradication. Zambia is a capital poor country. There is need to develop those activities which require less capital but create more employment and income. Apiculture activities need less capital but has the capacity to create more employment and generate more income for poverty reduction in rural areas. But the apiculture sector in Zambia is facing many challenges relating to infrastructure, investment, technology, marketing, finance, etc. This study is important in finding out the potential of apiculture practices in creating employment and generating income in the KapiriMposhi district of Central Province in Zambia and suggests policy measures. This study fills the gap in the existing literature on the sources of cost and revenue of apiculture practices to understand profitability.

3. Objectives

The specific objectives of this study are to:

1. To know the socio-economic conditions of the apiculture practitioners.
2. Find out the type of plants/cultivated crops which can offer fodder to honey bees.
3. Investigate the type of technology used in honey production.
4. Assess the sources of cost of honey production.
5. Find out the sources of revenue, net income, income to investment ratio.
6. Research the employment creation potential, employment to investment ratio and income to employment ratio in apiculture activity.
7. Examine the sources of credit for apiculture activity.

4. Methodology

This study used multi-stage random sampling technique for selecting the sample. In the first stage Central Province was selected. In the second stage KapiriMposhi district was selected. There are six agricultural blocks in KapiriMposhi district. They are: Mulungushi, Changondo, Chipepo, Lounchu, Lukanga and Nkole. In the third stage, out of these six blocks, Mulungushi Block was selected for this study due to higher number of bee keepers (about 40%). The Mulungushi Block consists of six agricultural camps. They are: Imansa, Kakulu, Luanshimba, Lukanda, Kaunga and Kambosha. In the fourth stage, out of these six camps, two camps, namely, Lukanda and Luanshimba, were selected due to higher number of bee keepers. In the fifth stage, a total of 128 bee keeping households were selected- 82 from Lukanda and 46 from Luanshimba. The required data were collected through questionnaire and interview with the respondents. The information was collected in February/March 2015 for the recent bee keeping season, i.e., September to December, 2014. Estimation of the factors influencing net income and employment involved the use of ordinary least square regression techniques.

The traditional technology includes fixed comb-hives and the modern technology used was movable frame hives, top bar hives, smokers and protective cloth in honey production. The sources of cost of production of honey were technology cost, imputed value of family labor, cost of hired labor, cost of empty containers and transport. The source of revenue includes the value of quantity of honey and beeswax sold. To measure income to investment ratio, the net income was divided by the total cost. To calculate employment to investment ratio, number of man-days of employment created was divided by the cost of production. Income to employment ratio was measured by dividing the net income with the number of man-days of employment created. The sources of credit for beekeeping activity was taken as banks, micro finance institutions, co-operatives, relatives and friends.

5. Model Specification and Estimation

Estimation of the factors influencing net income of the bee farmers involved the use of ordinary least square regression techniques and specified by equations:

$$NY=\beta 0+\beta 1BE+\beta 2T+\beta 3CT+\beta 4HL+\beta 5FL+\mu$$

Where:
NY= Net Income
BE= Beekeeping Experience (years)
T= Training in beekeeping (No. of days)
CT= Cost of Technology (in Kwacha)
HL= Cost of Hired Labor (in Kwacha)
FL= Cost of Family Labor (imputed value in Kwacha)

βo= is a constant

β1 to β5= Regression parameters that were estimated

μ= Error term associated with data collection which was assumed to be normally distributed with zero mean and constant variance.

Estimation of the factors influencing employment involved the use of ordinary least square regression techniques and specified by equations:

$$Emp=\alpha0+\alpha1T+\alpha2I+\alpha3C+\alpha4Tg+\alpha5BE+\mu$$

Where:

Emp= Employment (in man days)

T= Value of technology used (in Kwacha)

I= Value of investment (in Kwacha)

C= Value of credit (in Kwacha)

Tg= Training in beekeeping (No. of days)

BE= Beekeeping experience (in years)

μ= Error term

6. Data Analysis and Discussion

6.1. Factors Affecting Net Income

The following results showed that when all the independent variables were zero, the income level was 329.8894 Kwacha. The income increases by 15.40401 Kwacha for an additional year of experience in beekeeping. The income increased by 21.25744 Kwacha for one additional day of training in beekeeping. When all the other independent variables are constant, the income reduced by 5.76671 Kwacha for an additional kwacha in technology cost. The income increased by 0.602546 Kwacha for one additional kwacha in hired labor cost but it increased by 2.994260 Kwacha for an increase in family labor cost by one kwacha. The family labor is significant in explaining the model.

Table (1) shows the factors affecting net income, i.e., experience, training, technology, hired and family labor.

Table 1. *Factors Affecting Net Income.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	329.8894	112.8849	2.922353	0.0042
EXPERIENCE	15.40401	11.12775	1.384287	0.1689
TRAINING	21.25744	35.26279	0.602829	0.5478
TECHNOLOGY	-5.766718	5.800598	-0.994159	0.3222
HIRED	0.602546	0.477716	1.261305	0.2097
FAMILY	2.994260	0.580063	5.161954	0.0000
R-squared	0.482592	Mean dependent var		661.7177
Adjusted R-squared	0.460668	S.D. dependent var		506.3556
S.E. of regression	371.8637	Akaike info criterion		14.72211
Sum squared resid	16317347	Schwarz criterion		14.85857
Log likelihood	-906.7708	F-statistic		22.01197
Durbin-Watson stat	1.429433	Prob(F-statistic)		0.000000

6.2. Factors Affecting Employment

The following results showed that when all the independent variables are zero, the level of employment was 93.58010 days of work. Employment increased by 0.453627 days for one additional kwacha increase in investment. The impact of loan on employment was negative. The employment reduced by 0.028188 man days for an increase in loan by one kwacha. The implication was that if more loan was available the employment opportunities would have increased. The employment increased by 3.165543 man days for an additional day of training and it was increased by 3.433432 man days for an additional year of experience in beekeeping. Thus, investment, credit and experience were significant to the model.

Table (2) shows the factors affecting on employment, i.e., technology, investment, etc.,

Table 2. *Factors Affecting Employment.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	93.58010	9.752642	9.595358	0.0000
TECHNOLOGY	0.453627	0.484721	0.935851	0.3513
INVESTMENT	0.170424	0.022832	7.464224	0.0000
CREDIT	-0.028188	0.010422	-2.704717	0.0078
TRAINING	3.165543	3.051500	1.037373	0.3017
EXPERIENCE	3.433432	0.974293	3.524026	0.0006
R-squared	0.471225	Mean dependent var		148.1935
Adjusted R-squared	0.448819	S.D. dependent var		43.39864
S.E. of regression	32.21982	Akaike info criterion		9.830218
Sum squared resid	122497.8	Schwarz criterion		9.966683
Log likelihood	-603.4735	F-statistic		21.03147
Durbin-Watson stat	1.591085	Prob(F-statistic)		0.000000

6.3. Socio-Economic Conditions of Apiculture Practitioners

Table (3) shows the socio-economic conditions of apiculture practitioners.

Table 3. *Socio-economic conditions of Apiculture Practitioners.*

Distribution	Value	Percentage
Mean age (years)	43.4	-
Gender:		
a) Male	106	82.81
b) Female	22	17.19
c) Total	128	100.00
Marital Status:		
a) Married	119	92.96
b) Un-married	04	3.12
c) Divorced	02	1.56
d) Widow	03	2.36
e) Total	128	100.00
Main Occupation:		
a) Agriculture	125	97.65
b) Beekeeping	03	2.35
c) Total	128	100.00
Subsidiary Occupation:		
a) Agriculture	03	2.35
b) Beekeeping	125	97.65
c) Total	128	100.00
d) Average Land ownership (ha)	13	-
Level of Education		
a) Illiterate	20	15.62
b) Primary	46	35.93
c) Secondary	52	40.62
d) Tertiary	10	7.83
e) Total	128	100.00
Training in Beekeeping (days)	1.52	-
Experience in Beekeeping (years)	5.58	-

Source: Primary data

The total number of apiculture practitioners were 128 and their mean age was 43.4 years. The age distribution of the beekeepers shows that 3.12 percent were between 15-24 years, 21.87 percent between 25-35 years; 58.6 percent between 36-60 years and 16.41 percent above 60 years. 82.81 percent were men and only 17.19 percent were female. This implies that majority of beekeepers were above middle age and beekeeping is a male dominated sector. These findings were similar to Ajao and Oladimeji (2013); Babatude et. al (2007); Ebojetet.al., (2008) Chaleet.al., (2013); and SNV (2010). 92.96 percent were married, 3.12 percent were un-married, 1.56 percent were divorced and 2.36 percent were widows. The main occupation of the apiculture practitioners was agriculture (97.65%). They were taking beekeeping activity as subsidiary occupation. The average land ownership of the beekeepers was 13 ha. It is interesting to know that majority of beekeepers studied up to secondary level (40.62%). The mean days of training in beekeeping was 1.52 and experience in beekeeping activity was 5.58 years.

6.4. Type of Plants/Cultivated Crops Which Can Offer Fodder to Honey Bees

Table (4) shows the type of plants/cultivated crops of Beekeepers, which can offer fodder to honey bees.

Table 4. *Types of plants/cultivated crops of Beekeepers, which can offer fodder to honey bees.*

Details of Plants/Cultivated Crops	Number of Beekeepers	Percentage
Maize	121	94.53
Sunflower	92	71.87
Tomato	120	93.75
Banana	114	89.10
Coffee	0	0
Mango	127	99.25

Source: Primary data

The above table (4) shows that 94.53 percent beekeepers were having access to maize, 71.87 percent to sunflower, 93.75 percent to tomatoes and 99.25 percent to mango trees for offering fodder to honey bees.

6.5. Technology Used in Honey Production

Table (5) shows the technology used in honey production.

Table 5. *Technology used in Honey Production.*

Details of Technology	No. of Bee keepers	Percentage
Traditional (Fixed Comb-hives)	89	69.53
Modern (Movable Frame hives, Top bar hives, Smokers and Protective Cloth)	03	2.35
Both	36	28.12
Total	128	100.00

Source: Primary data

The traditional technology (fixed comb-hives) was used by 69.53 percent beekeepers and the modern technology was used by only 2.35 percent beekeepers. Both traditional and modern technology were used by 28.12 percent beekeepers for producing honey.

6.6. Cost of Production of Honey

Table (6) shows the cost of production of honey.

Table 6. *Cost of Production of Honey.*

Details of cost of production	Amount (Kwacha)	Percentage
Technology Cost	12.81	7.27
Family Labor (Imputed)	87.50	49.65
Hired Labor	31.32	17.78
Other Cost (empty containers and transportation)	44.57	25.30
Total Cost	176.20	100.00
Cost per liter	4.90	-

Source: Primary data

The total cost of producing 35.94 liters of honey was K. 176.20. The cost per liter production of honey was K. 4.90 only. Half of the total cost (49.65%) was due to family labor. The hired labor cost was only 17.78 percent, as most of the work was done by the family labor. The technology cost was the lowest because in Lukanda Camp area all the farmers were using traditional technology, i.e., fixed comb-hives and in Luanshimba Camp area the beekeepers were supplied freely, both types of techniques, by a Non-government Organization. Hence the technology cost was zero in this camp area. The other cost includes purchase of empty containers and transportation of honey to the road side in Lukanda, as the road is far from the village.

6.7. Sources of Revenue, Net Income and Net Income to Investment Ratio

Table (7) shows the sources of revenue, net income and income to investment ratio in apiculture practices.

Table 7. *Sources of Revenue, Net income and Income to investment ratio.*

Source	Quantity Sold in Litres	Price per litre (Kwacha)	Revenue in Kwacha	Net Income in Kwacha	Net Income per Litre	Net income to Investment Ratio	Cost-Output Ratio
Honey	35.94	22.76	817.99	641.79	17.86	3.64	0.20
Beewax	-	-	-	-	-	-	-
Total	35.94	22.76	817.99	641.79	17.86	3.64	0.20

Source: Primary data

The total revenue from the sales of honey was K 817.99. The beekeepers are not benefited from bee wax. This result was consistent with SNV (2010) which pointed out that bee wax offers opportunities as an export by product whose potential remains unexploited and the development of bee wax and other by products' markets would significantly increase the economic benefits from the sector. All the beekeepers sold honey in the village and road side only. They were unable to sell in the towns due to transportation problems. This finding is synonymous with the study by CIFOR (2008). The average net income of the beekeepers was K 641.79 and the net income per liter sale of honey was K 17.86 (cost per liter being K. 4.90). The net income to investment ratio was K 3.64. It means increase in cost of production by one kwacha leads to increase in net income by K. 3.64. The cost –output ratio was K 0.20, which means increase in cost of production by one kwacha leads to increase in output by K. 0.20.

6.8. Employment Creation

Table (8) shows employment creation in apiculture practices.

Table 8. *Employment Creation in Apiculture Practices.*

Details	Employment (Man-days)	Percentage	Employment to Investment Ratio	Income to Employment Ratio
Beekeepers	78.74	52.98		
Family labor	61.07	41.10		
Hired labor	8.80	5.92		
Total	148.61	100.00	0.84	4.32

Source: Primary data

The total employment created in apiculture practices was 148.61 man-days. The percentage of employment creation for beekeepers was 78.74 man-days (52.98%), for family labor 61.07 man-days (41.10%) and for hired labor 8.80 man-days (5.92%) only. The employment to investment ratio was 0.84, which means one kwacha investment in beekeeping creates 0.84 man-days of employment. Income to employment ratio was 4.32, which means increase in employment by one man-day leads to increase in net income by K. 4.32.

6.9. Sources of Credit to Beekeepers

Table (9) shows the sources of credit to beekeepers.

Table 9. *Sources of Credit to Beekeepers.*

Source	Amount	Percentage
Banks	-	-
Micro Finance	-	-
Co-operatives	22.26	11.26
Relatives/Friends	175.35	88.74
Total	197.61	100.00

Source: Primary data

The sources of credit to the beekeepers ware co-operatives and relatives/friends. The total credit from these sources was K 197.61. The credit from relatives/friends was k 175.35

(88.74%) and from co-operatives it was K 22.36 (11.26%). There was no role of banks and micro finance institutions in providing credit to the beekeepers. A similar result was observed by Ajao&Oladimeji (2013); Ebojeiet.al., (2008); SNV (2010); ZHC (2010) and CIFOR (2008).

6.10. Challenges of Apiculture Practices

Table (10) shows the challenges of apiculture practices.

Table 10. *Challenges of Apiculture Practices.*

Details of Challenge	No. of Respondents	Percentage
Lack of beekeeping knowledge	53	41.40
Financial Constraints	127	99.21
Transportation problem	112	87.50
Total	128	100.00

Source: Primary data

Out of 128 respondents, 41.40 percent were lacking beekeeping knowledge, 99.21 percent were having financial constraints and 87.50 percent were having transportation problem to take honey to town/roadside for selling. These results were consistent with the study by CIFOR (2008); ZHC (2010) and SNV (2010).

7. Conclusions and Suggestions

1. The Beekeepers' main occupation was agriculture and beekeeping activity was their subsidiary occupation. Beekeeping was a male dominating activity and the average age of beekeepers was above 40 years. Those who studied up to tertiary, secondary and primary level were 7.83 percent, 40.62 percent and 35.93 percent respectively. The illiterates were 15.62 percent. The mean number of days of training given to the beekeepers was only 1.52 and the average number of years of experience in beekeeping activity was 5.58.
   It is suggested that the un-employed youth could take up beekeeping occupation. Since there prevails gender inequality in this activity, the women could be encouraged to take up this activity to support the household income.
2. It is suggested to establish bee farmers' co-operative associations for access to loan, marketing information, training to use modern technology and get input from government and non-government organizations.
3. The beekeepers should also sell bee wax for increasing their revenue. There is need to educate them on marketing of bee wax.
4. The cost of production of honey per liter was K 4.90 only, where as, the price per liter was K 22.76, even when they were paid less due to lack of regulatory framework cost guide and minimum price, thus the net profit per liter was K 17.86. Since the beekeeping activity has the capacity to reduce poverty in Zambia, it is suggested that an accredited certifying institute should be established for national honey standard to sell at a premium price within the country and to export.
5. The effect of apiculture practices on net income was positive. Since the income to investment ratio is higher (3.64:1) and the cost-output ratio is lower (0.20:1) apiculture activity is most suitable for Zambian situation where there is shortage of capital.
6. The impact of beekeeping activity on employment creation was also positive, as it was a labor-intensive activity. The employment to investment ratio was higher, i.e., 0.84:1 and the income to employment ratio was also higher, i.e., 4.32:1. Hence, it is suggested to sensitize the apiculture activities to reduce un-employment in Zambia.
7. Since lack of finance was the main challenge of the apiculture sector, it is strongly suggested that the banks and micro finance institutions could provide credit to the apiculture practitioners against their agricultural land, as apiculture activities were taken up by the agricultural farmers.

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