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Factors influencing honey production in the south Gujarat region, Gujarat

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Abstract

This study analyzed the factors influencing honey production per hive in the South Gujarat region. A multi-stage random sampling technique was used for the present study. Primary data were collected from 120 beekeepers through a structured schedule and analyzed using a log-linear regression model. Out of eleven explanatory variables, six were found to have a significant effect on honey production. Expenditure on comb foundation sheets, supplemental feed, medicines, and beekeeping experience showed a positive and significant influence on honey yield, indicating that improved colony management and disease control enhance productivity. In contrast, hive size and labour use (man-days) exhibited a significant negative relationship with per-hive output, suggesting inefficiencies at higher operational levels. Variables such as age, education, and selling price of honey were statistically non-significant. The R^2 value of 0.8449 suggests that 84.49 per cent of honey production per hive was explained by the Explanatory variables.

Keywords: Honey production, beekeeping, log-linear regression, input use efficiency, South Gujarat

1. Introduction

Beekeeping is a universally practiced agricultural activity. Bees are found across the world and play a dual role by producing honey and facilitating pollination of flowering crops (Adjare, 1990) [2]. Owing to their cosmopolitan distribution, multipurpose nature and simple management requirements, beekeeping can be carried out with minimal technological and capital inputs, making it a natural supplement to various farming systems (Bradbear, Fisher and Jackson, 2002) [7]. This activity does not require separate land and does not compete with other farm enterprises such as livestock or poultry for resources, as it depends mainly on naturally available nectar and pollen from forests, agricultural fields and fruit orchards. Beekeeping provides employment opportunities for all family members including women, adult children and persons with physical disabilities and can be practiced even in household backyards, thereby promoting self-reliance, livelihood diversification and rural economic development (Abrol, 2010) [1]. The primary objective of beekeeping is honey production, which has significant quantitative and economic importance and serves as a vital input for industries such as pharmaceuticals, food and beverages which contributing to socio-economic growth (Cartland, 1970; McInerney, 1990; Molan, 1999) [8, 11, 13]. In addition, bees play a crucial role in crop pollination, enhancing both the quantity and quality of agricultural output. Also, many studies indicate that pollination by bees can increase crop yields by about 25 per cent, thereby improving productivity per unit area and farm profitability (Hasanawi, 2008) [9].

India is seventh largest honey producing country in the world having a honey production capacity of approximately 1.4 lakh metric tonnes per year. The major honey-producing states in the country are Uttar Pradesh which contributing (17%) of total production followed by West Bengal (16%), Punjab (14%), Bihar (12%) and Rajasthan (9%) (Ministry of Agriculture and Farmers Welfare, 2025) [12]. Regarding exports, the United States is the largest importer of Indian honey, accounting for 78.22 per cent of total exports. This is followed by the United Arab Emirates with a share of 9.11 per cent and Saudi Arabia with 2.59 per cent (World Integrated Trade Solution, 2024) [5].

In India, Gujarat is considered a state with good potential for honey production and ranked 21st among honey-producing states, with an estimated production of 910 tonnes during 2021–22 (Indiastat, 2023) [4]. The state is naturally well-suited for beekeeping due to its rich floral diversity and favourable climatic conditions and the presence of extensive agricultural crops, forests and fruit orchards. The South Gujarat region offers abundant nectar and pollen sources from crops such as mango, sapota, cashew, coconut and various forest species, making it a favourable zone for beekeeping activities. To promote and popularize beekeeping as a livelihood option, the

Government of Gujarat has implemented several beekeeping development programmes through the Tribal Development Department especially targeting tribal and rural households (TDD, 2018) [3].

Despite these opportunities, beekeepers in South Gujarat face a range of factors that influence honey production both positively and negatively. These include beekeeping experience, cost of inputs such as comb foundation sheets, supplementary feeding, medicines, labour use and hive management practices. Although beekeeping plays an important role in income generation and employment, especially for small and marginal farmers, there is limited empirical information on how these different types of factors influence honey production in South Gujarat. Existing studies have mainly focused on the economic performance of traditional and improved beehives and the measurement of economic efficiency, while relatively little attention has been given to identifying and quantifying the specific factors affecting honey yield. Given that beekeepers in South Gujarat possess rich traditional knowledge that can be effectively integrated with improved technologies, it is essential to examine these influencing factors in a systematic manner. Therefore, the present study is undertaken to analyze the relationship between honey production and its determining factors in South Gujarat to support sustainable and economically viable beekeeping practices.

2. Materials and Methods

2.2. Study area

The study was carried out in the South Gujarat region, where a large number of beekeepers are present due to the availability of mango plantations and favourable agro-climatic conditions for apiculture. In this region, most of beekeepers rear Apis cerana indica and Apis mellifera species because of the suitable floral resources. Multi-stage random sampling technique was use for the selection of districts, talukas and clustered villages for present study. The districts of Valsad, Dang, and Tapi were purposively selected as they have a high number of beekeepers engaged in independent apiculture. From each district, two talukas (Dharampur and Kaprada from Valsad, Ahwa and Waghai from Dang, and Dolvan and Vyara from Tapi) were purposively selected based on the higher concentration of beekeepers and their closeness to the district headquarters. From each selected taluka, two villages were randomly chosen and 10 beekeepers were selected from each village.

2.2 Data

The study was based on primary data. Information related to factors affecting honey production was collected directly from beekeepers through personal interviews using a pre-tested and pre-structured schedule. The sample comprised 120 beekeepers selected from three districts of the South Gujarat region of Gujarat.

2.3 Analytical techniques

The Ordinary Least Squares (OLS) regression model was employed to analyze the factors affecting honey productivity (Hayes and Matthes, 2009) [10]. The analysis was carried out using the following linear specification of the regression model.

Specification of multiple linear regression model:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_{11} X_{11} + \varepsilon \quad (1)$$

If variable is highly skewed then we were used log linear forms of the regression model because logarithmic conversion is a suitable way to convert highly skewed into a more normalized data-set.

Specification of multiple log linear regression model:

$$\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \ldots\ldots\ldots\ldots + \beta_{11} \log X_{11} + \mu \quad (2)$$

Where,

Log Y = Production level of honey (kg)

β_0 = Intercept, $\beta_1 - \beta_{11}$ = Regression coefficient, μ = Error term,

X_1 = Age of the beekeeper,

X_2 = The education level of the beekeeper,

X_3 = Family size of the beekeeper,

X_4 = Hive size (number),

X_5 = Cost on Comb foundation Sheet,

X_6 = Supplementary Feed,

X_7 = Cost on medicine,

X_8 = Labour,

X_9 = Income of the beekeeper from other sources,

X_{10} = Experience of the beekeeper in honey production,

X_{11} = The selling price of honey.

Table 1 presents the description of the variables used in the regression.

Table 1: Explanatory variables description

Sr. No.	Explanatory variable X	Unit of measurement
X_1	Age of beekeeper	Years
X_2	Education level	Years
X_3	Family size of beekeepers	Numbers
X_4	Hive size	Numbers
X_5	Cost on comb foundation sheet	Rs./Sheet/hive
X_6	Supplementary feed	Kg/hive
X_7	Cost on medicine	Rs./hive
X_8	Labour	Man days/ hive
X_9	Income of the beekeepers from other sources	Rs. (in, 000)
X_{10}	Experience of Beekeepers	Years
X_{11}	Selling price of honey	Rs./kg

3. Results and Discussion

Table 2 presents the results of the log-linear regression analysis. The results indicate that out of eleven explanatory variables, six variables were found to have a statistically significant influence on honey production per hive per year. Among these, comb foundation sheet, supplementary feed and expenditure on medicines were significant at the one per cent level of significance. Hive size and beekeeping experience showed significance at the five per cent level, while labour input (man-days) was significant at the ten per cent level. The remaining five variables, namely age of the beekeepers, educational level, family size, annual income and selling price of honey exhibited a non-significant relationship with honey production per hive. Further, the coefficient of multiple determination (R^2) was estimated at 0.8449, Which indicating that the 84.49 per cent of the variation in honey output was explained by the variables included in the regression model, while the remaining 15.51 per cent was attributed to unexplained factors or error terms

Table 2: Estimated regression coefficients (log-linear) for factors affecting honey output(kg/hive/yr.)

Sr. No.	Factors	Units	Coefficient	Standard Error	P - value
1	Intercept	-	-0.1936	0.2001	0.3354
2	Age of beekeepers	Years	-0.0072	0.0156	0.6462
3	Education of beekeepers	Years	-0.0042	0.0070	0.5466
4	Family size of Beekeepers	Numbers	-0.0193	0.0133	0.1500
5	Hive size (no.)	Numbers	-0.0474**	0.0187	0.0126
6	Cost on comb foundation sheet	Sheet/hive	0.4234***	0.0702	0.0000
7	Supplement feed	Kg/ hive	0.3126***	0.0489	0.0000
8	Cost on medicine	Rs./ hive	0.1909***	0.0290	0.0000
9	Labour	Man days/ hive	-0.0838*	0.0498	0.0956
10	Income level	Rs.	-0.0085	0.0061	0.1628
11	Experience of beekeepers	Years	0.0578**	0.0250	0.0229
12	Selling price of honey	Rs/kg	0.0172	0.0628	0.7844
	R^2	0.8449			

Source: Primary data

Note: ***, ** and * indicates significance level at 1%, 5% and 10%, respectively.

3.1 Hive size (Number of box)

The results of the analysis clearly indicate a significant inverse relationship between the number of hives owned and annual honey production per hive. An increase in the number of hives does not necessarily lead to a higher level of honey production per-hive basis. The regression coefficient indicates that a one per cent increase in the number of hives tend to decrease in the amount of honey produced per hive per year by approximate 0.05 per cent. This finding is consistent with the results reported by Bhattarai *et al*., (2021) [6].

3.2 Cost on comb foundation sheet

The results of the analysis indicate a positive relationship between expenditure on comb foundation sheets and honey production per beehive. Specifically, a one per cent increase in cost of comb foundation sheet provided to bee colonies for increases size of colony cause an increase of 0.42 per cent in honey production. This finding suggests that higher investment in comb foundation sheets enhances colony strength and population, thereby resulting in greater honey yield. The result is consistent with the findings of Tadesse *et al.*, (2021) [17], who also reported a positive and significant relationship between expenditure on comb foundation sheets and honey production.

3.3 Supplement feed

Based on the estimated coefficient of supplementary feeding, a one per cent increase in the quantity of supplement feed provided to bee colonies led to a 0.31 per cent increase in honey production per beehive. Supplementary feed, particularly sugar syrup serves as an important energy source for bees during the periods of floral scarcity. It helps maintain bee activity during stress conditions thereby enhancing their ability to resist diseases and predator attacks. Additionally, supplementary feeding supports colony development by stimulating egg laying and promoting brood rearing, which contributes to overall colony growth. The results of the analysis therefore indicate that supplementary feeding has a positive and significant influence on honey production. This finding is consistent with the observations of Shrestha (2018) [16], who also reported a positive and significant relationship between supplementary feeding and honey production.

3.4 Cost on medicine

The results of the model reveal a positive and statistically significant relationship between expenditure on medicines and honey production per beehive. Specifically, a one per cent increase in spending on medicines for treating diseases in bee colonies leads to a 0.19 per cent increase in honey production. This suggests that greater investment in disease and pest management improves colony health and strength, which ultimately enhances honey yield. This finding is consistent with the observations of Tadesse *et al.*, (2021) [17], in their study on factors influencing organic honey production and marketing in Southwest Ethiopia.

3.5 Labour

The quantity of labour (measured as the number of man-days per year devoted to managing each bee colony for honey production) exhibited a significant negative relationship with annual honey yield per hive. The estimated regression coefficient for labour was -0.0838, indicating that a one-unit increase in labour input resulted in a 0.08 per cent reduction in honey production. This suggests that small-scale beekeeping operations require only a limited amount of labour for effective care and management of bee colonies

and that excessive labour use may reduce operational efficiency. This finding contrasts with the results reported by Peter (2015) [15], who found labour to have a positive and statistically significant effect on honey production.

3.6 Experience of beekeepers

The results of the model indicate that beekeeping experience has a positive and statistically significant effect on honey yield with a regression coefficient of 0.06 significant at the five per cent level. This implies that one per cent increase in the number of years of beekeeping experience results in a 0.06 per cent increase in honey production per hive. This outcome is expected as greater experience enhances beekeepers' knowledge and skills in colony management and hive operations. Experienced beekeepers are better able to apply appropriate beekeeping techniques, leading to more efficient care and management of bee colonies. This finding is consistent with the studies of Bhattarai *et al.,* (2021) [6] in Nepal and Oladimeji and Ajao (2018) [14] in Nigeria, which also reported a positive relationship between beekeeping experience and honey output.

4. Conclusion

The study concluded that, honey production is mainly influenced by management and input-related factors. Expenditure on comb foundation sheets, supplementary feed and medicines showed a positive and highly significant impact on honey yield which indicating the importance of colony strengthening, nutrition and disease control. Beekeeping experience also had a positive and significant effect, highlighting the role of skills and practical knowledge in efficient hive management. In contrast, hive size and labour input were found to have a significant negative effect on honey production per hive which suggesting inefficiencies due to over-expansion and excessive labour use. Overall, the findings emphasize the need for scientific management practices, optimal input use and capacity-building initiatives to enhance honey productivity and improve beekeepers' livelihoods in this region.

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