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Practical assessment of the effectiveness of beekeeping training courses using return on investment (ROI): A step forward toward quantifying tangible and intangible impacts of education

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Abstract

The effectiveness and return on investment (ROI) of agricultural training programmes have always been among the most significant challenges for experts and managers in agricultural extension and development. Based on this, the main objective of the present study was to evaluate the effectiveness of beekeeping training courses using the ROI technique. This study is applied and quasi-experimental research, conducted by collecting data in two phases (before and after the training course). The data collection tool was a semi-structured, researcher-made questionnaire. Additionally, the ROI calculation was carried out through a nine-step process, enabling the assessment of ROI for both participants of the beekeeping training courses and the Agricultural Research, Education, and Extension Organisation. In this process, along with tangible and/or monetary effects, intangible and non-monetary impacts were also quantified. The findings of this study indicated that, on average, beekeeping training courses had a 1302% return on investment for participants. Furthermore, these courses yielded an average ROI of 770% for the Agricultural Research, Education, and Extension Organisation. The results provide strong evidence supporting the enhancement and expansion of beekeeping training courses and similar programmes conducted by the organisation. Moreover, this study and its findings serve as a starting point for further research on evaluating the impacts of agricultural training programmes, ultimately supporting decision-making and investment development in training farmers and agricultural beneficiaries.

Keywords: Effects of agricultural training, Decision-making tool, Return on investment for the organisation, Return on investment for individuals.

1. Introduction

Achieving sustainable development goals such as food security, poverty reduction, natural resource conservation, etc., is facilitated by adopting empowerment approaches in the form of agricultural training courses (Qasemi et al., 2023; Pandey et al., 2024; Ogbari et al., 2024).

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Agricultural training courses significantly contribute to transferring both specialised and general skills to farmers (Hajimirrahimi, 2022; Miiro et al., 2024). Therefore, it can be mentioned that one of the most important prerequisites for agricultural development is training agricultural technical knowledge and providing conditions for the practical use of the skills acquired by course participants (Raji et al., 2024). Many researchers (see Drejeris et al., 2021; Laurent et al., 2022; Fitriana & Sukur, 2024) believe that various courses, including agricultural training courses, must undergo continuous evaluation to assess their value. In other words, the organisers and evaluators of these programmes must be able to present reliable and dependable evidence that these agricultural training programmes are effective and offer a return on investment (ROI) (Abbasi Rostami et al., 2016). Only then can the value of these programmes be judged, and this judgement can be used as leverage to secure additional funding and support the continuity and expansion of these training programmes (Abili et al., 2016).

However, a few organisations and companies have measured the effectiveness and ROI of their educational and development programmes (Hale, 2003; Elliott et al., 2009; Rothwell et al., 2024). Agricultural training courses are no exception to this rule, and there have been few studies (see Fazeli et al., 2016; Abbasi Rostami et al., 2016; Hajimirrahimi, 2022; Moumenihelali et al., 2024) on the effectiveness and ROI of agricultural training courses in Iran. The evaluation of agricultural training courses faces challenges due to the intangible nature of outcomes and technical difficulties in measurement (Bazrafkan & Alipour, 2024; Millar & Hall, 2013). Often, ROI assessments are conducted by those lacking expertise, and a standardised methodology is absent (Phillips, 2012;). Moreover, while training impacts are long-term, organisations demand short-term evidence of effectiveness (Millar & Hall, 2013; Phillips & Phillips, 2016).

To assess the value of training, an organisation must have a method for determining performance in education and learning (Russ-Eft & Preskill, 2024). One way to evaluate the value of training is by measuring the participants' performance in generating business-valued outcomes from the training. For training to be effective, it must have specific objectives and results (Morey and Frangioso, 1998). These objectives and results should directly lead to the profit of the business for the course participant and the organisation hosting the course (Pfister & Lehmann, 2024). Despite heavy investments in training, organisations often fail to appropriately evaluate the value or success of their programmes (Hale, 2003; Elliott et al., 2009; Kim & Belzer, 2021). One method for evaluating the value of training is to compare activities and outputs with a well-known

performance model, such as the Kirkpatrick Training Evaluation Model (Turner, 2006), which has been used in various studies (see Hajimirrahimi, 2022; Moumenihelali et al., 2024). This model evaluates agricultural training through four levels: Level 1— satisfaction and planned actions, Level 2— improved skills or knowledge, Level 3— application of these skills, and Level 4— improvements in business performance (Hajimirrahimi, 2022; Moumenihelali et al., 2024).

Phillips (2002) extended the Kirkpatrick model by incorporating ROI, converting business impacts into monetary values and comparing them with the cost of investment. He critiqued the use of participant satisfaction as the primary form of evaluation, arguing it doesn't guarantee the application of knowledge (Elliott et al., 2009). A key criticism of the Kirkpatrick model is that it lacks an initial assessment to place training in context or identify agricultural business needs. Based on this, the evaluation of the effectiveness of beekeeping training courses using the ROI technique was chosen as the main objective of this research. To achieve this goal, three specific objectives were set: 1) Calculating the ROI for each participant in the training course, 2) Calculating the ROI for the organisation implementing the training courses, and 3) Analysing the results of the ROI calculation for the participants and the organisation and providing practical implications to strengthen the weaknesses of the training courses.

This study makes a valuable contribution to agricultural education by providing a framework for measuring the ROI of agricultural training courses. Unlike previous studies that have concentrated on satisfaction or knowledge acquisition, this research incorporates business-based indices to quantify the economic impacts of training. By employing the ROI approach, the study links the outcomes of agricultural training to tangible business improvements, such as increased productivity, enhanced skills, and cost savings in agricultural practices. The methodology bolsters the evidence for the value of training courses, offering a practical tool for policymakers and agricultural organisations to justify investments and secure future funding. Furthermore, it aligns agricultural training with broader economic objectives, emphasising its potential to contribute to the sustainability and profitability of agricultural enterprises. The study also provides insights into how the knowledge and skills acquired are applied in real-world settings, benefiting both individual participants and the wider agricultural economy. By acknowledging both tangible and intangible benefits, the study offers a comprehensive perspective on the effectiveness of agricultural training and contributes to the body of literature on agricultural education and

extension. It provides a robust framework for assessing the economic and social impacts of training investments in this vital sector.

2. Methodology

2.1. Research type

The present study is a quasi-experimental and applied piece of research in terms of purpose. In quasi-experimental applied research, the goal is to develop and improve a product, a process, an activity, or to test theoretical or conceptual ideas in real-world situations (practical application of knowledge). The results and conclusions drawn from this study can be generalised to the population from which the sample was selected. Additionally, data collection and analysis were conducted in two phases: before (during) the training course and after the course. Furthermore, in terms of research design or paradigm, the present study is classified as quantitative research. The required data were collected from respondents before and after the training course.

The present study did not formally examine a control group. However, a pre-post design was used to examine changes over time in a group of beekeeping training course participants. Such within-subjects approaches allow researchers to observe changes in impacts that are generally and temporally related to the beekeeping training courses. Although causal inferences cannot be made from the results without a control group in the study, the ROI-based framework provides a structured and conservative way to link improvements to the implementation of the beekeeping training programme or participation in these courses. It is important to note that this association is supported by feedback from study participants.

2.2. Statistical Population and Sample Selection

The statistical population of this study included all individuals who participated (either in-person or online) in the short-term beekeeping training courses organised by the Fars Agricultural Research, Education, and Extension Organisation (AREEO) between 2022 and the first eight months of 2023 (a total of 20 months). Due to time and financial constraints, the training course selected for this study was purposefully chosen based on its early-return nature to evaluate its effectiveness and return on investment. According to AREEO, a total of 1,497 individuals participated in this early-return course. However, 732 cases were excluded due to inconsistencies between their registered and actual information or because they had attended the course during

their mandatory military service. Among the remaining 765 participants, 174 individuals attended in person, and 591 individuals participated online. Since in-person access to all participants was challenging due to their geographical dispersion across the province, data collection was conducted partially through telephone calls and online surveys. As a result, an attempt was made to survey all 765 participants, aiming for a census-based study. Ultimately, 56 participants fully responded to the required information. Notably, one-third of the responses were collected in person by the researchers, while two-thirds were gathered via telephone interviews and online questionnaires. Among these 56 respondents, 42 participants had successfully implemented their beekeeping business after completing the course. Although this sample size may seem limited, it should not be forgotten that it included individuals who had the intention and capacity to implement the training in practice. Therefore, this group of beekeeping course participants was considered a suitable group for evaluating the ROI. Furthermore, using the quantitative feedback included in the ROI methodology and the qualitative feedback obtained from the beekeeping course participants increases the depth and robustness of the study results in situations where there is no true control group (as in the present study).

The final response rate was around 7%. Several factors contributed to this low response rate. For example, outdated or incorrect contact information, participant migration, and very varied access information among respondents were among the most important of these factors. Despite all these limitations, an effort was made to collect the required information from a geographically and demographically diverse group in order to achieve an acceptable level of representativeness. In other words, the sample included both participants in the in-person beekeeping courses and participants in the online courses. Although the sample selection was not conducted in a biased manner, the researchers tried to ensure that the sample was exhaustive. In other words, every participant in the beekeeping course was invited to participate in the study. Therefore, a census-based convenience sample was ultimately selected. Although such a sampling method may have limitations in terms of generalisability to wider communities, it minimises selection bias because an attempt was made to include all members of the population as a sample in the study. It should be noted that an attempt was also made to reduce nonresponse bias by using a data collection strategy that employed a variety of methods (in-person, online, and telephone). The simultaneous use of these methods allowed researchers to reach participants at different levels. The response

rate was one of the limitations of the present study, and this issue has been addressed in the conclusions section to increase the transparency and validity of the research results.

Given that the quality of data in telephone and online survey methods could be negatively affected, several operational strategies were employed to maintain data quality. In other words, to ensure that respondents or participants in the beekeeping training programme understood the questions well and that their responses were accurate, strategies such as simplifying the questionnaire's writing or language and making explanatory calls were used. In many cases, these two strategies were also accompanied by a third strategy, which was to provide explanations through follow-up messages. It should be noted that the information or responses provided by the training course participants were systematically monitored and guided by the research team and interviewers. This significantly reduced misinterpretation and also increased the quality of the responses. Although in-person interviews provide more appropriate data quality, in cases where in-person interactions with all respondents are not possible due to the limitations mentioned above, online methods and telephone surveys can be used. However, it is necessary to reduce the validity and reliability concerns of the data by using methods such as simplifying the questionnaire's writing or language, making explanatory calls, follow-up messages, and systematic monitoring and guidance of respondents by the data collection team and researchers.

2.3. Method for calculating ROI

The calculation of ROI in this study was conducted in two phases, each consisting of distinct sub-steps, which are explained below.

2.3.1. ROI for training programme participants

2.3.1.1. Analysis of Costs Incurred for Participation in the Training Programme: Categorising and tabulating costs is a fundamental step in ROI calculations, as costs are placed in the denominator of the ROI formula. When discussing costs, all direct and indirect expenses are considered. Section 3.1.1 in the results of the study presents a detailed list of expenses for each participant. Notably, the cost of time spent was calculated by multiplying the hours dedicated to participating in the course (including session duration, commuting time, registration time, etc.) by the hourly wage set by the Iranian Labour Administration for the year 2023.

2.3.1.2. Financial Benefits Derived from the Training Programm: Another crucial step in ROI calculation is estimating all financial benefits obtained from training. These benefits may be monetary or non-monetary. Section 3.1.2 of the paper outlines the financial benefits gained by participants after completing the course. To measure the increase in honey production, the difference in honey yield before and after the training was multiplied by the number of hives owned by each participant. This figure was then multiplied by the average price per kilogramme of honey to determine the total financial gain. Cost savings in production expenses refer to the reduction of unnecessary expenditures in the beekeeping process due to knowledge gained during the training. For instance, if the training helped participants eliminate costly traditional methods or provided insights that reduced operating expenses, those savings were factored into the financial benefits.

2.3.1.3. Converting non-financial benefits into monetary value: Section 3.1.3 of the results presents the conversion of non-financial benefits into financial terms using the expert estimation method. Based on participants' feedback on factors such as “the training's impact on their decision to start a business” and “improved interaction between farmers, experts, and researchers,” experts estimated a monetary value for these benefits. They also provided a confidence level percentage, which was multiplied by the estimated value to yield the adjusted financial equivalent in Iranian Toman (10 Rials). For estimating the adjusted financial value for each non-financial benefit of the beekeeping training programme, three criteria were used: the percentage of respondents, expert cost estimation, and confidence level.

There is always a degree of subjectivity and variance in expert estimates. Researchers should try to reduce these as much as possible. For this purpose, the present study attempted to consult a group of experts. The group had expertise in various fields such as beekeeping, agriculture, entrepreneurship, and agricultural and rural development. To reduce bias, the triangulation method was used. In other words, the estimates were triangulated among the advisory members. To use the average values, a cut-off value of 70% was applied. In other words, when there was 70% consensus on the average value among the advisory team members, the researchers used it. Additionally, the expert advisory team received explanations on the methodology from the members of the effort. The strategy of providing feedback anonymously also allowed them to offer their assessments with greater

consistency and transparency. This step was taken to improve the reliability and validity of monetary conversions despite the inherent subjectivity of expert judgment.

2.3.1.4.Expert assessment of training's contribution to financial gains: To determine how much of the financial benefits were directly attributable to the training, expert estimation was used. Experts provided "the percentage of each financial gain that resulted directly from the training" and "their confidence level in their estimation." The process of estimating these gains is presented in Section 3.1.4. The final adjusted percentage impact of training was obtained by multiplying the average training impact percentage (as estimated by experts) by the average confidence level percentage.

2.3.1.5.Calculating ROI for each participant: Section 3.1.5 presents the ROI percentage for each participant in the study. After estimating costs and financial benefits, the ROI percentage for each participant was calculated using the following formula:

$$\text{ROI (\%)} = \frac{(\text{Benefit of training} \times \text{Average percentage of training impact}) \times \textit{Total costs of training}}{\textit{Total costs of training}} \times 100$$

2.3.2. ROI for the organisation

2.3.2.1.Listing the Costs of Conducting the Training Programme: The first and most important step in calculating the costs of conducting the beekeeping training programme is to identify the various types of expenses incurred. Section 3.2.1 in the results section provides a detailed breakdown of the costs associated with running a beekeeping training course, organised by the Agricultural Research, Education, and Extension Organisation (AREEO).

2.3.2.2.Financial benefits derived from conducting the training program: The next step in calculating ROI is to estimate the financial gains generated by hosting the training course. Section 3.2.2 outlines the monetary benefits received by the organisation as a result of running the course.

2.3.2.3.Converting non-financial benefits into monetary value: In addition to direct financial revenue, certain benefits from conducting the training may be non-monetary but can still be quantified in financial terms. To achieve this, expert estimation/opinions were used, as shown in Section 3.2.3. Thus, two key intangible benefits were evaluated: "advertisement of the training programme by participants" and "participants enrolling in additional training courses." Experts assigned monetary estimates to these benefits and provided a confidence

level percentage for their estimates. The final adjusted monetary value was obtained by multiplying the estimated cost by the confidence level percentage.

2.3.2.4.Calculating ROI for the organisation: After calculating total costs and benefits, the organisation's ROI percentage was determined using the following formula (also see Section 3.2.4 in the results section):

$$ROI\ (\%) = \frac{Program\ Benefits - Program\ Cost}{Program\ Cost} \times 100$$

3. Results

3.1. Evaluation of ROI for participants

3.1.1. Analysis of the cost list for participating in the training course

The results from the analysis of the training course cost breakdown, presented in Table 1, indicate that, on average, each participant paid approximately 253,571 Tomans as a fee to attend the beekeeping training course. Additionally, each participant spent an average of 130,238 Tomans on transportation to and from the training venue. The analysis of participants' food expenses during the course shows that, on average, each participant spent around 165,714 Tomans on meals. Furthermore, the analysis of the time cost reveals that, on average, each participant's time cost amounted to 502,857 Tomans. The overall cost analysis indicates that, on average, each individual spent a total of 1,053,809 Tomans to participate in the training course.

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Table 1. List of costs incurred by participants

Row	Training course fee	Transportation costs	Food costs	Time costs	Total
1	350000	350000	0	720000	1420000
2	250000	0	0	720000	970000
3	0	50000	200000	360000	610000
4	200000	50000	200000	360000	810000
5	400000	20000	100000	480000	1000000
6	200000	100000	300000	336000	936000
7	250000	150000	500000	840000	1740000
8	200000	500000	0	720000	1420000
9	200000	200000	0	288000	688000
10	400000	200000	0	408000	1008000
11	0	50000	200000	720000	970000
12	300000	100000	500000	528000	1428000
13	400000	50000	0	360000	810000
14	400000	50000	0	480000	930000
15	300000	300000	200000	408000	1208000
16	450000	900000	0	384000	1734000
17	500000	300000	0	720000	1520000
18	200000	200000	200000	360000	960000
19	700000	300000	500000	672000	2172000
20	0	100000	0	480000	580000
21	200000	100000	100000	408000	808000
22	400000	0	0	408000	868000
23	400000	100000	0	432000	932000
24	0	0	0	720000	720000
25	200000	800000	500000	288000	1788000
26	400000	50000	200000	408000	1058000
27	200000	50000	0	336000	586000
28	150000	30000	20000	720000	920000
29	500000	200000	500000	720000	1920000
30	400000	20000	0	408000	828000
31	150000	200000	150000	864000	1364000
32	150000	300000	100000	312000	862000
33	300000	300000	500000	720000	1820000
34	150000	50000	100000	432000	732000
35	150000	500000	200000	720000	1570000
36	400000	200000	0	408000	1008000
37	400000	50000	0	408000	858000
38	0	0	0	432000	432000
39	0	0	200000	384000	584000
40	0	20000	0	408000	428000
41	400000	20000	0	408000	828000
42	0	0	0	432000	432000
Mean	**253571**	**130238**	**165714**	**502857**	**1053809**

3.1.2. Financial benefits from attending the training course

Table 2 outlines the financial benefits for participants after attending the courses. To calculate the increase in production, the difference in honey yield before and after the training is multiplied by the number of hives owned by the individual. The term "cost savings in production" refers to the reduction in unnecessary expenses in the beekeeping process, which occurs as a result of the knowledge gained during the training course. For example, the training might eliminate the use of outdated and costly methods or provide information that helps reduce expenses. The results of the analysis on the production increase for participants in the beekeeping training course indicate that,

on average, each participant experienced a financial gain of 39,478,536 Tomans due to increased production. Additionally, attending the training courses enabled each participant to save an average of 5,928,571 Tomans in production costs. Finally, the overall financial benefits analysis shows that, on average, each participant in the beekeeping training courses gained a total financial benefit of 45,405,365 Tomans from attending the course (Table 2).

Table 2. Financial benefits gained from attending the training course

Row	Increase in production	Cost savings in production	Total
1	1300000	500000	1800000
2	10400000	1500000	11900000
3	0	0	0
4	1560000	500000	2060000
5	2080000	500000	2580000
6	1560000	500000	2060000
7	65000000	20000000	85000000
8	26000000	4000000	30000000
9	13000000	4000000	17000000
10	62000000	3500000	65500000
11	0	12000000	12000000
12	9100000	3000000	12100000
13	390000000	24000000	414000000
14	26000000	10000000	36000000
15	54600000	5500000	60100000
16	0	0	0
17	13000000	4000000	17000000
18	0	12000000	12000000
19	2600000	500000	3100000
20	0	0	0
21	260000000	16000000	276000000
22	7800000	2500000	10300000
23	0	500000	500000
24	2600000	1000000	3600000
25	101400000	10500000	111900000
26	0	32000000	32000000
27	26000000	4000000	30000000
28	46800000	24000000	70800000
29	26000000-	6000000	20000000-
30	2600000	1000000	3600000
31	325000000	20000000	345000000
32	31200000	0	31200000
33	0	5000000	5000000
34	20800000	6500000	27300000
35	23400000	2500000	25900000
36	5200000	1500000	6700000
37	13000000	4000000	17000000
38	3120000	500000	3620000
39	0	0	0
40	71500000	4500000	76000000
41	0	0	0
42	0	1000000	1000000
Mean	**39478536**	**5928571**	**45405365**

3.1.3. Conversion of non-financial benefits into financial gains from attending the training course

The conversion of non-financial benefits into financial gains from attending the training course (Table 3) was conducted for two non-financial and qualitative outcomes: The results for the percentage of respondents (i.e., the percentage indicating that attending the course improved their decision-making for starting or expanding a business) showed that, on average, from the participants' perspective, the course contributed to a 52.79% improvement in their decision-making for starting or expanding their beekeeping business. As the second criterion, experts in the field of beekeeping were asked to estimate the financial value of the training course in improving decision-making for starting or expanding a business. The analysis revealed that, on average, experts believe attending the course could provide a financial benefit of 3,883,333 Tomans to each participant. The third criterion was the confidence level in expert responses. The results indicated that, on average, there is a 76.70% confidence in the claim that attending the beekeeping training course improves decision-making for starting or expanding a business. Finally, the adjusted cost analysis (representing the financial value of the non-financial benefit of improved decision-making for starting or expanding a business) showed that attending the beekeeping training course resulted in an average financial benefit of 2,722,952 Tomans per participant (Table 3).

Table 3. Conversion of non-financial benefits into financial gains from attending the training course

Row	Decision-making for starting or expanding a business				Better and closer interaction among farmers, experts, and researchers				Total
	Percentage of respondents (%)	Estimated financial value (Tomans)	Confidence level (%)	Adjusted financial value (Tomans)	Percentage of respondents (%)	Estimated financial value (Tomans)	Confidence level (%)	Adjusted financial value (Tomans)	
1	60%	3200000	82%	2624000	60%	1200000	84%	1008000	3632000
2	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
3	20%	1200000	61%	732000	20%	410000	65%	266500	998500
4	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
5	60%	3200000	82%	2624000	20%	410000	65%	266500	2890500
6	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
7	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
8	80%	3900000	71%	2769000	40%	900000	75%	675000	3444000
9	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
10	80%	3900000	71%	2769000	60%	1200000	84%	1008000	3777000
11	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
12	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
13	60%	3200000	82%	2624000	40%	900000	75%	675000	3444000
14	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
15	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
16	40%	2100000	78%	1638000	60%	1200000	84%	1008000	2646000
17	80%	3900000	71%	2769000	60%	1200000	84%	1008000	3777000
18	80%	3900000	71%	2769000	100%	2100000	67%	1407000	4176000
19	60%	3200000	82%	2624000	60%	1200000	84%	1008000	3632000
20	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
21	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
22	60%	3200000	82%	2624000	60%	1200000	84%	1008000	3632000
23	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
24	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
25	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
26	60%	3200000	82%	2624000	40%	900000	75%	675000	3299000
27	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
28	80%	3900000	71%	2769000	100%	2100000	67%	1407000	4176000
29	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
30	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
31	60%	3200000	82%	2624000	40%	900000	75%	675000	3299000
32	80%	3900000	71%	2769000	60%	1200000	84%	1008000	3777000
33	60%	3200000	82%	2624000	80%	1950000	69%	1345000	3969000
34	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
35	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
36	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
37	100%	4700000	65%	3055000	80%	1950000	69%	1345000	4400000
38	100%	4700000	65%	3055000	100%	2100000	67%	1407000	4462000
39	20%	1200000	61%	732000	20%	410000	65%	266500	998500
40	80%	3900000	71%	2769000	100%	2100000	67%	1407000	4176000
41	60%	3200000	82%	2624000	20%	410000	65%	266500	2890500
42	80%	3900000	71%	2769000	80%	1950000	69%	1345000	4114000
Mean	**79.52%**	**3883333**	**70.76%**	**2722952**	**73.33%**	**1624761**	**71.07%**	**1141500**	**3867904**

3.1.4. Estimation of the impact of training on the benefits achieved by experts

The results of estimating the impact of the training on benefits such as increased production, cost savings in production, improved decision-making for starting or expanding a business, and better interaction among farmers, experts, and researchers are presented in Table 4. As the results of this section show, the training had a positive effect on all four benefits considered in the beekeeping training course. Among these, the research findings revealed that the training had the most significant impact on the interaction between beneficiaries, experts, and researchers. The adjusted

306 percentage impact of the training on this interaction was found to be 64%, indicating that the
307 training improved communication and collaboration between farmers, experts, and researchers.
308 Additionally, the results showed that the training had the second most powerful effect on reducing
309 production costs. This suggests that the training enabled participants to reduce beekeeping and
310 honey production costs through the production and management methods and strategies learned
311 during the course. Another important outcome of this study was that the training had a positive
312 impact on increasing production for the participants. In other words, the training led to a 51%
313 increase in production. Finally, it was found that the training had a 33% effect on improving
314 participants' decisions regarding starting or expanding their beekeeping businesses (Table 4).

Table 4. Estimation of the impact of training on achieved benefits by experts

Row	Benefit	Average Percentage of training impact (%)	Average confidence level (%)	Adjusted percentage of training impact (%)
1	Increased production	56%	91%	%51
2	Cost savings in production	74%	85%	%63
3	Decision-making for starting or expanding a business	52%	63%	%33
4	Better and closer interaction among farmers, experts, and researchers	76%	84%	%64

Average adjusted percentage of training impact: 53%

315

316 **3.1.5. Calculating the ROI for each participant**

317 Table 5 shows the ROI for each participant. The ROI calculation revealed that most participants in
318 the beekeeping training course experienced a good return on investment. However, two
319 participants (the third and sixteenth participants) had a negative ROI. On the whole, the results of
320 the ROI analysis showed that each participant in the beekeeping training course had an ROI of
321 1302%. This ROI figure provides a strong justification for the development of such training
322 programs by the Agricultural Research, Education, and Extension Organization (Table 5).

Table 5. Calculation of return on investment (ROI) for each participant

Row	Costs	Benefits			Total ROI (%)
		Financial benefit	Converted non-financial benefit	Total	
1	1420000	1800000	3632000	5432000	103%
2	970000	11900000	4462000	16362000	794%
3	610000	0	998500	998500	-13%
4	810000	2060000	4462000	6522000	327%
5	1000000	2580000	2890500	5470500	190%
6	936000	2060000	4114000	6174000	250%
7	1740000	85000000	4114000	89114000	2614%
8	1420000	30000000	3444000	33444000	1148%
9	688000	17000000	4462000	21462000	1553%
10	1008000	65500000	3777000	69277000	3543%
11	970000	12000000	4462000	16462000	799%
12	1428000	12100000	4114000	16214000	502%
13	810000	414000000	3444000	44844000	2834%
14	930000	36000000	4462000	40462000	2206%
15	1208000	60100000	4462000	64562000	2733%
16	1734000	0	2646000	2646000	-19%
17	1520000	17000000	3777000	20777000	624%
18	960000	12000000	4176000	16176000	793%
19	2172000	3100000	3632000	6732000	64%
20	580000	0	4462000	4462000	308%
21	808000	276000000	4114000	31714000	1980%
22	868000	10300000	3632000	13932000	751%
23	932000	500000	4462000	4962000	182%
24	720000	36000000	4400000	8000000	489%
25	1788000	111900000	4400000	15590000	362%
26	1058000	32000000	3299000	35299000	1668%
27	586000	30000000	4400000	34400000	3011%
28	920000	70800000	4176000	74976000	4219%
29	1920000	-20000000	4400000	24400000	574%
30	828000	36000000	4400000	8000000	412%
31	1364000	345000000	3299000	37799000	1369%
32	862000	31200000	3777000	34977000	2051%
33	1820000	5000000	3969000	8969000	161%
34	732000	27300000	4114000	31414000	2175%
35	1570000	25900000	4462000	30362000	925%
36	1008000	6700000	4114000	10814000	469%
37	858000	17000000	4400000	21400000	1222%
38	432000	36200000	4462000	8082000	892%
39	584000	0	998500	998500	-9%
40	428000	76000000	4176000	80176000	9828%
41	828000	0	2890500	2890500	85%
42	432000	1000000	4114000	5114000	527%

Average Return on Investment (ROI): 1302%

3.2. Evaluation of return on investment (ROI) for the organisation

3.2.1. List of costs for organising the training course

The most important step in calculating the costs of organising the beekeeping training course is identifying the types of costs associated with the educational programme. Table 6 presents the breakdown of the costs involved in organising a beekeeping training course by the Agricultural Research, Education, and Extension Organisation. The results from this section indicate that the needs-assessment for implementing this course incurs no costs for the Agricultural Research, Education, and Extension Organisation. One possible reason for the absence of needs-assessment

costs is that the organisation organises and executes the course based on the demand or requests from the beneficiaries themselves. As a result, the demand-driven nature of the course means that the organisation does not need to allocate funds for needs-assessment. Additionally, the results from this study showed that the cost of course coordinators (per hour) is also zero for the organisation. This is because the organisation uses its internal staff to coordinate the course, and therefore does not incur separate costs for coordinating these courses.

The travel expenses of beneficiaries attending the course were also zero, as these expenses were borne by the beneficiaries themselves, and thus, no additional costs were imposed on the organisation. Furthermore, the costs for evaluating the training courses were zero. However, the results from this section revealed that the only cost items for the organisation in organising these courses were the instructor's fees, costs for purchasing equipment, facilities, and educational materials (such as notebooks, booklets, CDs, workbooks, certificates, handout copies), catering costs for both participants and instructors, utility costs (water, electricity, gas, phone, internet), and advertising costs.

Table 6. List of training course expenses

Row	Type of cost	Value (Tomans)
1	Needs assessment	0
2	Compensation for the trainer	700000
3	Costs of purchasing equipment, facilities, and educational materials for training (notebook, booklet, compact discs, workbooks, certificates, photocopying handouts)	520000
4	Costs of course coordinators (per hour)	0
5	Hospitality costs for participants and the trainer	400000
6	Conference hall or venue rental for the course	0
7	Transportation expenses for participants and the trainer	0
8	Costs of utilities such as water, electricity, gas, telephone, internet, etc.	200000
9	Advertising costs	40000
10	Costs for evaluating the training course	0

Total: 1,860,000

3.2.2. Financial benefits from conducting the training course

The results of calculating the financial benefits to the organisation from conducting the mentioned course showed that the benefits of conducting the beekeeping training course for the Agricultural Research, Education, and Extension Organisation with 13 participants was 7,800,000 Tomans.

3.2.3. Conversion of non-financial benefits into monetary value from participation in the training course

The analysis of non-financial benefits for the organisation was based on two factors: advertisement of the course and participation in other courses (Table 7). The results indicate that the non-financial

benefit from the advertisement of the course by participants in the beekeeping training course was approximately 4,118,000 Tomans. Additionally, the non-financial benefit from participants enrolling in other courses provided by the organisation was approximately 4,270,000 Tomans. Overall, it can be concluded that by conducting the beekeeping training course for 13 participants, the Agricultural Research, Education, and Extension Organisation gained an approximate benefit of 8,388,000 Tomans.

Table 7. Conversion of Non-Financial Benefits into Monetary Value from Participation in the Training Course

Average response percentage of participants	Course advertisement			Participation in other courses				Total
	Estimated cost by experts	Confidence level %	Adjusted cost	Average response percentage of participants	Estimated cost by experts	Confidence level %	Adjusted cost	
78.2%	5800000	71%	4118000	81%	6100000	70%	4270000	8388000

3.2.4. Calculation of return on investment (ROI) for the organization

After calculating the costs and benefits of holding the training course, the return on investment (ROI) can be determined. The results demonstrated that the ROI for conducting the beekeeping training course for the Agricultural Research, Education, and Extension Organisation is 770%.

4. Discussions and recommendations

The results of the ROI analysis of the beekeeping training course for each participant indicated that these programmes had a positive impact on the attendees. In other words, the average ROI obtained for the participants demonstrated that these training courses played a significant role in improving various aspects of their economic well-being. Additionally, the findings revealed that beekeeping training programmes had a positive and significant impact on the production efficiency of the participants and enhanced their capabilities for successfully starting a beekeeping business. However, two participants in this study (the third and sixteenth participants) experienced a negative ROI after attending the beekeeping training courses. Although this result was unexpected, it serves as a warning sign that further studies should be conducted to identify and analyse the factors influencing the success of beekeeping training courses. The high ROI for most participants in the beekeeping training course suggests that the programme significantly improved their beekeeping practices and strategies. It can be inferred that these improvements were generally due to increased productivity, better performance, and enhanced management practices at their

beekeeping farms. In this regard, it can be confidently stated that the benefits of conducting these training courses outweigh their disadvantages and costs. This conclusion serves as a strong basis for the continued development and implementation of such training courses by the Agricultural Research, Education, and Extension Organisation (AREEO). It is evident that beekeeping requires sufficient technical knowledge and efficient resource management. Considering this fact and the research findings indicating a high ROI, it can be concluded that the beekeeping training programme has successfully equipped participants with the necessary skills to optimise their beekeeping operations. Moreover, the high ROI of the beekeeping training course highlights the potential of beekeeping as a sustainable and profitable economic activity for rural communities in Fars province and Iran. More specifically, by improving the knowledge and skills of beekeepers and local communities, training programmes can contribute to agricultural sustainability and rural livelihoods. This positive outcome can, in a feedback loop, further support the success of beekeeping businesses and the growth of the industry.

While the overall ROI of the beekeeping training course was highly successful, the data analysis showed that two participants experienced a negative ROI. This finding suggests that while all participants benefited from the beekeeping training, they did not necessarily achieve the same level of success. Several key factors may explain the negative ROI. First, their initial beekeeping conditions may not have been sufficiently favourable. For example, those who experienced a negative ROI may have lacked adequate and appropriate beekeeping equipment, operated in unsuitable farm conditions, or had insufficient initial bee colonies. These factors could have hindered the application of the knowledge and skills acquired during the training course. In other words, if a beekeeper starts their business with poor infrastructure or minimal resources, their ability to generate a positive ROI will be reduced. Additionally, insufficient support and logistical challenges may pose serious obstacles to implementing a beekeeping business. For example, some training participants or beekeepers may have difficulties accessing markets for selling their products or face challenges in maintaining bee colonies at their farms. Issues such as pests and diseases can also impose significant constraints on their business. In a broader sense, the knowledge provided during the beekeeping training course does not necessarily guarantee that participants can overcome these challenges. External factors such as environmental conditions, pest outbreaks, and local regulations may also contribute to negative ROI outcomes. Furthermore, individual motivation plays a critical role in business success. Beekeeping, like any other

entrepreneurial activity, requires effort, adherence to scientific principles, and patience. A lack of personal commitment may prevent participants from effectively implementing the training content, reducing their likelihood of success and leading to a negative ROI.

The results showed that the beekeeping training courses had a high ROI. This outcome demonstrates that the alignment of the learners' or participants' needs, the educational content of the courses, and the environmental context plays an important role in the effectiveness of the courses. It should be noted that the motivations and readiness of the participants can effectively lay the groundwork for the application of the training outcomes. Accordingly, it can be concluded that individual/personal counselling and guidance, along with follow-up after training, are of great importance. Of course, it should not be forgotten that the continuous updating of the content of the beekeeping course helps to ensure that the content remains demand-driven. In other words, this approach enables the course content to be adapted to market conditions and real-world needs. On this basis, it can be expected that by creating a supportive learning environment, the effectiveness of beekeeping programmes can be enhanced. Naturally, this supportive learning environment should be established both during and after the course.

Based on the research findings, several practical recommendations are proposed to enhance the effectiveness and ROI of beekeeping training courses:

1. First, support should be personalised for participants in training programmes. In other words, participants facing specific challenges, such as logistical issues and illiteracy, should be identified. To customise support and guidance for participants with special conditions, a detailed monitoring programme can be designed to assist them in implementing their businesses. It is recommended that this programme include strategies such as pairing inexperienced beekeepers with experienced ones. Additionally, providing practical guidance through mentors from the organisations running the training programmes, as well as offering emotional and motivational support to newcomers in the beekeeping business, can be beneficial. These strategies, integrated into a monitoring programme, can help participants with special conditions overcome initial business barriers. To further enhance the effectiveness of this proposal, it may be beneficial for course organisers to continue providing support even after the training has ended. This ensures that participants receive the necessary technical assistance while implementing the knowledge gained from the beekeeping training courses

2. Secondly, it is recommended that monitoring and evaluation of beekeeping training programmes should not be limited to the periods before, during, and immediately after the course. Instead, a follow-up evaluation is one of the most essential steps in ensuring the effectiveness and return on investment of beekeeping training programmes. Conducting regular evaluations and periodic surveys after the course can significantly help in identifying and analysing the long-term impacts and challenges of beekeeping businesses. Moreover, systematic follow-up evaluations can help organisers of beekeeping and similar training programmes identify emerging and future challenges faced by participants. As a result, future training courses can be designed to be more demand-driven, tailored, and based on real feedback. Finally, establishing a follow-up evaluation approach can serve as an early warning system for training organisations by identifying participants who require additional support.
3. Thirdly, it is recommended that the content and curriculum of beekeeping training programmes be continuously reviewed and updated by instructors and the organisations implementing these programmes. This ensures that the training content remains focused on the most important, up-to-date, and urgent needs of the beekeeping industry. For example, issues such as access to suitable honey markets or challenges related to climate conditions may be among the most significant global concerns in beekeeping. In such cases, instructors and the training content should place greater emphasis on these topics. In other words, instructors should focus their lessons on introducing strategies for mitigating environmental risks and diversifying income sources through the production of honey-based products.
4. Fourthly, it is recommended that pre-course assessments be used to reorganise certain aspects of the training content. Currently, pre-assessments are conducted just a few days before the training begins or even minutes before the session starts. This makes it difficult to utilise pre-assessment results to guide the course content and execution process. However, conducting early pre-assessments can help evaluate participants' knowledge levels and identify the specific equipment, infrastructure, and needs of each trainee. In this way, instructors can use the results to restructure the training content to address knowledge gaps and participants' specific requirements. This approach enhances the demand-driven nature of beekeeping training programmes. For instance, if some participants come from

regions with a high prevalence of pests, instructors can design and conduct specialised sessions to help them manage this challenge effectively.

5. Finally, as the sixth recommendation, the authors suggest providing financial incentives or discounts for purchasing equipment and establishing beekeeping infrastructure for participants facing financial challenges. Such financial support and incentives can help reduce the initial investment costs for participants. In other words, participants in beekeeping training programmes can apply their newly acquired knowledge without worrying about the startup costs of their business. Access to subsidised beekeeping kits or equipment for low-income participants can significantly impact their success after training and improve their return on investment.

5. Conclusions

This study led to two key conclusions. First, beekeeping training courses yield a significant ROI for many participants. Second, these training courses also generate a return on investment for the Agricultural Research, Education, and Extension Organisation. Therefore, the findings provide strong evidence for enhancing and expanding training programmes for farmers and agricultural beneficiaries. Like any research, this study had certain limitations. The first limitation was the economic and time constraints that prevented the inclusion of a broader range of training courses. The Agricultural Research, Education, and Extension Organisation offers various training programmes for farmers, but due to financial and time constraints, only one training course was evaluated in this study. Future researchers are encouraged to investigate other training programmes offered by the organisation. The second limitation was inconsistencies between the actual information of many training participants and the data they provided. This issue was highlighted in the research methodology section. As a result, the authors were unable to reach many respondents who had attended the training, leading to their exclusion from the sampling process. Additionally, the lack of response from many participants further restricted the sample size. Future studies could overcome this limitation by conducting research on a national scale and accessing participant data on a broader level. Moreover, the organisation itself should improve the documentation and recording of participant information in training programmes. The third limitation was that this study relied solely on the ROI method and its techniques to assess the effectiveness of the beekeeping training courses. However, effectiveness can also be evaluated in

cognitive, emotional, and behavioural dimensions. Future researchers are encouraged to focus on these additional aspects in their studies. Finally, this study only examined certain intangible effects of the beekeeping training courses and quantified them to calculate ROI. The primary aim of this quantification was to illustrate the process of measuring tangible training effects. The authors believe that many researchers face significant challenges in this area, leading either to the perception that training is ineffective or to a lack of awareness regarding how to measure its impacts. However, it is crucial to recognise the wide variety of intangible and non-monetary effects that training programmes can have. Future research should focus on measuring a broader range of these effects to provide a more comprehensive assessment of training effectiveness.

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