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Profitability and socio-economic analysis of beekeeping and honey production in Karaj state, Iran

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Abstract
Despite the extensive beekeeping practices in Karaj state, Iran relevant information related to socio-economic profiles of beekeeping and factors affecting the adoption of improved beekeeping technologies were lacking. To understand these conditions, 176 beekeepers from eight regions were interviewed using exhaustive questionnaires. The objectives of this study were to identify determinants of improved box hive adoption by the beekeepers; and to analyze financial benefits from adopting improved box hive technology. It was found that credit, knowledge, education level of household head, perception and visits to demonstrations positively and significantly influenced adoption of box hive. The average annual productivities of colonies were 8.64±5.54 kg and 3.89±2.52 kg honey/colony/annum for modern and traditional hives, respectively. The average annual household earnings from beekeeping was relatively high ($68,845.6), and contributes to an average of 26.64±28.95% of the total annual income of beekeepers which shows that beekeeping plays a vital role in increasing and diversifying the incomes of rural communities.

Keywords: Socio-economics, honey production, profitability, Karaj, Iran

1. Introduction
Keeping honey bees is very much essential for man's benefit. Traditionally, honey bees are kept in many countries where they are used for many purposes. For example; A beekeeper can develop knowledge and skill, which is rewarding and generate self-reliance and other local traders benefit by making hives and equipment, and from using and selling the products. The other hand, regarding recent government policy to reduce dependence on oil income and to increase agricultural and industrial export crops to provide The country with necessary foreign exchange, This will encourage producers to increase those products in that we have more potentials. So, honey production is of special importance. In addition, rural development has become more and more important issue in Iran since rural areas also contribute to the efficiency of the national economy. Animal production deputy of Jihad Agriculture ministry (2011) reports, the total of honey bee colonies, native and modern colonies of Iran is 5172082, 365160 and 4806922 respectively. During the last 33 years the honey production and number of hives has been increased by 510% and 750% respectively. The number of hives in 1977 was 850000 and reached to 5172082 in 2011. According to (FAO, 2010) [13], Iran is one of the ten largest honey producing countries in the world [13]. The honey production value in Iran approximately is about 3.5 tones [13]. Now a days in most of the countries (expect Iran) attention to honey bees at first is due to its role in economical return through pollinating and increasing of agricultural crops in crescent. The Iranian honey bee (*Apis mellifera* meda) play a dominant role, being the major pollinator available for field and outdoor fruit crops in Iran country [14]. Recent estimates for the value of agriculture and horticultural crops grown commercially in the Iran that benefit from bee pollination are in the region of $ 100-143 million per annum, while the value of honey production annually in the Iran fluctuates between $10 million and $20 million [27]. Honey bee has important role of pollination in different agriculture products in Iran, agricultural production play an important role in Alborz province economy and in the Alborz province, the economic value of commercial crops that benefit from pollination is estimated to be about 1.5 million per year, which is significantly higher than estimated value ($1.5-$2 million per 12 months in year) from share honey production in Alborz province [26]. The crop in this report, tomatoes, melons, watermelons, cucumbers, apple, peaches, pear, cherry, grape, sunflower, bell pepper, saffron, forage corn

and nectar plants contributed ($1.5-$2 million) in 12 months 2012 and represent about 12% of fruit, vegetable, and nectar plant production in Alborz province [25]. Iran is the largest honey producing country in Asia after China and turkey countries and one of the top 10 producing countries in the word [13]. It takes important role in the preservation of rural landscape, traditions and their regional values. Rural development has become more and more important issue in Iran since rural areas also contribute to the efficiency of the national economy. Development of rural areas also very important issue in Iran, which could contribute to the improvement of profitability of small family businesses, higher employment rate in rural areas as well as slow down the migration of people from rural into urban areas. Address to surveys in Iran, it is clear that the value of honey bees in increasing agricultural crops are 90 times of their direct production and that is equal to 4 percent of GNP (gross national product) [14]. Although the contribution of honey production to the Gross Domestic Product (GDP) in Iran is only a few per cent, other benefits play more important role. According to the statistics of Agriculture Ministry, Alborz province has had 400 beekeepers and 33600 colonies in 2012. Agriculture section has a specific situation among economical sections in Iran. Alborz province is one of the most important poles of agriculture and Beekeeping is a major integral component in agricultural economy of developing countries and produce much more than food. Since Iran's economy is dependent on agriculture as explained above it follows that the role played by bees in pollinating crop is very crucial. In addition the majority of people involved in agricultural production in Iran are poor and live in the rural areas where large tracts of forests are found. In this regard the government of Iran has adopted poverty reduction as one of its development strategy, and apiculture is one of the industries that are being promoted in the rural areas to improve off farm income and employment. The apiculture industry provides the much needs diversification in the agriculture production base. Iran has a total labor force (aged 18 years and above) of approximately 70 million people, of whom under half are gainfully occupied. Of those employed, over 20 percent work in traditional agriculture. Maximum unemployed people live in urban areas. Bees pollinate a wide range of crops and fruit trees such as the various species of citrus fruits like apple, pear, cherry, peach, grape, sunflower, bell pepper, tomato, saffron, forage corn and nectar plants, cotton, vegetables, etc [27]. This activity is so vital that it is important for crop farmers (especially commercial farmers) to keep bees on their farms or to commission a beekeeper to send his bees to the farm during the flowering period. In the USA, for example beekeepers are paid by farmers for providing a four week pollination service with their bees. The bees pollination service is estimated to be worth over 15 times the value of all hive products together [16]. Current interest in quality of environment is influencing the people to look more deeply at the factors upon which food production, health and aesthetic aspects of the environment depends [24]. The most important component in the beekeeping industry is the bee as it is involved in the primary production of bee products [2]. Several papers have been published on the economics and profitability of honey production [3, 5, 6, 18, 36, 39] but there is still need for research, especially in national and international level. The focus of this research is to evaluate, the socio-economic and technical characteristics of beekeepers under the light of survey in terms honey production.

1.1 Economic Importance of Beekeeping in Iran

Beekeeping has been part of the farming system in Iran since time immemorial. It has been a tradition since long before other farming systems. Beekeeping is a very long-standing and deep rooted practice in the rural communities of the country and around one million farmers are estimated to keep bees [14]. Beekeeping has been and still plays a significant role in the national economy of the country as well as for the subsistence smallholder farmers. The contribution of bees and hive products, though difficult to assess, is probably one of the most important small-scale income generating activities for hundred thousands of farmer beekeepers. The honeybee *Apis mellifera* is one of the most successful species in the animal kingdom judged by its ability to adapt to a wide climatic range. It is believed to have evolved in the tropics. It is highly productive and can adapt well in different climatic conditions. Although they are known as vicious and aggressive bees, they are good producers [17]. Beekeeping is an enterprise that offers great potential for development in Iran since it is easy and cheap to manage. In arable farming, bees also improve crop yields through increased efficiency in pollination and also beekeeping diversifies agriculture as it can be integrated with other agricultural activities as well as agroforestry [34]. A study by (Carruthers and Rodriguezi 1992) [11] have revealed that, beekeeping provides local people with an economic incentive for preservation of natural habitat enhancing environmental quality thus, labour in rural areas can be utilized especially during dry seasons. Beekeeping can play an important role in the urban and rural areas as small-scale farmers may produce products such as honey, beeswax, propolis to name a few, and selling them in order to generate income. However, beekeepers encounter different challenges when in the course of the practice. The low yield of honey and other beekeeping products such as honey, beeswax and propolis may result from insufficient management practices and lack of adequate training. On the other hand, honey production is affected by climatic conditions such as bad weather and lack of water and some bee diseases such as *Varroa* mites and colony collapse disorder. Low quality and limited supply of honey are the most critical problems in the value chain, which is mainly caused by limited availability of bee forage (due to deforestation), shortage of honeybee colonies, backward technology, poor pre and post-harvest management. To boost honey production and make it a means of livelihood in the nation, there is the need to improve or modernize the technology of honey production. The fact that beekeeping can alleviate poverty in Iran cannot be over emphasized. A study by (Folayan and Bifarin 2013) [11], beekeeping can boost incomes particularly in the rural communities and benefit the country's economic situation. Honey is widely consumed with many medical values and beeswax has a number of individual uses. Trader in bee products has gained grounds. However despite this enormous potential, not enough has been done to earnests its production. Other benefits of bee keeping include cheapness as the insects can produce their own food all year round, availability of all necessary input locally can easily be initiated on limited level for employment and income generation, does not depend on importation of foreign equipments or inputs, the availability of technologies in the rural localities, readily availability of markets for bee keeping both locally and abroad. Many uses of honey [21] include pollination of flowers for food increases, production. Beekeeping can rightly be seen as a liable key in reducing poverty and malnutrition. Age also impact negatively on inefficiency; the implication is that increased

and sustainable honey production would better be achieved through young producers who can devote their full time to honey production [1]. Honeybees have a lot to offer in terms of agricultural products and ecosystem services. However, bees are exposed to a number of threats such as climate change, reduced biodiversity, and invasive species that reduce their quality of health and longevity [35]. The cost of dealing with these problems is increasing for apiarists, thus making the beekeeping business less profitable. Predators, parasites and diseases are some of other factors that affect beekeeping, thus reducing honey production. Since limitations of beekeeping may affect honey production in a way that these may feed on the honeybees, thus decreasing the population hence lowering production. Parasites and diseases also affect beekeeping and this will eventually lower production due to the fact that honeybees will be engulfed by a lot of diseases, limiting the status of bees making honey [26]. Other benefits of bee keeping are the price of Iran honey ranges from N 47.000 to N 71.000 per ton. If Iran were to export 3.5 tons of honey produced annually, this earning is expected to increase with increase and improved beekeeping in Iran [12]. Based on the above, this research assesses the extent to which honey production could alleviate poverty especially under the modern beekeeping technologies. The study is to address the following questions. What are the contributions of beekeeping to the livelihood of other local people? What technologies are being used by beekeepers? What are the factors that govern the price of the honey in the particular locality? What are the major constraints of beekeeping in the area? What are the major honeybee floras in the particular area? List in terms of priority? What are the major pests and predators found in the area that threat your colonies? (List is ordered of importance). Does beekeeping profitable to the area? How profitable is the honey production? The general objective of the study was to analyze profitability of honey production in Karaj State of Iran. The specific objectives were to (i) examine the socio-economic importance of the honey bee to man (ii) ascertain the honey production technology being used, (iii) identify the economic activities in beekeeping, identify and examine the socio-economic factors hindering increase production of honey in the study area (Tables 1, 2). Identification of factors that influencing the adoption of technologies, either positively or negatively, are important for policy makers, researchers and development practitioners to suitably modify the approach or/and the technology to improve its up taking by end users [38]. In this regard many studies have shown that a careful diagnosis of honey production systems significantly contributes to identifying major constraints of the subsector and to increase honey production and incomes of beekeepers in sustainable ways [15, 37]. Moreover, study that focused on identifying constraints and opportunities, able to demonstrate the existing beekeeping production systems and come up with recommendations for both research and development interventions [22]. In addition, A study by (Workneh *et al* 2008) [38], that focused on identification of determinants of the adoption of improved box hive technology, they able to pinpoint the major factors influencing its adoption. Despite the extensive beekeeping practices in Karaj state (Iran), there is little information related to honey production systems, constraints of the subsector, factors affecting the adoption of beekeeping technologies the socio- economic profiles of beekeepers and the role of beekeeping in household income generation and diversification. Thus, it was essential to assess the beekeeping production system as whole and identify determinants of improved beekeeping technology adoption and major constraints of the subsector.

2. Materials and Methods

2.1 Description of the Study Area/Altitude and Climate

Fieldwork was conducted in Karaj region in Alborz province, Iran. The study was conducted in the Karaj apiaries in Alborz province of Iran by considering eight representative regions: Karaj, Garmdarreh, Baghestan, Nesa, Heydarabad, Asara, Kalak & Hesar, and Mohammadshahr (Figure 2). Purposive sampling technique was employed to identify the target population of the study area. Accordingly, the required data were collected between April, 2012 – December, 2012. The research was carried out in (2012-2014) in the Karaj District, located between (35° 50′ 8″ North latitude and 51° 0′ 37″ East longitude in the Alborz province of Iran. The study was conducted in the Karaj districts in central Alborz province (Figure 1).

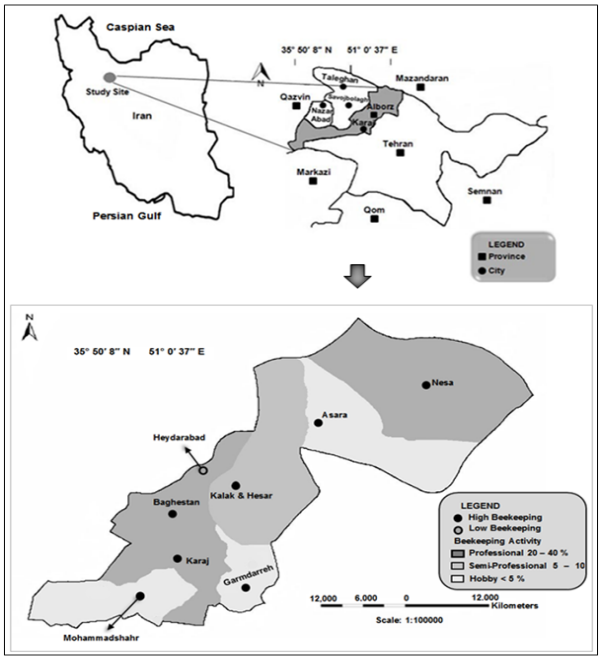

Fig 1: Map of Iran and the study area of Karaj apiaries in Alborz province.

3. Data collection

Accordingly, in this study, exhaustive questionnaires were prepared and used to generate all relevant information regarding the beekeeping production systems of the sampled regions. Data was collected through the use of semi structure interview with randomly selected 176 beekeepers representing 24.6% of the total beekeepers in the Karaj apiaries in Alborz province. Generally, the instrument was designed to generate information in the following areas: annual income, number and type of beehive owned, constraints of beekeeping, honey yield/hive, year of adoption of modern beehives and beekeeping experience. Accordingly, from the lists of beekeepers in the respective regional agricultural offices, an average of 22 beekeepers (ranging from 16-32 per region) and total of 22, volunteer beekeepers were randomly selected. The major information that was generated include: the socio-economic profiles of beekeepers; honeybee colonies holding size/beekeeper; the types of honey bee races used; and the average honey yield per hive, per harvest, and per annum. Moreover, the types of hives (log or box) used, their preferences, reasons of preferences and the determinants of

box hive adoption, were assessed. Furthermore, the financial returns of beekeeping, the annual household net incomes from beekeeping and its share of the total annual income of beekeepers were estimated. The major constraints of beekeeping and the major honeybee enemies and diseases according to their degree of importance were also recorded. Moreover, the marketing of bee products and the prices of different types of honey by region. The production, harvesting and marketing of honey, propolis, pollen, royal jelly and bee venom is insignificant in Karaj state. During this study it was established that there is no commercial production and marketing of these products. The main reason could mainly be (but not limited to) absence of production and harvesting technologies. Low adaptation of modern beehives by beekeepers makes it difficult to harvest these high valued bee products. Most of Karaj beekeepers use Iranian Longstroth wooden and wooden open floor hives.

4. Production Technologies

The rearing of bees for honey has been practiced since time immemorial. Beekeepers used a combination of honey hunting and traditional methods. Among traditional beekeepers, locally constructed beehives are used to trap swarming bees. Production is predominantly done on a small scale by farmers who are often organized in farmers groups. The colonized beehives are usually harvested six months a year (May, June, July, August and November - December) and comb honey is extracted using rudimentary methods, which in most cases disrupts the bee colony. Based on locally available materials used for construction of different hives, environmental conditions and positions used to keep bees, the following variants of basic design are found throughout the country: hollowed logs, bark hive, bamboo or reed grass hive, mud (clay) hive, woven straw hive and so on. The beekeepers that are experienced and skillful in using these hives could do many operations with less facility. Today, there is a shift in technologies of production. At the processing stage different technologies including the traditional manual way of extracting honey is common, however new technologies like the centrifuge (especially manual) can be obtained on the Karaj's market. A study by Ehui *et al*. (2004) have explain that a new technology is introduced to small holders farmer by itself alone does not guarantee for a wide spread adoption and efficient use. For efficient utilization of the technology the fulfillment of specific economic, technical and institutional conditions are required. As also noted by Yapa and Mayfeld, (1978) have revealed that, adoption of an entrepreneurial innovation by an individual requires at least four conditions. These are: the availability of sufficient information, the existence of a favorable attitude towards the innovation, the possession of the economic means to acquire the innovation and the physical availability of the innovation. Research in the diffusion of agricultural innovations has demonstrated that knowledge/awareness of a new technology is a necessary first step in the adoption decision making process [28]. A study by Rogers, (1962) have revealed that, defined adoption as the mental process through which an individual passes from first hearing about an innovation to final adoption. [30] Defined adoption as a decision to make full use of new ideas as the best course of action available. The decision of whether or not to adopt a new technology hinges upon a careful evaluation of a large number of technical, economic and social factors. The authors further explained that adoption or rejection of an innovation is a decision to be made by an individual. Agricultural technology has its own factors, which affect its adoption by a given society. These factors are technologies relative advantage, compatibility, complexity, trialability and observability. The major role of extension in many countries in the past was seen to be transfer of new technologies from researcher to the farmers [29]. Now it is seen more as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose, and by helping them to develop insight into the consequences of each option [4]. Information collected include socio-economic variables like age of farmers, educational status, year of experience in beekeeping honey product output, number of colonies types and sources of beekeeping equipment, marketing system, cost and returns of honey production. Secondary data were collected via existing information from literature and previous studies. Accordingly, the required data were collected, between (April and December, 2012).

5. Experimental Treatments

Five beehive types namely: Polystyrene open floor, Wooden open floor, Iranian langstroth hive (ILH), Iranian top bar hive (ITH) and Traditional log bee hives were used as treatment. Four strong and well established honeybee colonies from each hive type were selected and kept under uniform environmental condition. Equal honeybee management practice was undertaken to each beehive type. During the study period the data was collected on honeybee colony strength, honey yield and production cost of each beehive types. Honeybee colony strength was simply assessed as strong, medium and weak based on honeybee population estimation during the study period due to the limitation of traditional hive to manipulate detailed internal observations like measurement of brood area and pollen stored. In the present study, colonies were considered as strong when honeybee population occupied full of the hive, medium if more than half and weak when they covered less than half of the hive volume including the combs during honey harvesting season. Moreover, data on honey and beeswax productivity (yield performance) of each of five beehive types (Polystyrene open floor hive, Wooden open floor hive, Iranian langstroth hive, Iranian top bar hive and Traditional hive) were recorded and compared both in major (March-June) and minor (September and December) honey flow seasons.

6. Data Analysis

Descriptive statistics were used to analyze the quantitative data. Pair-wise ranking technique was used to determine the preferred types of technology by users and to identify and prioritize the major beekeeping constraints. Moreover, matrix ranking was applied to identify the reasons for the respondents' preferences for one technology type over another. A rank score was also calculated for each variable to screen the major constraints perceived by beekeepers. Besides the technological and environmental factors that might influence the adoption of box hive, the role of some socio economic profiles of beekeepers in determining the adoption of box hives were also analyzed using logistic model by comparing adopters and non-adopters. The data that generated were analyzed using (SPSS version 16.0). Every comparison was made assuming variation between the beehive types in honey and beeswax productivity. One way ANOVA were computed to compare honey and beeswax productivity means per annum as well as in major and minor harvesting seasons between beehive types.

7. Cost Benefit Analysis

The most important issue of present study was to determine the type of beehive with better profit for better life of small scale beekeepers. In order to perform cost benefit analysis, major production cost of each beehive type was considered. Hence, production cost of beehive, input for honey production, honey colony purchase, apiary establishment expenses, protective clothes, labour and etc, were considered to be the major total production costs. Accordingly, the price of beehives (Polystyrene open floor hive, Wooden open floor hive, Iranian langstroth hive, Iranian top bar hive and Traditional hive) were obtained and honeybee colonies purchasing cost were assessed based on the average price to the study area. Hence, total cost of production was calculated for two honey flow seasons. Cost benefit analysis of each beehive type was determined using the following below formula. Simple descriptive statistics farm budget techniques and Gross Return analysis frequency, percentages and tables were utilized. The farm income model is as shown:

NI = GR - TC

Where:

NI = Net Income for honey production in Karaj.

GR = Gross Returns to honey production in Karaj.

TC = Total production cost in Karaj.

The total revenue represent the honey sales and other hive products receipts while the total expenses (TVC + TFC) represent direct purchases for the beekeeping project. Total production cost include fixed cost (e.g. rent on land, interest on borrowed fund, cost of hives, bee kits etc.) and variable cost (labour, storage, bottles, drawn comb, drug, fuel (Gasoline), queen catcher, Honey extractor, Frame wire, Sieve cloth, soft brush, Straw hat, detergent, torchlight etc). The gross return represents the income from honey sales while the total production costs represent direct expenses and purchases for the beekeeping activities.

8. Results and Discussion

The strength of Iranian honeybee colonies (*Apis mellifera* meda) in the current study was higher in Polystyrene open floor hive, Wooden open floor hive, Iranian langstroth hive types but medium in Iranian top bar hive and lower traditional hive types. In the present study, the reason that wooden open floor hive, Iranian langstroth hive types to be preferred by honeybee colonies could be due to its insulating nature of the hive to maintain optimum hive temperature during hot and cold season than other hive types. Whereas reasons for relatively lower performance of Iranian top bar hive and traditional log hive types could be due to fixed volume and susceptible to absorb both high temperature and cold weather conditions which affect honeybee colony establishment or performance. The main objectives of the demonstration stations were to introduce improved beekeeping technologies (box hives, casting mold, honey extractor, honey presser, smoker, veil, glove, etc.) imported from abroad to the beekeepers. Modern beehives allow honeybee colony management and use of a higher-level technology with larger colonies and can give higher yield and quality honey [8]. Moreover, improved box hive has advantages over the others in that it gives high honey yield in quality and in quantity. High yield, quality honey, ease for inspection and harvesting of products are the major relative advantages of modern beehives compared to the traditional one. The probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies and the ability of the farmer to perceive the advantages and efficiently utilize the new technology [32]. The obtained results as regard the demographic and economic characteristics of the respondents are contained in (Tables 1, 2 and 3). (Table 1) shows the result on gender, marital status and age of beekeeper, family population, educational level and major occupation. It revealed that 97% of the respondents were males. A study by Folayan and Bifarin, (2013) [11], have revealed that, this may be due to the nature of the vocation since the farmers are exposed to the risk of being stung by the bees for which the women fold may not be strong enough to withstand. 5% of the beekeepers were younger than 35 years old, 15% were between the ages of 35 and 39, and the remaining 80% were over 40 years old. So present of younger in this occupation is not enough. This indicates that all the respondents are still in their active age while the vocation is an emerging one for which the youth are attracted in order to generate income [1, 11, 19]. The results further show that there were 168 beekeepers that were married (96%) and 8 beekeepers were single (4%). All (96%) of the respondents were married implying that the vocation is capable of sustaining families from the steady flow of income. Also 89% of the respondents had between 1 and 3 children in their households and all of them had one form of formal education or the other. This could afford them the opportunity to read literatures and adopt new innovations. Also 77% of the respondents were farmers who diversify into honey production to ensure optimum and continuous flow of income. According to the results most 86% of the beekeepers had Middle level of income, while 12% and 2% had low and high level of income. (Table 2) shows the respondent claims as regard the source of credit (Funding Resources of Capital), honey production experience, technology use and quantity produced and visits of extension workers. It revealed that 82% of the respondents depend on personal capital as source of credit while 7% depends on debt of friends and acquaintances. Also about 82% of resources funding beekeepers from personal capital, 7% from loans, 2% of local credit, 7% of the debt from friends and acquaintances and 2% are non-bank sources. More about the personal investment and the debt from friends and acquaintances and loan that these three sources of about 96% share of the funding have been beekeepers. In this section should be considering this matter in order to increase production, which is required in order to finance various groups produced good policies to be used. This implies that all the respondents do not have access to formal credit. Also 11% of the respondents had less than 6 years of honey production experience suggesting that the business is relatively new in the study area. Further 32% of the respondents used traditional methods of honey production while 68% of them used modern technology. This conforms to earlier observation that because all of the respondents are literate, they would adopt new innovation with ease in order to produce at the optimum level [11, 20, 23]. The results in (Table 3) show that about 11% of the beekeepers used the log hive, and they preferred it the most, whilst 20% of the preferred the Iranian top-bar hive, 33% of the preferred the Iranian longstroth hive, 32% of the preferred the wooden open floor hive and 4% of the preferred the polystyrene open floor hive. In the present study, the reason that wooden open floor hive to be preferred by honeybee colonies could be due to its insulating nature of the hive to maintain optimum hive temperature during hot and cold season than other hive types. (Table 3) shows that 69% of the beekeepers have used modern hives types. Modern frame hives can permit colony management for high yield and colony propagation. With

good management, these hives can last for up to 5 years before they are replaced. Similarly, improved frame hive is convenient to manage its volume or chambers according to the strength of honeybee colonies and environmental condition. Whereas reasons for relatively lower performance of Iranian top-bar hive and traditional log hive types could be due to fixed volume and susceptible to absorb both high temperature and cold weather conditions which affect honeybee colony establishment or performance. Furthermore, 11% of the respondents produce 1 to 10 L of honey, this is small considering the fact that they can only harvest once or twice in a year, however, since they operate small farm size the output is expected to be small. The quantity of honey a farmer may realize from his apiary depends mainly on the number of hives and the period of harvest. The findings further revealed that only 68% of the respondents claimed to be visited by extension workers. This implies that there is inadequate link between the extension workers and the honey producers. Farmer to farmer experience sharing visits also contributes towards developing positive perception towards an innovation or a new technology. From the study result it concluded that transitional and modern beehives had better performance in terms of honey yield and quality compared to traditional hives in the study area. Significantly higher honey yield from transitional, modern and traditional hives types were recorded at Karaj, Garmdarreh, Baghestan, Nesa, Heydarabad, Asara, (Kalak and Hesar), and Mohammadshahr research station respectively. Whereas low honey yield from the five hive types were recorded at Karaj apiaries (Table 6 and 7). Modern hive demand high expensive beekeeping equipment and accessories as well as skilled personnel compare to transitional and traditional hives.

8.1 Honey Yield Performance of Beehive Types

The overall average annual honey productivity analysis clearly revealed three wooden open floor hive, Iranian longstroth hive and polystyrene open floor hive types were significantly ($p<0.0001$) higher than Iranian top-bar hive and traditional log hive types (Table 4). In general, the present study clearly revealed that wooden open floor hive, Iranian longstroth hive and polystyrene open floor hive types were the most productive while Iranian top-bar hive and traditional log hive types evaluated (Table 4). In the present study, higher honey yield (45.09 kg/hive/annum) was obtained from polystyrene open floor hive type than the other hives. similarly, the average annual honey yield (10.36 kg pure honey/hive) of traditional log hive in the present study was higher than the national average of traditional hive. Annual honey yield obtained from wooden open floor hive (40.71 kg/hive) in the present study was higher than the honey yield (30.51 kg/hive) reported by [33].

Table 4: Presentation of honey and bee wax productivity of beehive types (Mean ± SD)

Beehive types	Honey yield (kg/hive/annum)	Honey productivity (kg/hive/season)		Bee wax (kg/hive/annum)
		Major season	Minor season	
Polystyrene open floor	$45.09^{a***} \pm 2.74$	$24.4^{a***} \pm 1.58$	$17.59^{a*} \pm 2.98$	$0.5^{a} \pm 0.06$
Wooden open floor hive	$40.71^{b***} \pm 2.69$	$20.0^{a***} \pm 1.32$	$13.07^{a*} \pm 2.48$	$1.57^{b**} \pm 0.22$
Iranian longstroth hive	$30.09^{c***} \pm 2.46$	$18^{a***} \pm 0.62$	$10.25^{a*} \pm 2.24$	$2.84^{c***} \pm 0.30$
Iranian top-bar hive	$15.46^{a} \pm 2.42$	$11.33^{b} \pm 0.89$	$9.35^{ab} \pm 1.76$	$1.54^{b**} \pm 0.16$
Traditional log hive	$10.36^{b} \pm 0.73$	$9.85^{c} \pm 0.66$	$6.48^{b} \pm 0.66$	$1.35^{b**} \pm 0.29$

Different letters in each column indicate significant differences between treatments means. $^{*}p<0.05$, $^{**}p<0.001$, $^{***}p<0.0001$.

8.2 Production cost and net income of honey production

The overall average total production cost and net income per beekeeper from honey production were 54,387.29 and $218,016 per annum, respectively. The results in (Table 5) show that the highest average annual earnings were recorded in the Baghestan region ($271,693), while the lowest ($157,739) Mohammadshahr. In addition to family labor, most beekeepers hire at least one to two employees and a total of 180 permanent and 118 temporary laborers from other countries were working in beekeeping activities. This study shows that beekeeping contributes an average of 26.64 ±28.95% of the annual income of beekeepers in the studied regions. However, this contribution varies from 1% to 100%. There are regional differences in the role of honey production with respect to total household income per annum. Honey production contributes as much as 45.09 ± 30.64% to the total household income in the Baghestan region and as little as 11.24 ± 12.08% in Mohammadshahr (Table 5). Generally, the results show that beekeeping is a profitable business in the Karaj apiaries of Alborz province in Iran. The annual average share of income from beekeeping (26.64 ± 28.95%) in relation to beekeepers' total annual income indicates that beekeeping plays a significant role in increasing and diversifying the incomes of rural communities and provides a means of self-employment opportunities.

Table 5: Average cost of production and net annual income of beekeeping ventures per apiary

Region	Fixed cost (A)	Variable cost (B)	Total production cost (A + B) = C	Gross annual income from honey sale (D)	Annual net income from honey sell (D - C)	Average% annual share of income from beekeeping
Karaj	20476.44	12375.73	30152.57	215384.57	185232	20.12
Garmdarreh	20026.30	14140.69	34166.99	220999.99	186833	20.43
Baghestan	37341.96	13351.19	50693.15	322386.15	271693	46.09
Heydarabad	30416.97	17684.81	48101.78	207108.78	159007	13.11
Nesa	31285.68	31332.56	62618.24	218545.24	155927	34.77
Asara	34127.29	16646.77	50774.06	295071.06	244297	31.21
Kalak & Hesar	39082.50	15878.67	54961.17	321384.17	266423	41.18
Mohammadshahr	35435.86	15688.86	51124.72	208863.72	157739	11.24

Source: field survey, 2014.

9. Conclusion

From the results of the study the average of honey yield per hive/year was found to be low from traditional and transitional hives compared to modern hive but modern hive demand high expensive beekeeping equipments and accessories as well as skilled personnel compare to transitional and traditional hives. The costs of modern hive two times as much as a transitional hive. It is therefore recommended that government and nongovernment organization should focus on scaling up and promoting the adoption of transitional bee hives to improve farmers' income with little skills and low costs. Despite many challenges, beekeeping is a viable business that contributes significantly to increasing and diversifying the income of many rural households in the Karaj apiaries in Alborz province. Moreover, beekeeping provides a means of supplementary business and self-employment opportunities for many families. Although there is continuous problem of deforestation, there are still immense resource base (if properly conserved and managed) that can provide huge opportunities for apiculture. The Iranian government has recognized the role of the apiculture and has put in its development agenda, A strong extension and research supports to enhance the development of the subsector like: consideration of local conditions in technology selection and adoption; conservation and rehabilitation of vegetation with integration of beekeeping and government support and paying attention to price policies and also shift to the appropriate commerce to stable the price fluctuations and managing the price of inputs energy (gasoline, sugar and effective drug), effort to increase efficiency of the insurance system and improvement of methods in offering insurance services, payment of compensation by the fund under certain circumstances and planting drought resistant bee forage species around the apiary, increasing the productivity, production and quality of honey by improving the management of the traditional hives and introducing improved beehives, increasing the productiveness of bee colonies by improving bee forage and providing feed and water and introducing bee plants and drought resistant honey bee flora and improving the efficiency of breeding queens in Iran is very important and improved beekeeping technology requires knowledge on the practical aspects. The research and development organizations should identify and document the existing indigenous technical Knowledge of beekeepers to integrate it optimally into improved beekeeping practices. It is therefore recommended that government and non-government organization should focus on scaling up and promoting the adoption of transitional bee hives to improve farmers' income with little skills and low costs.

Table 1: Socio-economic characteristics of honey according to producers.

Gender	Frequency	Percentage
Male	170	97.00
Female	6	3.00
Total	176	100.00
Marital status		
Married	168	96,00
Single	8	4.00
Total	176	100.00
Age of beekeeper		
30 – 34	8	5.00
35 – 39	28	15.00
40 – above	140	80.00
Total	176	100.00
Family Population (Person)		
1 – 3 children	156	89.00
4 – 6 children	20	11.00
Total	176	100.00
Education Level		
Primary	136	77.00
Post Primary	16	9.00
Technical	24	14.00
Total	176	100.00
Major Occupation		
Farming	136	77.00
Public Service	12	7.00
Honey Production	28	16.00
Total	176	100.00
Income Level		
Low income	20	12.00
Middle income	152	86.00
High income	4	2.00
Total	176	100.00

Table 2: Distribution of the respondents Economic characteristics.

Funding Resources of Capital	Frequency	Percentage
Personal Capital	144	82.00
Loan	12	7.00
Local Credit	4	2.00
Debt of Friends / Acquaintances	12	7.00
Non – bank Sources	4	2.00
Total	176	100.00
Production Experience		
Less than 6 years	20	11.00
6 – 10 years	148	85.00
10 – 14 years	4	2.00
More than 14 years	4	2.00
Total	176	100.00
Determinant of Beehive Technology		
Traditional	56	32.00
Modern	120	68. 00
Total	176	100.00
Preferred Hive Types		
Log hive	20	11.00
Iranian Top-bar hive (ITH)	36	20.00
Iranian Longstroth hive (ILH)	57	33.00
Wooden open floor hive	56	32.00
Polystyrene open floor hive	7	4.00
Total	176	100.00
Quantity produced litres /(per hive type top rank)		
1 – 10 litres (Log hive)	20	11.00
10 – 15 litres (ITH)	26	15.00
21 – 30 litres (ILH)	57	32.00
31 – 40 litres	59	34.00
More than 40 litres	14	8.00
Total	176	100.00
Extension Workers for inspection		
No. of farmers visited	120	68.00
No. of farmers not visited	56	32.00
Total	176	100.00

Table 3: Transitional, traditional and modern types of hives own, reason for honey production, months of harvest and problems encountered.

Types of hives own (transitional, traditional and modern)	Frequency	Percentage
Log hive	20	11.00
Iranian Top-bar hive (ITH)	36	20.00
Iranian longstroth hive (ILH)	57	33.00
Wooden open floor hive (WOFH)	56	32.00
Polystyrene open floor hive (POFH)	7	4.00
Total	176	100.00
Reason for honey production		
For home consumption	8	5
For commercial purpose	164	93.00
As hobby	4	2
Total	176	100.00
Honey harvesting season of the study are		
May	4	5.00
Jun	12	15.00
Jul	20	25.00
Aug	40	50.00
November/December	4	5.00
Total	176	100.00
Problems Encountered		
Lack of insurance support and social secure insurance	10	5.68
Lack of enough money for payoff premium	10	5.68
Lack of communication between beekeepers and honey bee department of Karaj research institute	10	5.68
Absence of government support via surveillance on cost	10	5.68
Fluctuations in the price of inputs (drug and sugar) and Lack of effective drug	10	5.68
Demolition pastures and lack of proper plant cover in the area	13	7.39
Absence or inadequate rainfall (climate change) / (extreme temperatures and drought)	13	7.39
Increase cost of production / lack of fund and low rate of selling price	10	5.68
Honeybee mortality due to herbicides and spraying	10	5.68
Honeybee diseases (*Varroa mites*) and Colony Collapse Disorder (*CCD*)	10	5.68
Deficiency of qualified queen and loss of queen genotype	10	5.68
Poor bee product marketing and Inadequate advertising of bee products to consumers	10	5.68
Lack of commitment of insurance in observing its undertakings	10	5.68
Problems in choosing suitable place and identification nectar plants used by honeybee	10	5.68
Absence of insurance services for some products and high premium	10	5.68
Lack of payment of compensation by the Fund under certain circumstances	10	5.68
Bottlenecks and hardships existing in current laws and regulations with regard to agriculture insurance	10	5.68
Total	176	100.00

Source: field survey, 2014.

Table 6: Cost and profitability of transitional and traditional bee hive types at study area

Gross output	Unit	Ave. yield *	Quantity	Unit price	Total
Production	Kg	13.88	208.2	110	22,902
Total gross income	$	-	-	-	**22,902**
Cost of production					
Cost of sugar	kg		30	24	720
Cost of bee wax	kg		35	18	630
Total variable cost	$				1,350
Gross margin	$				**20,100**
Fixed cost					
Cost of hive	$		15	150	2,250
Annual depreciation of hive (25%)	$		15	37.5	562.5
Total fixed cost	$				2,812.5
Total overall cost	$				4,107.5
The net income attribute to farmer	$				18,749.8

Note: * (average yield), source: field survey, 2014.

Table 7: Cost and profitability of modern bee hive types at study area

Gross output	Unit	Ave. yield *	Quantity	Unit price	Total
Production	Kg	23.18	-	130	347.7
Total gross income	$	-	-	-	**45,201**
Cost of production					
Cost of sugar	kg		30	24	720
Cost of bee wax	kg		40	140	5,600
Total variable cost	$				**6,950**
Gross margin	$				41,350
Fixed cost					
Cost of hive	$		15	850	12,750
Annual depreciation of hive (25%)	$		15	212.5	3,187.5
Cost of hive tools	$				12,000
Total fixed cost	$				29,937.5
Total overall cost	$				34,887.5
The net income attribute to farmer	$				10,313.5

Note: * (average yield), source: field survey, 2014.

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