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Alborz province beekeeping and its economic efficiency: A case study of district Karaj, Iran

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Abstract

Apis cerana F. is indigenous to Asia and is an important pollinator for Asian ecosystems; the Western honey bee *Apis mellifera* L. has been introduced to Asia because of its high honey yields. These studies were mainly based on household survey of beekeepers for which a representative sample of farmers with different socio-economic background were selected from different counties of district Karaj in Iran. Data so collected was statistically analyzed and inferences were drawn. Informations were taken on following aspects: socioeconomic profile, age, beekeeping experience, managing level, occupations and technologies contents: colony age, honey production, royal jelly production, etc. distribution of two exotic bee *Apis mellifera* L. and *Apis cerana* F. colonies in study areas and challenges.

Keywords: Economic efficiency, *Apis cerana* F. *Apis mellifera* L. Alborz province

1. Introduction

Today, all countries of world try to get progress in productivity, in other word, they try to get more output by decreasing input usage. For increasing productivity in Iran's economic, agricultural sector as important and major sector, should considered, because increasing productivity growth in this sector, can help us to achieve economic development. *Apis mellifera meda* is main species of existing honeybees in Iran [22]. There are four types of honey bees worldwide: *Apis mellifera*, *Apis dorsata*, *Apis florea* and *Apis cerana* of the honey bee species imported to the Iran. The natural ranges of *Apis mellifera* includes Europe, Africa, and Western Asia [2, 24]. Because of this large range, there are several at least 26 subspecies of *Apis mellifera* [3, 27]. *Apis mellifera* ('honey-making bee') is one of the most successful species in animal kingdom. It became more adapted to wide range of environmental condition to a greater extent: one and the same species is able to survive in semi-desert tropical regions as well as in cold-temperate zones [23]. Asiatic honeybee; *Apis cerana* is not native to the Iranian continent and is not adopting apiaries by the beekeepers in Iran. Agriculture section has a specific situation among economical sections in Iran. Alborz province is one of the most important poles of agriculture. Apiculture is one of the agricultural majors that their production has a significant share in this province revenue. *Apis mellifera* L. is the only species of bees found and seen everywhere in the world except poles. Fortunately, Iran has got an independent race *Apis mellifera meda*, because of ecological situations, topographic, long history of beekeeping, having four seasons and its vastness [21]. Economic efficiency measurement have received considerable attention from both theoretical and applied economics in Iran. However, little attention has been directed to beekeeping and to the various components of efficiency of the beekeeping industry despite the availability of a number of techniques for estimating efficiency components of production units. This paper therefore attempts to bridge this gap by focusing among other things, on firm level economic efficiency measurement between in traditional and modern honey production. Economic efficiency measurement provides the much needed information which gives useful insight into the potentials for improved performance as well as the possibility of increasing the output of honey. The study estimated economic efficiency among a sample of beekeepers in the Karaj district of northwest of Iran.

1.1 Important Races of Honeybee

Bees that produce enough honey to be worth harvesting belong to the two sub families of the family Apidae: *Apinae* (honeybees) and *Meliponinae* (stingless bees). *Apinae* has only one genus, *Apis* and about nine species of which the *Apis mellifera* L. species is of much greater

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economic importance than any others. The races and strains of *Apis mellifera* is overriding world importance in beekeeping, and is the basis of world's beekeeping industry. *Apis mellifera* is now the most productive and widely distributed in almost all places of the world. Tropical subspecies of *Apis mellifera* L. are smaller than temperate zone subspecies, and they have a more slender abdomen. They are generally less amenable to handling and management, swarm readily; also, the whole colony may abscond as a result of damage and disturbance of their nest or shortage of food, according to [14]. Beekeeping also known as apiculture, is the act, science and/or business of managing honey bees for the purpose of producing honey, beeswax and other bee products for personal consumption and industrial use. The most important component in the beekeeping industry is the bee as it is involved in the primary production of bee products.

1.2 Importance of Beekeeping in Iran and District Karaj

According to global ranking in 2010, Iran is the 8th producer of honey in the world. The number of honeybee colonies of Iran ranks 5th in the world. According to FAO^[6] and Animal production deputy of Jihad Agriculture ministry of Karaj (2011) in Iran reports, the total of honeybee colonies, native and modern colonies of Iran are 5172082, 365160 and 4806922 respectively. The number of hives in 1977 was 850000 and reached to 5172082 in 2011. The prospect for helping peasant farmers of third world and raising their living standard through the development of beekeeping activities are bright [25]. Beekeeping has many advantages that help farmer beekeepers to improve their well-being. Its advantages can be itemized for the socio-economic impact of beekeeping. For instance, successful beekeepers raise their socio-economic standing in areas with subsistence agriculture, and farmers in developing countries can substantially supplement the family income, sometimes even double it. 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 increased. The results of surveys in other countries showed that, role of honey bees in increasing of the agricultural crop was about 69 to 143 times of their direct production. 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) [10]. According to FAO^[6], Iran by 45000 ton of honey production respectively after China, Turkey, USA, Ukraine, Argentina, Mexico, Russian Federation as a 8th country. The honey production value in Iran approximately is about 3.5 tones according to FAO report [7]. Beekeeping is a promising non-farm activity for the rural households in Iran. It contributes to the incomes of households and the economy of the nation. The direct contribution of beekeeping includes the value of the outputs produced such as honey, bee wax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine [12]. It also provides an employment opportunity in the sector. The exact number of people engaged in the honey sub-sector in Iran is not well known. However, it is estimated that around one million farm households are involved in beekeeping business using the traditional, intermediate and modern hives [11]. *Apis mellifera* and *Apis cerana* have evolved in distinct ecologies; their social organization as well as mating behavior has been successfully shaped by their respective ecosystems. The Eastern honeybee, *Apis cerana* is indigenous to Asia and is an important pollinator for Asian ecosystems; the Western

honeybee *Apis mellifera*, has been introduced to Asia because of its high honey yields. These two species are now sympatric and share a similar environment [29]. The success of beekeeping depends upon some basic factors such as suitable climatic conditions, bee forage, bee management and bee breeding. The combinations of these factors lead to better honey and beeswax production [9]. Beside better strains of bees and their appropriate management, production of honey also depends upon the bee floral resources available within the flight range of bees. Various climatic and ecological factors also affect the production and availability of nectar to the honeybees. Thus, abundance and richness of nectar and pollen resources around an apiary is quite important for the success of beekeeping in an area [13, 18]. Pollen is practically the sole source of proteins, lipids, minerals and vitamins that are needed by the honey bees for the production of larval food and for the development of newly emerged bees; whereas nectar a source of energy is rewarded to the bees in return for their indispensable services in cross pollination [28]. Very little efforts have, however, been made so far to quantify the income and employment contributions of beekeeping in the southern districts of central Alborz mountain range in Iran, where this enterprise is becoming popular in rural area. Besides illustrating income and employment benefits of beekeeping, it is also necessary to quantify contribution of important inputs, such as number of hives, colony strength (number of frames/hive) and labor days employed in increasing the honey production per year.

1.3 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^[10]. 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 *A. 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. Iran has considerable potential in beekeeping with her rich flora, good ecological conditions and existence of colony. However, the beekeeping sector in Iran has not yet sufficiently utilized the rich natural resources. 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. 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 FAO [7]. Beekeeping has long history in Iran. Honey bee has important role of pollination in different agriculture products. Honey production and other products of honey bee industry have less importance of pollination value in agricultural products. Alborz province has desirable climate and pastures for

beekeeping. According to the statistics of Agriculture Ministry, Alborz province has had 400 beekeepers and 33600 colonies in 2012^[20]. Agriculture section has a specific situation among economical sections in Iran. Alborz province is one of the most important poles of agriculture. Apiculture is one of the agricultural majors that their production has a significant share in this province revenue. 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 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.

2. Materials and Methods

The studies were made during 2014-2016 in order to know the current status of several traditional and modern beekeeping technologies in district Karaj of Iran. These studies were mainly based on household survey of beekeepers for which a representative sample of farmers with different socio-economic background was selected from different counties of district Karaj in Alborz province. The study population consisted of households rearing honey bees (apiaries) in these areas. According to the regional Agriculture Offices and Local Deputy of Animal Affairs, Ministry of Agricultural Jihad in Alborz province, the lowest administrative unit is a county/cell/zone, several counties/cells/zones constitute block and several blocks constitute a Sub-county or city division for districts with a city status such as Karaj. A total of 225 households rearing honey bees (apiaries) were interviewed, 24 from Karaj division, 24 from Asara division, 6 from Garmdarreh division, 12 from Kamalshahr division, 15 from Mahdasht division, 12 from Meshkindasht division, 15 from Mohammadshahr division, 12 from Zibadasht division, 24 from Kalak & Hisar division, 9 from Azimiye division, 9 from Aderan division, 21 from Hesarak division, 18 from Baghestan division, 9 from Mehrshahr division, 6 from Nesa division and 9 from Hyderabad division. Karaj County is located Equator at 35°50'8" N and 51°0'37" E (Figure1). For sample selection purpose, all the blocks in each of the four divisions were classified into four groups according to size of total landholding by the majority of households (above 0.20 ha: between 0.120 and 0.20 ha: between 0.0425 and 0.120 ha: and 0.0425 ha or less). Accordingly, to the Regional Agricultural Jihad offices (administrative assistants) in Alborz province were asked to provide lists of all households rearing livestock (honey bees, apiaries, queen rearing farm) in their parishes of jurisdiction. Based on these lists, the interviewed households were selected randomly. Accordingly, the required data were collected, between April and December, 2014. Collected data were tabulated using Excel software and data were analyzed using Statistical package for Social Scientists (SPSS 16.0). In this study, the below econometric model has been developed in order to estimate the effect of change in the number of old hive (traditional) and new type hives (modern) on the honey production and estimate Economic Efficiency between Modern Beekeeping with *Apis mellifera* L. and Traditional Beekeeping with *Apis cerana* F. in Karaj district in Alborz province.

$$\ln BU_t = \beta_0 + \beta_1 \ln ES_t + \beta_2 \ln YN_t + u_t$$

BU: annual honey production, ES: number of old hive (traditional), YN: number of new hives (modern) and LN: Natural logarithm.

2.1 Description of the Study Area / Altitude and Climate

The study was conducted in the Karaj district in central Alborz province (Figure1). Alborz province is one of the 31 provinces of Iran, centered in Karaj. Alborz province was formed by division of Tehran province into two provinces after the Parliamentary approval on June 23, 2010, and was introduced as 31st province of Iran. In 2014 it was placed in Region. Alborz is surrounded by Mazandaran in the north, Markazi in the south, Qazvin in the west and Tehran in east. Situated northwest of Tehran, the province of Alborz has 4 counties, Karaj, Savojbolagh, Taleghan and Nazarabad. Karaj is the seat of the province. Alborz province is situated 20 km west of Tehran, at the foothills of the Alborz Mountains, and is Iran's smallest province in area. The city has effectively become an extension of metropolitan Tehran. The county is subdivided into two districts: the Central District and Asara District. The county has sixteen cities: Karaj, Asara, Garmdarreh, Kamalshahr, Mahdasht, Meshkindasht, Mohammadshahr, Zibadasht, Kalak & Hisar, Azimiye, Aderan, Hesarak, Baghestan, Mehrshahr, Nesa and Heydarabad. Apart from arable crops, and livestock production in the area, melliferous flora is common in the area under study. There are a lot of weed climbers and ornamentals which are plants visited by the honeybees, the common tree plants include *Medicago sativa*, Yellow sweet clover, *Robinia pseudoacacia*, *Centaurea Montana*, *Lepidium sativum*, *Silene vulgaris*, and *Dactylus glomerata*, pinto peanut *Arachis pintoi*, chickweed *Stellaria spp*, Thymus vulgaris *Labiatae*, *Astragalus brachycalyx* and *Astragalus susianus*, *Tamarix gallica*, etc. Apart from these, fruit trees like apple, pear, fig, apricot, cherry, peach, grape, sunflower, bell pepper, tomato, cabbage, lettuce, carrot, cucumber, saffron, forage corn, oil seeds and nectar plants, etc. are scattered around the area which provide good flora for bees^[15]. The state of Karaj (35° 50' 8" N, 51° 0' 37" E) represents one of the most important beekeeping area in Iran (Figure4). District Karaj altitude is 1,312 m (4,304 ft). The annual rainfall is 262 mm. Such diversity of geographical features plays a dominant role in determining the topography, climate and plant species present in the region. It offers great potential for both migratory and non-migratory beekeeping.

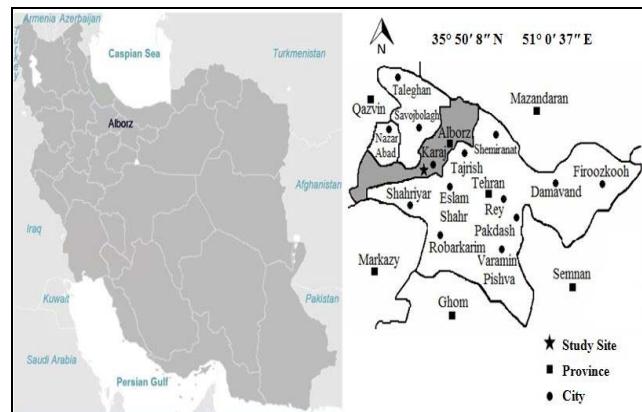


Fig 1: Map of Iran and the study area of Karaj district in Alborz province

The area is home to four species of honey bee: the native species *Apis mellifera meda* Iranian honeybee, *Apis mellifera* L. and the exotic two species *Apis mellifera florea* and *Apis mellifera carnica*. The major type of honeybee races used in country is the indigenous honeybee *Apis mellifera meda* and the imported hybrid bees, *Apis mellifera carnica* and *Apis*

florae is one the main four species of existing honeybees in Iran, which is found greatly or abundantly in provinces of Iran [22]. All four species coexist without competition for resources. But the Asiatic honeybee, *Apis cerana* F. is not adopting apiaries by the beekeepers in provinces of Iran. However, beekeeping is not well organized and exhibits various degrees of development. Surprisingly, despite the great potential, beekeeping is still considered as a small-scale cottage industry. Honey production (% share) in the different districts of Karaj state in Alborz province is given in (Figure 2). For the selection of sample of traditional beekeeping practices in different parts the district Karaj of Iran, the criteria for the selection of appropriate study sites were remote areas of district, where farmers were experiencing productivity problems. Farmers were trying to improve productivity by various ways and means. These were a partner institution willing and interested to carry out the survey and assistances in this area. Keeping these criteria in mind and through meeting with farmers and local leaders, government officials and agricultural extension workers we selected the district Karaj to conduct case studies on traditional beekeeping techniques and related problems. For production function and comparison, some private apiaries and horticulture center were chosen. According to the statistics of Agriculture Ministry, Alborz province has had 400 beekeepers and 33600 colonies in 2014-2015^[20]. In 2006-2007 another survey was conducted to determine the status of *Apis cerana* F. in Kohgiluyeh and Boyer-Ahmad province of Iran. The survey revealed very encouraging results. More than between 800 and 900 colonies were found in different areas in Kohgiluyeh and Boyer-Ahmad province of Iran, in both modern and traditional hives^[16]. Despite the suitability of climatic conditions for life of bee species *Apis cerana* hybrid in Alborz province region, by now not any comprehensive study on these bees *Apis cerana* F. have been done. Before this, just there was one record of *Apis cerana* F. in Kohgiluyeh and Boyer-Ahmad province^[16]. 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^[26]. 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^[20, 26] (Figure 5). A more recent survey districts of Karaj conducted in 2014-2016 has again given interesting results. Over 3000 *Apis cerana* F. colonies were recorded in the region (Table 1). A recent survey of district Karaj has shown the presence of 9000 European honey bee colonies *Apis mellifera* L. in the different districts of Karaj in Alborz province (Table 2).

3. Field survey and statistical analysis

The data prepared for the present study is primary as well as secondary in nature. Primary data was collected with the help of a questionnaire prepared for this purpose, and final questionnaire was prepared related to socio-economic condition of the beekeepers. Primary data was collected after discussing the questionnaire with various beekeepers in different parts of the district based on their personal interviews. Data so collected was statistically analyzed and inferences were drawn. Data were analyzed using Statistical Package for Social Scientists (SPSS 16.0). Informations were taken on following aspects; socio-economic profile, beekeeping experience, managing level, occupations, and technologies contents: colony age, occupancy rate, honey production, constraints. The questionnaire was pre-tested on (10% of sample size) respondents in study area. As a result of the pre-testing necessary revision of the questionnaire was done. The secondary data (honey production) was collected from different agencies like Directorate of Agriculture Research and Education Organization of Alborz province (AREO), Agricultural Planning Economic and Rural Development Research Institute (APERDRI), Agricultural and Natural Resources Research center of Alborz (ANRR) and Department of Honeybees, Animal Sciences Research Institute Karaj of Iran (ASRI). Elaborate interactions were made with the district and State level officials of beekeeping department of government of Iran. The main limitation of this study was mainly related to coverage of the study area. However, the study focused only in Karaj district due to budgetary and time limitations. The other limitations of the study were that, this study being the first in the District lack many detailed investigations. The study shows that in general the people engaged in beekeeping are males aged between 23 and 70 years and most (76.9%) are between 30 and 60 years. The public service and retired represent 13.6% of the total number of beekeepers. Beekeeping is a main source of income to beekeepers who own more than 101 colonies and a secondary activity for the other group (Table 3).

Table 1: Distribution of *Apis cerana* F. colonies in the districts of Karaj state in (2014-2016)

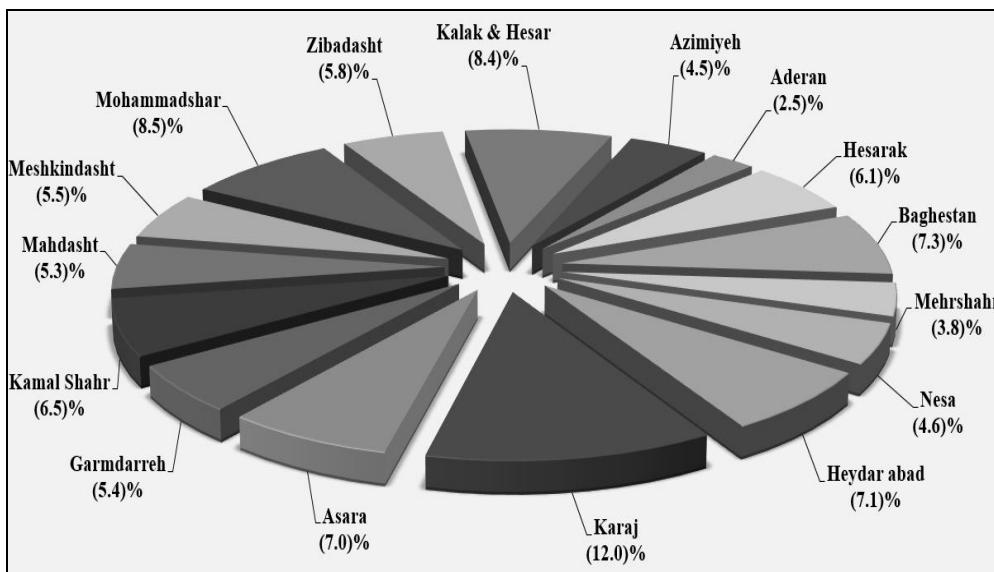
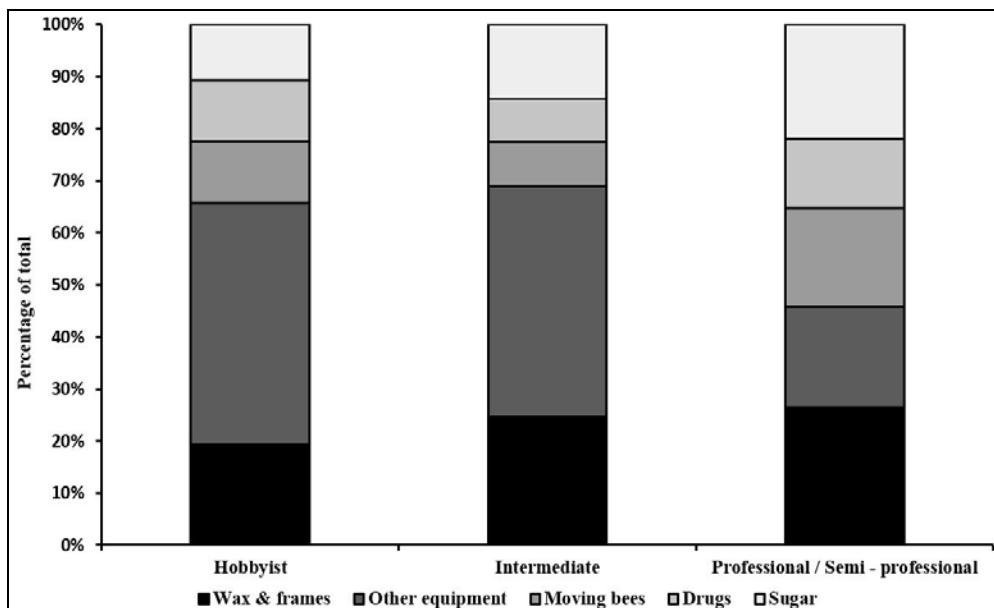
Province	District	Colonies (N)
Alborz	Karaj	500
	Asara	300
	Garmdarreh	450
	Kamalshahr	85
	Mahdasht	170
	Meshkidasht	260
	Mohammadshahr	145
	Zibadasht	150
	Kalak & Hisar	200
	Azimiye	140
	Aderan	65
	Hesarak	280
	Baghestan	400
	Mehrshahr	173
	Nesa	37
	Heydarabad	160
	Total	3515

Source: Field survey, 2014 - 2016

Table 2: Distribution of *Apis mellifera* L. colonies in the districts of Karaj state in (2014-2016)

Province	District	Colonies (N)
Alborz	Karaj	1500
	Asara	850
	Garmdarreh	750
	Kamalshahr	260
	Mahdasht	350
	Meshkindasht	380
	Mohammadshahr	280
	Zibadash	460
	Kalak & Hisar	800
	Azimiye	240
	Aderan	145
	Hesarak	380
	Baghestan	1000
	Mehrshahr	250
	Nesa	145
	Heydarabad	280
	Total	8070

Source: Field survey, 2014 - 2016

**Fig 2:** Honey production (percentage share) in the districts of Karaj during 2014-2016.**Fig 3:** Total expenditure for the average Karaj beekeepers (16 zones) expressed as percentage classes.

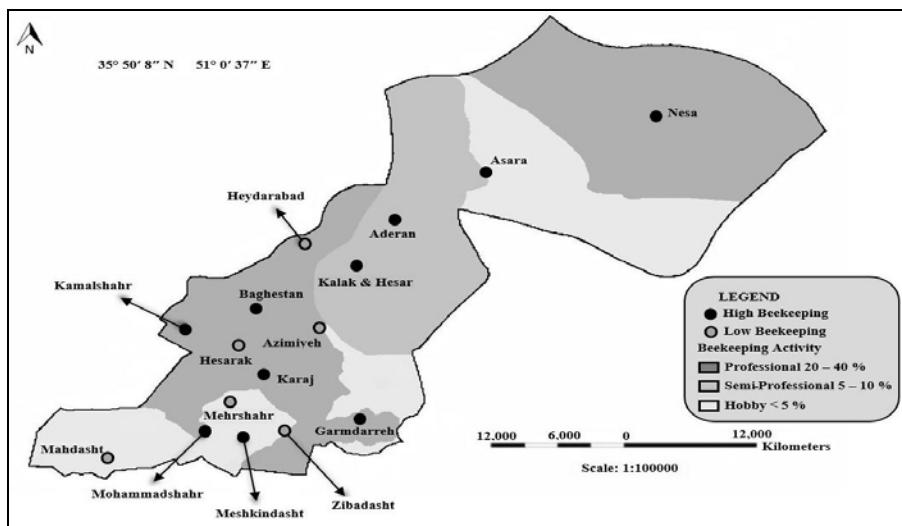


Fig 4: Location of study sites and beekeeping populations in areas with high and low and percentage of the different types of beekeeping operations in Karaj County (16 zones) during 2014-2016.

Table 3: Number of Karaj beekeepers expressed as percentage classes depending on age, profession, managing background level & specialization on beekeeping and beekeeping practical experience.

S. No.	Indicators	Number of honeybee colonies			Overall average
		1 – 50	51 - 100	101 +	
1.	Age of beekeeper				
	< 30	6.8	-	-	6.8
	30 – 60	81.2	66.7	73.9	76.9
	> 60	12.0	33.3	26.1	16.3
2.	Profession				
	Farmer	22.2	8.4	22.7	18.9
	Apiculture	24.8	39.1	42.6	29.9
	Public service + retired	14.3	6.9	25.5	13.6
	Other agr. activities	38.7	45.6	9.2	37.6
3.	Managing background level & Specialization on beekeeping (years)				
	1 – 4	15.3	1.8	3.6	11.9
	5 – 8	25.1	17.8	58.6	26.8
	≥ 12	58.6	81.4	37.8	61.3
4.	Beekeeping practical experience (years)				
	< 5	16.1	5.4	1.8	12.3
	6 – 10	15.7	2.5	5.4	11.7
	> 10	68.2	92.1	92.8	76.0

Source: Field survey, 2014 - 2016

4. Results and Discussion

Economic efficiency of modern beekeeping with *Apis mellifera* L. in district Karaj of Iran was carried out using data from 16 zones (Karaj, Asara, Garmdarreh, Kamalshahr, Mahdasht, Meshkindasht, Mohammadshahr, Zibadasht, Kalak& Hisar, Azimiyeh, Aderan, Hesarak, Baghestan, Mehrshahr, Nesa and Heydarabad in the season 2014-2016. Technical and economic aspect of beekeepers are given under three Sub-groups by number of colonies (hobbyist beekeepers with 1-50 colonies, intermediate beekeepers with 51-100 colonies and professional beekeeper more than 101 colonies). Equipment expenses almost half of the total cost for hobbyist and intermediate beekeepers and approximately 22% for professional/semi-professional beekeepers, labor cost excluded (Figure3). One modern beekeeper can manage on an average 96.25 (hives) colonies per apiary. Research on traditional beekeeping with *Apis cerana* F. was carried out on 225 households in the same season. One household managed colonies with a maximum 60 (hives) colonies per household (Table 5). To find out the economic efficiency of these two systems, production costs, gross production value, production cost per unit are the major indicators. In Modern Beekeeping

equipment cost comprised of beehives, honey extractor, Smoker, queen catcher, veil etc. but in case of Traditional Beekeeping no such type of equipments are used. They used only local and household man-made things, such as hollowed logs, reed grass hive, mud (clay) hive, log hive (from tree trunk) discarded packing boxes (used) in place of beehives. Traditional clay hives and basket hives woven from willow are still used in some areas. Clay hives are housed inside clay bee houses, with their entrances opening to the outside (Figure 6-7). This arrangement protects the bees from cold in winter and heat in summer, and they are almost without cost. Sugar feeding is a necessity of Modern system in winter and shortage of bee forage season (drought) but in case of beekeeping with *Apis cerana* F. feeding is little required because they can survive easily as they are native of this area and spend thrifty. No transportation (seasonal migration) is required in Traditional system because they have fixed frame/combs with in hives or boxes. Beekeepers of Karaj district migrate their Modern Beekeeping colonies for seasonal migration in winter and Shortage of bee forage season (drought) to Asara, Kalak& Hisar, Garmdarreh, Nesa and Baghestan which requires lots of investment. Further, 2.5

days/hive/year labor is required for managing 60 hives in Traditional system of beekeeping. Whereas one person is engaged for 6 months and 15 days for managing a modern apiary (96.25 hives) with *Apis mellifera* L. Total days of laborer per hive for Modern Beekeeping required on an average are 4.50 days per hive/year 80,000Rial/day (Rial is Iran's monetary unit). Total capital interest is 17 % interest on production cost of both systems. Traditional beekeeping with *Apis cerana* F. was shown to be more economical than beekeeping with *Apis mellifera* L. We calculated that 60 *Apis cerana* F. colonies (total capital investment just Rial1595.65) would show higher ratio of economic benefit over keeping 96.25 colonies of *Apis mellifera* L. colonies (total capital investment Rial47923.13, i.e. Rial4979.0 for 96.25 colonies). Therefore, beekeeping with 60*Apis cerana* F. colonies seems to be economically better then beekeeping with 96.25 hives of *Apis mellifera* L. colonies. *Apis cerana* F. beekeepers can begin with only a few colonies. Even under low input condition they can be developed to 20-60 colonies. With *Apis mellifera* L. it is not feasible to have a low input and small number of colonies because there will not be sufficient income to cover overheads like apiary/colony migrations. Bees suitable for commercial /migratory mode, beekeeping with *Apis mellifera* L. gave higher annual profit of Rial (766.70/colony) as against Rial (566.10/colony) with *Apis cerana* F. Beekeeping with *Apis cerana* F. is however, less prone to risks then with *Apis mellifera* L. Shortage of bee forage season (drought) and under adverse climatic condition, poor forage etc. *Apis cerana* F. beekeepers had minimal loss as compared to *Apis mellifera* L. beekeepers. *Apis cerana* F. has been well adapted to the native flora and can take advantage of early honey flows *Apis cerana* F. seems to have more diversity in the local region than *Apis mellifera* L. which allows for diverse proliferation through breeding.

Regarding educational status in the district of Karaj state during 2014-2016 among the sample respondent 8% had not received any education, while 37.7% percent had received Diploma. Regarding their educational backgrounds, 20% had attended high school and 16.8% know to read and write, and the remaining 11.1% and 6.2% have completed Bachelor and Master of science respectively (Table 4).

Table 4: Educational Status of the apiaries Karaj (Iran) during 2014-2016

S. No.	Indicators	Total sample (N=225)	
1.	Educational Status	N	%
	Illiterate	18	8
	Read and Write	38	16.8
	High School	45	20
	Diploma	85	37.7
	Bachelor of Science	25	11.1
	Master of Science	14	6.2

Source: Field survey, 2014 - 2016

5. Conclusion

The number of colonies which can be managed by one laborer is higher in *Apis mellifera* L. then *Apis cerana* F. beekeeping. For *Apis cerana* F. a worker spent just 2.5 day/colonies, whereas 195 days per Apiary (96.25 colonies) in one season were spent in *Apis mellifera* L. colony. Because traditional beekeeping with *Apis cerana* F. system due to fixed nature of

combs there is no need to give extra attention to hives. This system has been passing on from generation to generation since long time. So, every person of the family knows how to care for it. By comparison the production cost per kilogram of honey in both systems, comes under Rial 24.89 in Modern system, whereas just Rial 2.99 in case of Traditional system. Production cost per hive in modern system was Rial 497.90 and in traditional system 26.59 Rial. When we see the ratio of profit, income and production value against production cost they are highly significant (20 % more beneficial in Traditional over modern system in all studied parameters). However, if the total /absolute annual income/profit is considered there is no match of beekeeping with *Apis mellifera* L. by *Apis cerana* F. beekeeping. *Apis cerana* F. colonies would survive anywhere in district Karaj because they were adapted to the area. *Apis mellifera* L. colonies were needed to be kept in suitable forage area (needed migration) and required considerable management and investment. *Apis mellifera* L. beekeeping is usually a full time profession, whereas for *Apis cerana* F. beekeeping the activities can remain optional. One beekeeper working full time can become rich with *Apis mellifera* L. while another working with *Apis cerana* F. can obtain a useful sideline income. Magnitude Beekeeping with *Apis cerana* F. may decrease but *Apis mellifera* L. beekeeping can never take its place in this Karaj region. Beekeeping with *Apis cerana* F. should be persuaded in marginal areas for rural households with low investment capacity and *Apis mellifera* L. should be introduced for commercial beekeeping to high potential beekeeping zones or for individuals who can invest larger sums on its distance migration.

Compared to Modern Beekeeping these Traditional systems of Beekeeping have the following advantages in the context of the life and customs of the rural and tribal populations of Karaj region.

- There is lower input requirement in the form of sugar feeding and comb foundations and chemicals etc.
- *Apis cerana* F. native species in study areas has less food consumption than *Apis mellifera* L.
- Management of colonies is minimal and consisted of arrangements of attraction of swarms and harvesting of honey.
- *Apis cerana* F. has less sting and aggressive behavior than *Apis mellifera* L. species.
- Traditional beekeeping integrates itself with the prevailing customs and socio-economic conditions of the people and would conserve the biodiversity in bee fauna.
- Saving manpower and time while controlling the colonies in apiary.

Integration of the traditional method with the modern concept of movable frames would add to ease of management operations in the field making the modernized wall hive an eco-friendly, readily acceptable, economically viable and environmentally sustainable technique for the future. Traditional hives, in shape and their location are solid and significantly safe element of environment for this indigenous bee fauna.

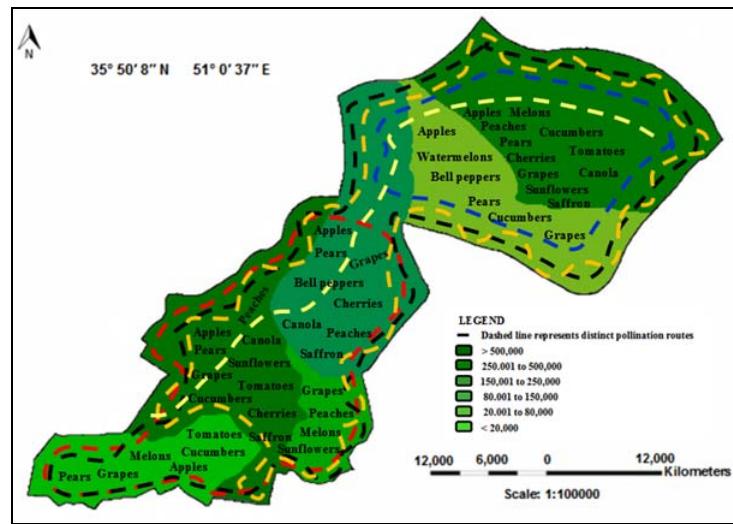


Fig 5: Total pollinated crop acres by Karaj county states and pollinator movement in the Alborz province in Iran
(Photograph by: Shakib. Vazirizabar).

Table 6: Major challenges encountered of beekeeping in Karaj district during 2014-2016

S. No.	Indicators	(N=225)
a.	Apiculture insurance problem & challenges	17%(2)
1.	Lack of insurance support and social secure insurance	2.5
2.	Lack of enough money for payoff premium	1.5
3.	Lack of commitment of insurance in observing its undertakings	1.5
4.	Less compensation payment than the real amount of damage	3.2
5.	Absence of insurance services for some products and high premium	2.2
6.	Failure to timely payment of compensation and high rates of insurance premium	2.2
7.	Lack of payment of compensation by the fund under certain circumstances	1.4
8.	Bottlenecks and hardships existing in current laws and regulations with regard to agriculture insurance (lack of employee sponsor for getting loan from insurance)	2.5
b.	Production problem & challenges	33%(1)
9.	Increase cost of production (migration cost, hired labor, fuel cost, etc)	12.8
10.	Lack of fund and low rate of selling price	8.5
11.	Absence of government support via surveillance on cost	2.5
12.	Lack of codifying support provision and inadequate government support	2.8
13.	Fluctuations in the price of inputs (drug and sugar)	6.4
c.	Technical problem&Low productivity challenges	4%(7)
14.	Deficiency of qualified queen and loss of queen genotype and poor quality queen	-
d.	Policy problem & Ecological disaster challenges	10%(5)
15.	Limited availability of bee forage (due to deforestation)	4.2
16.	Increasing use of pesticides and herbicides is severely threatening bee colonies implying conflicts of crop and honey production	2.5
17.	Honeybee mortality due to herbicides and spraying	3.3
e.	Environmental problem & challenges	8%(6)
18.	Absence or inadequate rainfall (drought) and climate changes in the region	-
f.	Marketing problem & challenges	13%(3)
19.	Lack of market information and poor access to international market	1.6
20.	Lack of access to credit services and market infrastructures in production areas	1.4
21.	Quality problem (adulteration) and illegal traders (honey collectors who might be added honey with sugar)	2.8
22.	Absence of organized market channel	1.4
23.	Existence of middleman and the absence of linkage between producer and buyers	3.5
24.	Lack of beekeepers bargaining power for honey selling and other products	2.3
g.	Managerial problem & challenges	3%(8)
25.	Problems in choosing suitable place and identification nectar plants used by honeybee, poor pre and post-harvest management	0.6
26.	Absence indigenous know how like swarm control and queen rearing	1.2
27.	Irregular immigration of other provinces beekeepers to Karaj districts	1.2
h.	Other problem & challenges	12%(4)
28.	Lack of enough and on time access of producer to something necessary like (effective drug and queen with proper price, etc)	3.2
29.	Honeybee diseases (<i>Varroa</i> mites) and Colony Collapse Disorder (CCD)	6.4
30.	Lack of training institutions and poor quality training	1.2
31.	Lack of communication between beekeepers and honeybee department of Karaj research	1.2
	Total	100.0

Numbers in parenthesis are according to beekeepers respondent which divides into the 8 following categories.

Table 7: Suggestions provided by the Karaj beekeepers (16 zones) in Alborz province, 2012-2014

S. No.	Indicators	Respondents (%)	
a	Suggestions beekeepers	Beekeeping (<i>Apis mellifera</i> L.)	Beekeeping (<i>Apis cerana</i> F.)
1.	Effort to increase efficiency of the insurance system and improvement of methods in offering insurance services.	65.5	12.7
2.	Commitment of insurance in observing its undertakings.	48.1	-
3.	Solving problem of producers in providing to collateral loan.	50	27.9
4.	Payment of compensation by the fund under certain circumstances and providing supportive facilities.	34.5	24.6
5.	Government support via surveillance on cost 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).	62.4	13.8
6.	Developing organized marketing channel starting from the local market to the central market to improve the quality, quantity and marketing of honey products.	53.9	15.4
7.	Codifying financial government support provision such as (warranty of purchasing honey and other products beekeeper) and elimination of middleman to market.	47.2	27.6
8.	Providing institutional supports, such as (credit, market information) and production insurance support.	61.4	9.2
9.	Controlling diseases and hive management and prevention of illegal migration unclean hives and lack of relocation a polluted hives have helped to decrease its spread from district to district and integrated pest management is recommended, breeding more tolerant bee strains and effective methods of biological control can be effective.	30.6	22.2
10.	Controlling adulteration (honey production and market center in Karaj District in Alborz province.	49.6	-
11.	Consideration of local conditions in technology selection and adoption and betterment training institutions.	-	26.8
12.	Developing bee pasture and stopping deforestation.	75.6	10
13.	Planting multipurpose and drought resistant honey bee flora.	44.6	-
14.	Prohibit utilization of pesticide poisoning and herbicides and preventing unseasonable spraying and take precaution.	52	16.8
15.	Certification for organic and management of quality standard and introducing better price for better quality products.	-	28.9
16.	Improving the efficiency of breeding queens.	40.6	6.8
17.	Improve sales by offering different sizes and styles of packaging.	-	15.4
18.	Improving bilateral communication among researcher and beekeepers.	24.7	-

Source: Field survey, 2014

**Fig 6:** The majority of the original traditional beekeepers in Iran's rural county still use log hives.**Fig 7:** Modern frame hives Iranian langstroth hive (ILH, top illustration), polystyrene open floor hive (middle illustration) and Wooden open floor (bottom illustration) used by Karaj beekeepers in Alborz province can permit colony management for high yield and good management.

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