

Original article

Beekeeping and honey production in Japan and South Korea: past and present

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ABSTRACT

Background: Bee honey is a main ingredient in traditional food culture in different regions of the world. Honey is widely utilized as an ethnic food item.**Methods:** This paper analyzes the historical and present status of beekeeping and honey production in Japan and South Korea based on the relevant literature and statistical data.**Results:** The findings reveal that Western honeybees are dominant in the two countries for economic and physical reasons. Honey production has declined and the amount of imported honey has increased in Japan and South Korea. The domestic and global honey markets closely influence reciprocally. Furthermore, urban beekeeping has emerged in these two countries as a hobby and an industry; it contributes to producing domestic honey and enhances the quality of the environment.**Conclusion:** To ensure sustainable forestry and conserve biodiversity, native beekeeping is necessary. This paper provides insight into beekeeping and honey production in Japan and South Korea.© 2017 Korea Food Research Institute. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Beekeeping has been historically practiced in various places as a part of the local food culture, as well as an activity related to the production of pollinators. For example, in countries such as Japan [1], Korea [2], and India [3], honey is a major element of food culture. Therefore, preserving beekeeping and honey production can greatly contribute to maintaining food culture.

Sustainable beekeeping requires overseeing the landscape. For example, the genetic diversity of Japanese bees correlates with landscape features such as cities and paddy fields [4]. In the case of South Korea, the number of native bee colonies is positively linked with the ecological soundness of forest ecosystem management [5].

In maintaining and developing local food culture, it is necessary to operate beekeeping in such a way that it produces food culture and helps govern the regional environment in an integrated manner. The idea of integrated management is included in Globally Important Agricultural Heritage Systems (GIAHS), a concept created by the Food and Agriculture Organization [6]. GIAHS is composed of components that include society, cultural activities,

the local environment, and products in social and ecological landscapes. GIAHS is closely related to preserving beekeeping, and stresses traditional knowledge cultivated in a regional setting. Regarding traditional knowledge of beekeeping, case studies are being conducted in South Korea [5]. Passing on traditional knowledge that contributes to environmental conservation, including the protection of regional forests, is an urgent issue worldwide. Pollination and its related knowledge are gaining salience, as symbolized in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) thematic report on pollination in 2016 [7].

In terms of the relationship between bees and the environment, there is a concern that the number of bees will decline due to infectious diseases and pesticides. In Japan, the influence of recent pesticides is decreasing the number of bee colonies [8]. In addition, the introduction of exotic species has posed a threat to specific species at the local level, thus threatening nectar sources. Furthermore, diseases brought by alien species can also affect endemic ones [9]. The rise in diseases and pesticides, and the international trade of bee honey and other related products are affected by beekeeping in each region. Those circumstances largely influence the quantity of bees in different regions of the world [10].

To explore the idea of sustainable beekeeping with international cooperation, as beekeeping in each country has cross-border influence, it is necessary to understand the past processes that

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regulate current beekeeping, and to share international information. In this paper, we focus on beekeeping in two Asian countries: Japan and South Korea. After reviewing historical developments of beekeeping in each country, we analyze the contemporary situation.

The meaning of beekeeping and the demand for honey have changed over time, which reflects a shifting food culture. This paper examines future challenges and the potential for beekeeping in each country, and aims to contribute to the sustainable development of beekeeping by promoting international partnership. In the next section, we will present the historical background of beekeeping in each nation.

2. Traditional beekeeping and honey production

2.1. Japan

In Japan, the oldest record of beekeeping and honey production can be traced back to the 7th century in *Nihon Shoki*. At that time, beekeeping is thought to have been regarded as a magical activity. There is a record that a historically important person released bees on Miwa Mountain, which is viewed as a mountain with anthropomorphic qualities [11]. Even today, Miwa Mountain is still a religiously important site.

Records of beekeeping have been scattered throughout the Middle Ages, and warfare caused many records to be lost. This is because during eras when the demand for luxury goods was low, honey from Japanese bees was abundant in terms of nutrition, but was produced on a small scale. Thus, production considered necessary for calorie intake and the cultivation of rice and other cereals were given priority. Starting in the Edo period, several manuals on beekeeping were published. These books include knowledge on how to harvest honey without killing bees and knowledge related to parting honey bee colonies (Fig. 1).

Japanese bees are characterized by low aggression, and they do not sting people even if they are touched by hand. A method of harvesting honey without killing bees was employed due to the low aggression of Japanese bees. It was a relatively rare way of beekeeping at the time, when old-style fixed nest boxes were

commonly used. Just before the Western honeybee was introduced, information on traditional Japanese beekeeping, including the abovementioned technique of honeying, was presented in books edited for the Expo in Austria in 1873 [11].

The Western honeybee transformed Japanese beekeeping at the end of the 19th century; beekeeping techniques were also introduced from the United States to Japan at the same time. Because of the difference in species, Western honeybees, which generate a high amount of honey, were more actively introduced than Japanese honeybees, which have low production. In the mid-20th century, after World War II, the demand for honey in the country increased, and production rapidly expanded by using Western honeybees [12].

Afterward, domestic honey production fell quickly due to the rise in imported honey. In recent years, honey production has remained at the same level against the background of the promotion policies surrounding beekeeping and the demand for domestic production.

2.2. South Korea

Beekeeping began around 2,000 years ago during the reign of King Dongmyeonseng of the Kokuryo Kingdom (BC 37–19) in Korea [13]. During the Chosun Dynasty (1392–1910), around half of the counties on the Korean Peninsula engaged in beekeeping [14]. Korean beekeepers have reared two species: (1) the oriental honeybee (*Apis cerana*), which includes native Korean bees; and (2) the Western honeybee (*Apis mellifera* L.), which is exotic and was first imported to Korea in the early 1900s [13]. By 2002, exotic bees accounted for 83% of beehives in South Korea [15]; currently, exotic bees are dominant there. Native species are usually kept deep in the mountains, whereas exotic species are kept on the outskirts of mountainous regions, including agricultural areas [16].

Honey is a valuable product for forest communities as food and medicine. According to Nongjeonhoiyo (who wrote about the subject in the 1830s), beekeeping contributes to the livelihood of forest communities [5]. In the 19th century, a beekeeper with 100 beehives could live comfortably and be rich, even if he did not have another job [5,17].

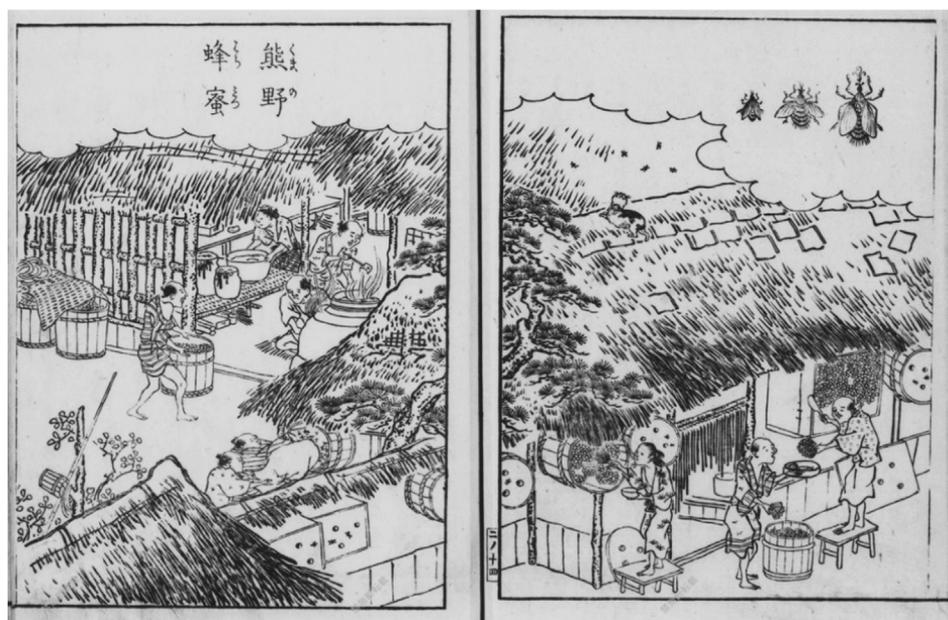


Fig. 1. Beekeeping in the Edo period using Japanese honeybees (*Apis cerana japonica*).

Note: From *Nihon Sankai Meibutsu Zue* (日本山海名物図会). Kochi Castle Museum of History (高知県立高知城歴史博物館). Japanese bees are characterized by low aggression, and they do not attack people even if they are touched. Because of their characteristics, distance between people and the bees are relatively close as described in the figure.

3. The present trend of beekeeping and honey production

3.1. Japan

Japanese honey today depends on Western honeybees. Japanese and Western bees differ greatly in several respects. Japanese honeybees are less likely to be used by those who make their living from beekeeping because they do not yield a lot of honey, and it is difficult to expand production due to Japanese bees' tendency to escape. However, the Japanese honeybee has characteristics not found in the Western one, such as resistance to disease, a response to hornets (heat-killing by enclosing) [18,19], and low aggression.

Western honeybees make several times the amount of honey that Japanese honeybees do; honey production in Japan was on a downward trend until 2005. Presently, the production of honey is relatively stable (Fig. 2).

However, current level is less than half of the level in 1985. Since 1985, Japan's honey consumption has depended on imported goods, and imports nowadays exceed 10 times the quantity of domestic production. Among the countries that import honey, China imports a relatively high amount (Fig. 2).

The output of beeswax and royal jelly has continued to fall compared with the production volumes of 1985 and 2005 (Fig. 3); furthermore, the amount of beeswax generated today is about half that of 2005. The rapid decline of these two products compared with honey shows that beekeepers are focusing on making honey, taking socioeconomic conditions (including domestic demand) into account.

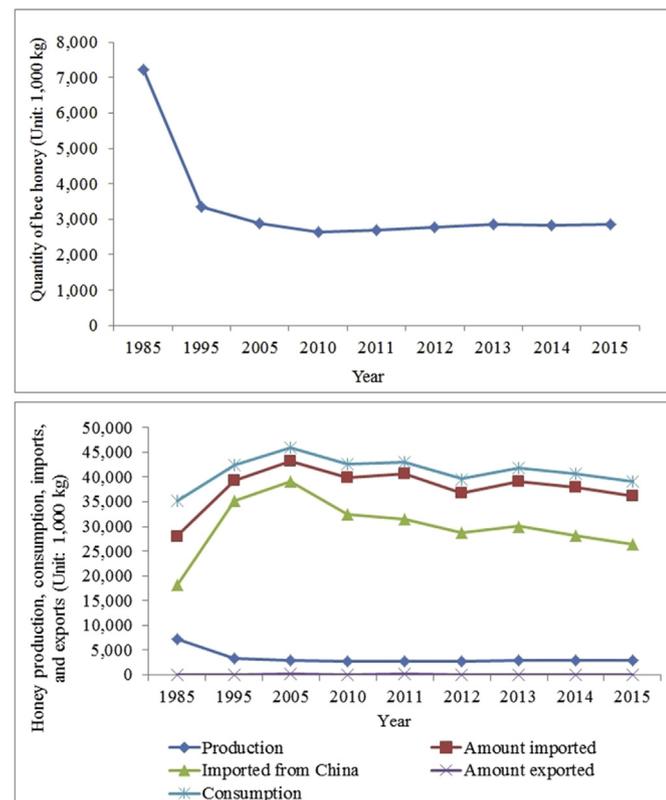


Fig. 2. Honey production, consumption, imports, and exports in Japan.

Note. From "Current trend of beekeeping [Internet]," by Ministry of Agriculture, Forestry and Fisheries (MAFF), 2016. Tokyo (Japan): MAFF [cited 2017 March 3]. Available from: <http://www.maff.go.jp/j/chikusan/kikaku/lin/sonota/attach/pdf/bee-3.pdf>. [In Japanese] [20]. As a recent trend, the amount imported gradually decrease and amount of production is stable from the year 1995.

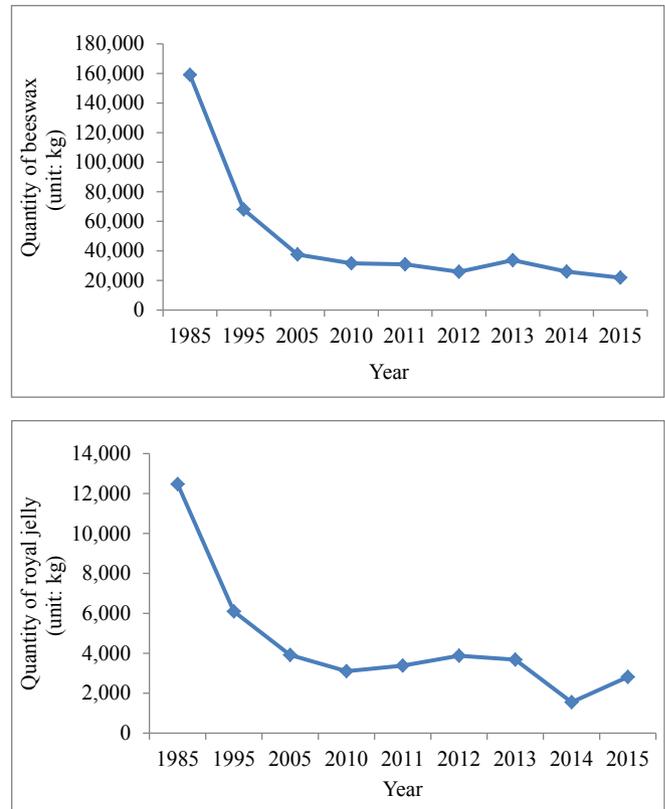


Fig. 3. Beeswax and royal jelly production in Japan.

Note. From "Current trend of beekeeping [Internet]," by Ministry of Agriculture, Forestry and Fisheries (MAFF), 2016. Tokyo (Japan): MAFF [cited 2017 March 3]. Available from: <http://www.maff.go.jp/j/chikusan/kikaku/lin/sonota/attach/pdf/bee-3.pdf>. [In Japanese] [20]. The amount of beeswax and royal jelly production is decreasing continuously, as compared with the amount of production of bee honey.

With the downward trend of beekeeping products (including honey), the number of households with beekeepers in 2016 is about the same as it was in 1985, and the number of groups is smaller than in 1985, but higher than in 2005 (Fig. 4).

There is a limitation in that the definition of statistical data is not exactly comparable among different periods. However, although the quantity of beekeeping products is declining, people who work in the industry might remain stable for the next 30 years.

The fact that production is falling is considered given that the number of households with beekeepers who are capable of large-scale production is decreasing. As of 2016, the number of groups per beekeeper household was about 65% that of 2005.

Like beekeeping products, nectar sources have also tended to fall, especially oranges, which are decreasing sharply. Among the main sources of nectar, the reduction speed of acacia is relatively slow compared with other sources (Fig. 5). As of 2015, oranges were not necessarily the most productive source of nectar because the ratio of the honey farm lands and the amount of honeybees that can access each honey source depend on the types of nectar sources. Honey from Nagano Prefecture, which yields the most honey, mainly uses acacia as a nectar source.

The aforementioned statistical data on beekeeping in Japan show that while beekeeping products and honey sources are falling in Japan, the number of small-scale beekeepers is rising. In addition, the historical overview in the "Traditional Beekeeping and Honey Production" section clarified the starting point of the

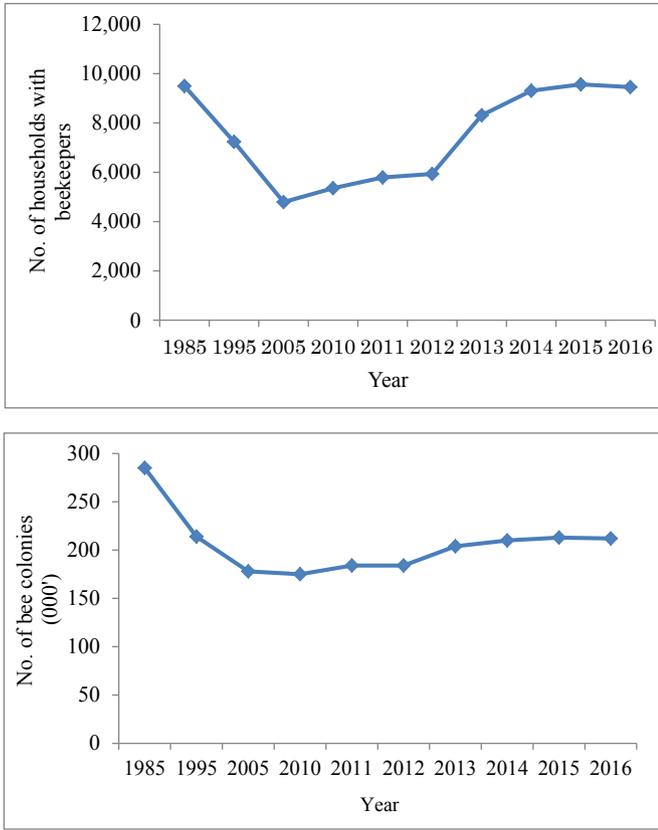


Fig. 4. Number of households with beekeepers and bee colonies in Japan. Note. From “Current trend of beekeeping [Internet],” by Ministry of Agriculture, Forestry and Fisheries (MAFF), 2016. Tokyo (Japan): MAFF [cited 2017 March 3]. Available from: <http://www.maff.go.jp/j/chikusan/kikaku/lin/sonota/attach/pdf/bee-3.pdf>. [In Japanese] [20]. The number of households with beekeepers and bee colonies is gradually increasing, and this trend is in contrast to the trend of the production of bee honey and other related products.

structural changes in Japanese beekeeping. Since the end of the 19th century, when the Western honeybees were introduced, Japanese beekeeping has shifted dramatically.

3.2. South Korea

Like Japan, in South Korea, current honey production depends on Western honeybees. There are some reasons for the dominance of Western bees [5]. Native beekeeping is a stationary practice, while exotic beehives can be relocated each season in search of a wide variety of nectar sources. Native bee honey is typically harvested once a year, whereas exotic bee honey is harvested several times a year. Native bees are smaller than exotic ones, which tend to attack the former.

Domestic honey production has risen and fallen repeatedly. The quantity of honey production has gradually increased, peaking at 30 million kg in 2003 (Fig. 6). However, it fell sharply due to the crop failure of black locust-based honey [21], which accounts for 70% of honey production in South Korea; after overcoming crop failure, it rose again and peaked at 38.5 million kg in 2010. Between 2011 and 2013, it declined by 24.6 million kg.

The value of honey production was around US \$100 million in the early 1990s. In 1998, it declined to US \$54 million, and in 2007, it rose to US \$535 million (Fig. 7).

South Korea has been exporting honey since 1982. Until 2006, the annual amount of exported honey was under 10,000 kg. In 2013, it peaked at 77,000 kg (Fig. 8). Considering the quantity of honey production and the amount of exported honey in 2013, 99% of all honey produced in South Korea is consumed domestically. Honey has been imported since 1963. Until 1994, the annual amount of imported honey was under 50,000 kg. Since 1995, the imported quantity of honey has grown and peaked at around 1.2 million kg in 2005. The sharp increase in imported honey may have been caused by the failure to harvest it in 2004.

Since 1961, the total number of beehives has gradually risen (Fig. 9). Starting in the late 1990s, this figure increased rapidly and peaked at 2,089,762 in 2005. However, it declined to 1,531,609 by 2011. The number of beehives of *A. cerana* has continuously fallen

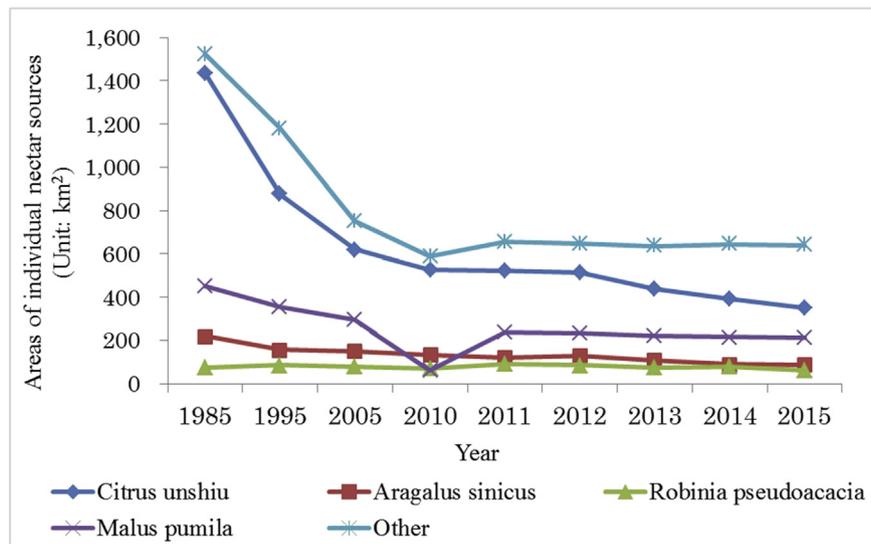


Fig. 5. Areas of individual nectar sources in Japan. Note. From “Current trend of beekeeping [Internet],” by Ministry of Agriculture, Forestry and Fisheries (MAFF), 2016. Tokyo (Japan): MAFF [cited 2017 March 3]. Available from: <http://www.maff.go.jp/j/chikusan/kikaku/lin/sonota/attach/pdf/bee-3.pdf>. [In Japanese] [20]. Beekeeping in Japan depends on diverse nectar sources, and areas of “other” sources are stable from the year 2010, although orange as nectar source is decreasing.

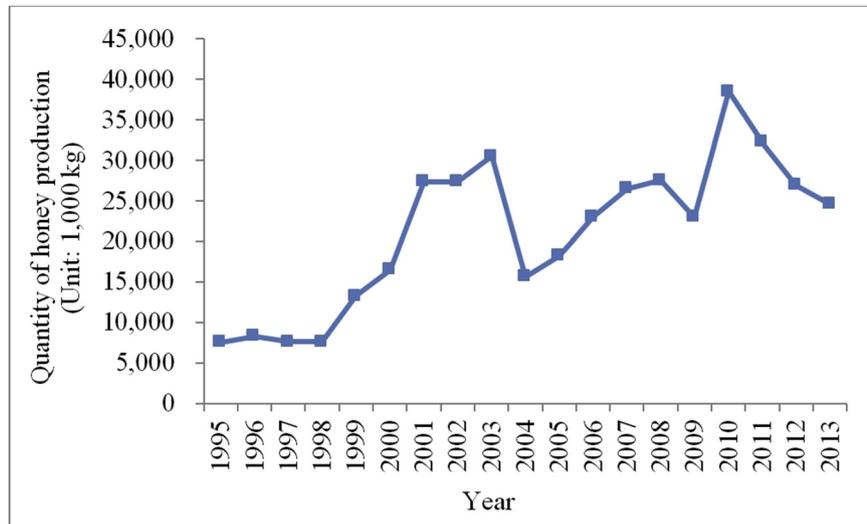


Fig. 6. The quantity of honey production in South Korea.

Note. From "2013 Food balance sheet [Internet]," by Korea Rural Economic Institute, 2014 [cited 2017 May 8]. Available from: http://library.krei.re.kr/dl_images/001/038/E05-2014.pdf. [In Korean] [22].

(Fig. 10). The number of beehives of *A. mellifera* grew from 1996 to 2005, then declined and slightly increased in both 2006 and 2015.

Since 1996, the number of total beekeepers (beekeeping households) has gradually fallen (Fig. 11). The number of total beekeepers peaked at 45,131 in 2002 and declined to 19,387 in 2011. The overall number of total beekeepers rearing more than 300 beehives was 93 in 1996, and rose to 2,788 in 2015 [24]. The number of beekeepers of *A. cerana* (native species) has continuously decreased. The number of beekeepers of *A. mellifera* (exotic species) grew from 1996 to 2002, declined starting in 2003, and rose once again starting in 2011. Between 2010 and 2011, the numbers of both total beekeepers and beekeepers of native bees fell rapidly.

As shown in the figures, there is a trend in which the number of beehives rises and the number of beekeepers falls over time in South Korea. The ratio of beekeepers with small-scale businesses (under 50 hives) decreased from 94.9% in 1990 to 45.9% by 2015, whereas the ratio of beekeepers with large-scale operations (over 300 hives) expanded from 0.024% in 1990 to 12.4% by 2015

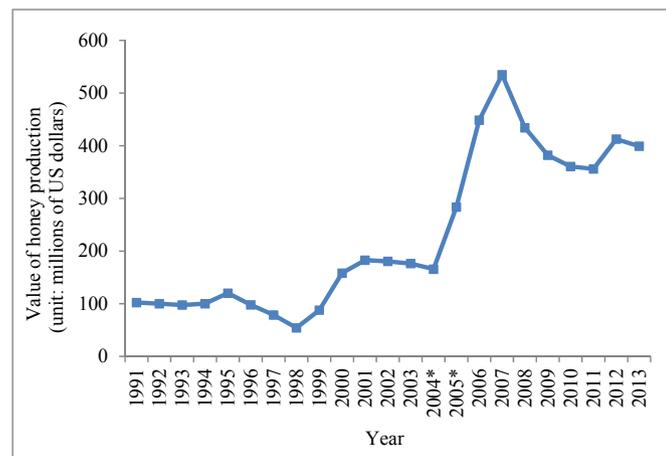


Fig. 7. The value of honey production in South Korea.* The estimated value by the FAO. Note. From "FAOSTAT [Internet]," by FAO. Geneva (Switzerland): FAO [cited 2017 May 8]. Available from: <http://www.fao.org/faostat/en/> [23].

(Table 1). The ratio of beehives with small-scale businesses declined from 66.1% in 1990 to 8.5% by 2015, whereas the ratio of beehives with large-scale operations rose from 1.1% in 1990 to 34.7% by 2015. This change indicates that since 1990, the size of beekeeping enterprises has grown in South Korea.

Buckwheat (*Fagopyrum esculentum*) was a major honey plant in the 1960s. However, in the 1970s, agricultural fields for buckwheat decreased due to reforestation activities and the expansion of irrigation facilities [21]. The flowers of buckwheat and bush clover fell sharply. Currently, four species—chestnut (*Castanea crenata*), the Korean cherry (*Prunus tomentosa*), bicolor bush clover (*Lespedeza bicolor*), and black locust (*Robinia pseudoacacia*)—are pollen plants [26]. Black locust has been a major honey plant since the 1950s.

4. Current issues and possibilities for sustainable beekeeping and honey production

4.1. Japan

The decline in the number of beekeepers and bee colonies has created a high dependency on imported honey while also leading to a shortage of pollinators in agriculture. The self-sufficiency rate of agricultural products in Japan is relatively low. The seriousness of issues related to beekeeping (including the lack of pollinators) has reduced agriculture's resilience in Japan.

The number of large-scale beekeeping enterprises is shrinking, but the quantity of small-scale beekeeping companies and individual beekeepers who pursue beekeeping as a hobby remains relatively stable. As the people involved in beekeeping become diversified, pollinators can be supplied even in areas where beekeeping has not been done so far. Consequently, the diversification of beekeeping can contribute to a wider range of pollination. As the total number of bees continues to fall, placing beekeeping in appropriate areas can contribute to solving the shortage of pollinators.

There are few beekeepers in urban areas. However, cities provide environments that correlate with the genetic diversity of bees [4], as activities like "Ginza bee" in the heart of Tokyo have spread to cities across the country. By conducting beekeeping in urban areas, consumers' attention is drawn to the activity and products are also brand named. As for Japanese bees, because they do not

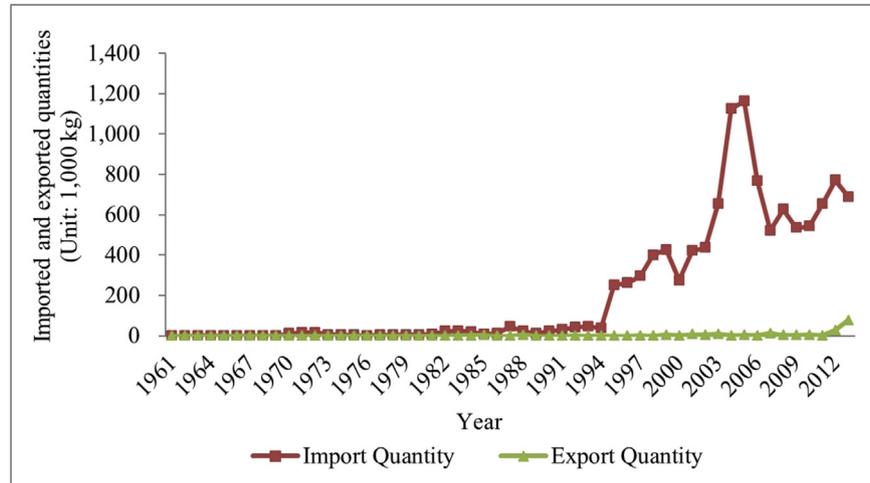


Fig. 8. Imported and exported quantities of honey in South Korea.
 Note. From “FAOSTAT [Internet],” by FAO. Geneva (Switzerland): FAO [cited 2017 May 8]. Available from: <http://www.fao.org/faostat/en/> [23].

produce large amounts of honey, branding is carried out based on their rarity and characteristics as a native species. Because Japanese bees are easy to touch directly with the hands, they are also used in environmental education.

Nagano Prefecture, which has expanded production to meet the needs of Japanese honey, has diverse ecosystems ranging from

plains to mountains. The prefecture is geographically long, stretching from north to south. Nagano provides relatively diverse honey sources, and produces the most honey in the whole country.

Beekeeping techniques are mainly passed from parent to child and among different generations. However, policies such as the hybridization of bees and ways of feeding them differ in each generation, so updating is simultaneously carried out while techniques are taught.

4.2. South Korea

In the 2010s, the quantity of honey production gradually declined. In the 2000s, the harvesting of honey failed several times. Because of a strange climate including unseasonably cool temperatures and early flowering, nectar volume fell [21]. The decrease in black locusts as a major honey plant caused honey production to shrink [27]. However, the self-sufficiency rate of honey has been over 95% since 2005 [28]. In 2010, the number of beehives and beekeepers rose slightly. In contrast to the situation in Japan, the number of large-scale beekeeping businesses expanded from 1990 to 2015.

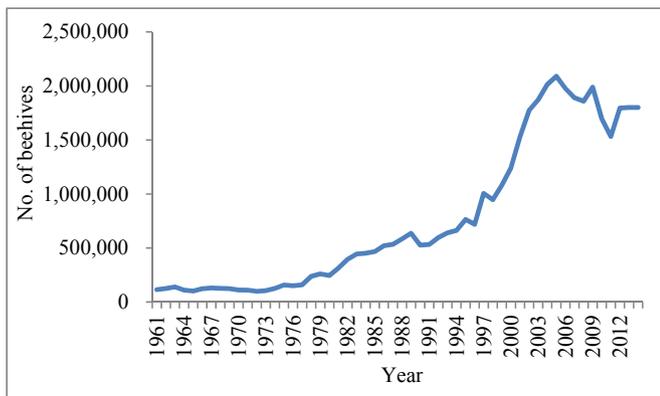


Fig. 9. The number of beehives in South Korea.
 Note. From “FAOSTAT [Internet],” by FAO. Geneva (Switzerland): FAO [cited 2017 May 8]. Available from: <http://www.fao.org/faostat/en/> [23].

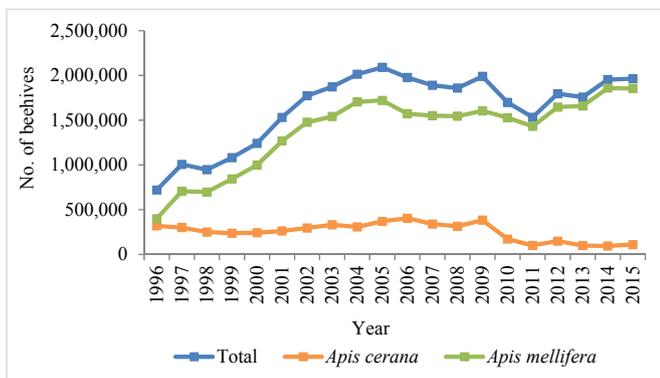


Fig. 10. The number of beehives in South Korea.
 Note. From “Major statistics of agriculture,” by Ministry of Agriculture, Food and Rural Affairs, 2015. Sejong (Republic of Korea): Ministry of Agriculture, Food and Rural Affairs [24].

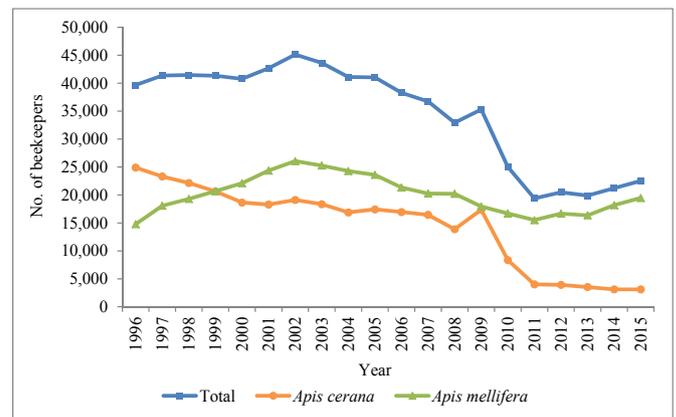


Fig. 11. The number of beekeepers in South Korea.
 Note. From “Major statistics of agriculture,” by Ministry of Agriculture, Food and Rural Affairs, 2015. Sejong (Republic of Korea): Ministry of Agriculture, Food and Rural Affairs [24].

Table 1
The percentage of beekeepers and hives in apicultural management.

Hive	1990		1995		2000		2005		2010		2015	
	B	H	B	H	B	H	B	H	B	H	B	H
1–9	69.4	22.6	62.4	13.5	51.8	7.0	39.8	3.2	33.0	2.0	17.4	0.8
10–49	25.5	43.5	27.8	31.5	30.8	20.6	32.7	13.4	29.3	9.4	28.5	7.7
50–99	4.0	21.6	6.0	22.2	8.4	17.7	10.9	13.6	14.4	13.6	17.9	13.3
100–199	0.9	9.8	3.0	21.3	5.9	26.3	8.9	22.0	12.5	23.0	16.8	24.8
200–299	0.1	1.3	0.6	7.4	2.0	15.0	4.0	17.8	5.4	17.7	7.1	18.6
300–499	0.02	0.5	0.2	2.9	1.0	10.6	2.8	19.6	4.0	20.6	5.1	20.4
500–999	0.002	0.4	0.012	0.5	0.1	2.6	0.7	8.0	1.3	11.0	1.8	11.8
>1,000	0.002	0.2	0.007	0.8	0.012	0.3	0.058	2.5	0.1	2.6	5.5	2.5

Note. B: Beekeepers, H: Beehives. From “Present status of Korean beekeeping industry,” by M.Y. Lee, I.P. Hong, Y.S. Choi, N.S. Kim, H.K. Kim, K.G. Lee and M.L. Lee, 2010, *Korean J Apic*, 25, p. 137–44 [25] and “Major statistics of agriculture,” by Ministry of Agriculture, Food and Rural Affairs, 2015. Sejong (Republic of Korea): Ministry of Agriculture, Food and Rural Affairs [24].

Like in Japan, urban beekeeping has emerged in South Korea. The number of beekeepers and beehives in seven metropolitan cities (Seoul, Incheon, Daegu, Busan, Ulsan, Daejeon, and Gwangju) was slightly increased between 2009 (1,650 beekeepers and 192,672 beehives) and 2015 (1,896 beekeepers and 198,383 beehives) [29,30]. Urban beekeeping enterprises have been recently established. Urban Bees Seoul, an urban beekeeping corporation, was founded in 2012; this corporation harvested honey and provided training programs on beekeeping [31]. The city of Seoul carried out a project titled “Urban Beekeeping for Disabled People” in 2013 and 2014. The project provided jobs related to beekeeping and contributed to enhancing social welfare [31].

Native beekeeping techniques are transferred mainly from older generations to younger ones in South Korea [5]. Recently, the South Korean government has introduced policies to strategically revitalize beekeeping. In 2010, the government launched comprehensive policies to facilitate the beekeeping industry as a life industry for sustainable and green growth [27]. These policies include planting honey plants and developing honeybee species, supporting beekeeping associations, as well as modernizing beekeeping methods and equipment.

5. Discussion and conclusion

Honey is a significant ethnic food in Japan and South Korea. Currently, multiple functions of beekeeping are emphasized such as pollination, environmental education, and community development [31]. The two countries share some similarities (and also have differences) regarding the status of beekeeping. In this paper, we summarized three characteristics of beekeeping in Japan and South Korea, as described in the following sections.

5.1. The dominance of Western honeybees

The introduction of Western honeybees significantly changed the structure of beekeeping in Japan and South Korea. For economic and physical reasons, Western honeybees are dominant in the two countries. Compared with Western honeybees, native ones are more sensitive to the environment, including forest resources and chemical pesticides. Therefore, protecting native bees contributes to ecologically sound, sustainable forestry [5].

5.2. Producing and trading honey

Honey production in Japan fell by half between 1985 and 1995. Since that time, the quantity of imported honey has increased two times. Honey production grew between 1995 and 2010, except for two years (2001 and 2009, respectively) when the harvesting of honey failed. In South Korea, production has declined since 2011.

The quantity of imported honey has risen since 1995. In 2004 and 2005, the amount of imported honey increased two times. This may have been caused by the domestic failure to harvest honey due to the strange climate. The changes in domestic honey production and imported honey indicate that the domestic and global markets are closely linked in Japan and South Korea.

5.3. Diversity and sustainability of beekeeping

As part of a new trend, people have carried out beekeeping as a hobby and an environmental educational activity in urban areas of Japan and South Korea. To develop beekeeping as an industry, beekeepers are becoming entrepreneurs and practicing new activities such as education and spreading regional brands, as well as traditional methods. The diversity of people involved in beekeeping as well as the methods should be considered as a basis to support the sustainability of beekeeping and agriculture. In terms of regional brands, hobbies, and education, there are efforts to reevaluate the storyline of beekeeping in the history of the regions. Beekeeping products including honey, which are traded across regions, share a story that involves several regions. Sharing this story with stakeholders, including producers and consumers, is the starting point of their regional brand debates. The history cultivated by local ecosystems and social/economic factors provides the potential for future growth while prescribing the development path of diverse beekeeping. If we can develop beekeeping using diverse approaches, it can help form the foundation that supports the diversity of agriculture and food culture. In such trajectory, sustainability of agriculture and food system based on regional culture can be enhanced, and traditional beekeeping and honey production in Japan and South Korea can be retained in diverse approach of beekeeping.

Conflicts of interest

The authors declare no conflicts of interest.

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