

# **Empirical Analyses of Urban Beekeeping Regulations and Governance: Towards Evidence-Based Policy Makings**

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## **Abstract**

Honey bees are major pollinators, influencing ecological relationships, genetic diversity in the plant kingdom, and ecosystem conservation and stability. In agroforestry systems, these organisms are essential for crop pollination and can be an important source of local's livelihoods such as the production of honey and beeswax. Their importance has been raised as an easily comprehended example of the ecosystem service brought by nature in the context of conservation of biodiversity. In a report published by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services/IPBES (Potts et al. 2016), the economic value of the pollinating service of honeybees is estimated to be up to 577 billion dollars, highlighting its importance particularly in the context of "Nature's Contribution to People" (NCP).

However, despite their socio-ecological importance, there has been a decline in honey bee colonies over the last decade. The decline of the pollination function has been a major concern globally in social, economic, and environmental aspects, which in turn resulted in renewed interest in honey bees. There is now growing evidence that beekeeping in urban spaces might be more beneficial for their survival due to the reduced exposure to agricultural pesticides and limited assortment of plants for foraging. In addition, urban beekeeping has gained salience because of its significance in biodiversity conservation, food production, and community building.

In recent years, there are an increasing number of municipalities that are actively adopting urban beekeeping as part of their environmental policies. As beekeeping practices in urban areas increase, concerns from local residents have also grown, which stemmed mainly from safety concerns and property disputes by neighbors. Thus, rules and regulations of urban beekeeping are set aiming to maximize profits while minimizing the risks. However, to date, not many municipalities or other governmental bodies have set rules for urban beekeeping, and in cases with existing regulations, it is not clear whether it is evidence-based.

This work highlights these knowledge gaps by conducting a mix-method approach to identify how urban beekeeping functions and what are the existing legal regulations, which are still limited globally despite being an essential part of streamlining urban beekeeping practice. Specifically, this study conducted a comprehensive systematic review (globally and country-specific) of existing urban beekeeping regulations, empirical analysis of bees' flight behaviors, and environmental DNA analysis. These analyses aim to provide insights and suggestions for the future of urban beekeeping regulations. An overview and the list of associated publications of this dissertation are shown in Figure 1.1 and Table 1, respectively. The contents of each chapter are summarized as follows:

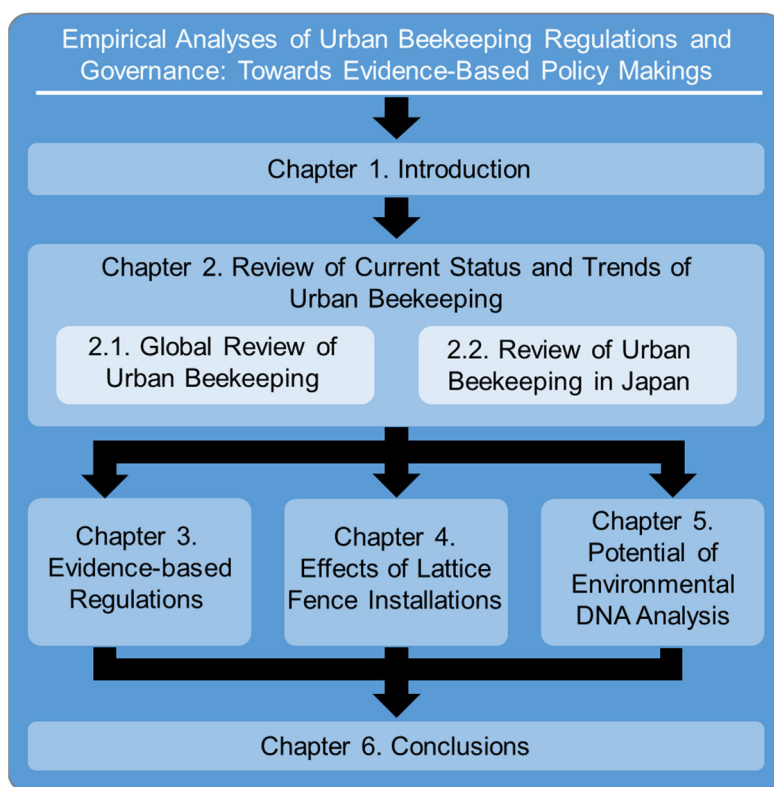


Figure 1. Overview of the research dissertation.

Table 1. List of peer-reviewed publications associated with each chapter.

Chapter	Corresponding Publication
2.1	Matsuzawa, T.; Kohsaka, R. 2021. Status and Trends of Urban Beekeeping Regulations: A Global Review. <i>Earth</i> , 2(4), 933 - 942. DOI: 10.3390/earth2040054
4	Matsuzawa, T.; Kohsaka, R. 2022. Preliminary Experimental Trial of Effects of Lattice Fence Installation on Honey Bee Flight Height as Implications for Urban Beekeeping Regulations. <i>Land</i> , 11(1), 19. DOI: 10.3390/land11010019
5	Matsuzawa, T.; Kohsaka, R.; Uchiyama, Y. 2020. Application of Environmental DNA: Honey Bee behavior and Ecosystems for Sustainable Beekeeping. In <i>Modern Beekeeping-Bases for Sustainable Production</i> ; In Tech Open: Rijeka, Croatia. DOI: 10.5772/intechopen.92717

**Chapter 1** – Introduction. This chapter presents the research background and framework of this study. Humankind has long used the honey, beeswax, and royal jelly produced by honeybees. At the same time, honeybees and other flower-visiting insects

have provided enormous benefits to mankind through their pollination function. In recent years, urban beekeeping has been expanding worldwide, but it has only been in the past 20 years or so that beekeeping has flourished in urban areas around the world (e.g., London, New York). In Japan, beekeeping began in Ginza in 2006 and has now expanded to over 100 locations. The significant ecosystem services provided by beekeeping, coupled with the spread of urban agriculture and the occurrence of Colony Collapse Disorder/ CCD, has led to expansion of urban beekeeping in many regions of the world. This, in turn, raised certain negative aspects of urban beekeeping such as interspecific competition with native flowering insects. There has been little research on the benefits and risks of urban beekeeping, particularly studies on the regulations and governance of urban beekeeping. Thus, there is a need to increase efforts to maximize the benefits while minimizing the risks of urban beekeeping through the application of suitable rules and regulations. This study focused on the governance of urban beekeeping, specifically the rules that are based on evidence, in an effort to address the above-mentioned issues, and analyzed and discussed them by combining social science and natural science (mix-method) approaches.

*Chapter 2* – Review of Current Status and Trends of Urban Beekeeping. To date, urban beekeeping is practiced globally on all continents except for Antarctica. However, there are limited integrated and organized sources of information regarding beekeeping regulations and governance despite practical and academic demands. There is mounting evidence of the negative impacts of urban beekeeping on ecosystem services. Governance is critical for minimizing these negative aspects while maximizing the positive aspects of urban beekeeping. Thus, there is a need to understand the regulations, which face critical governance challenges, and summarize points to achieve sustainable urban beekeeping. This chapter presents two comprehensive systematic reviews conducted at global and country-specific (Japan) scales on the current status and trends of urban keeping are

presented. Chapter 2.1 discusses a global overview of official (and partially informal or voluntary) regulations related to urban beekeeping (Matsuzawa and Kohsaka, 2021). Results showed that there were about 10 types of regulatory items on urban beekeeping, and most of them were geared towards the safety of urban residents. There were cases where non-government organizations (NGOs) established their own guidelines to complement the rules established by the government. Meanwhile, Chapter 2.2 reflects the current status and regulations of urban beekeeping in Japan. There were few laws and regulations on beekeeping identified in the country, and, in general, there were no laws and regulations targeting honeybees that ensure the safety of urban dwellers and the conservation of biodiversity.

**Chapter 3 – Evidence-Based Regulations.** In this chapter, a social science approach was used to review if the existing rules of urban beekeeping and beekeeping in the United States, Australia, and Japan were evidence-based. Results showed that the development of rules for urban beekeeping was relatively advanced in Australia, developed in limited number of cities (particularly with larger populations) in the United States, and almost non-existent in Japan. Current regulations in urban beekeeping in the United States and Australia included items such as the number of hives that could be installed, hive density, installation of barriers, distance to property boundaries (setbacks), and water supply. These were often regulated with concrete numerical parameters, however, the scientific bases of these parameters were not confirmed. In general, the findings indicated that the regulatory requirements for urban beekeeping or apiculture, although often accompanied by numerical regulations, lack scientific evidences.

**Chapter 4 – Effects of Lattice Fence Installations.** There is an increasing trend of municipalities adopting urban beekeeping as part of their environmental policies, yet, the practice received growing concerns from local residents due to safety and property disputes. This in turn led to the establishment of suitable rules and regulations that

maximize profits while minimizing the risks such as nuisances. However, to date, the effectiveness of these regulatory items in urban beekeeping is not well studied. Thus, this chapter (Matsuzawa and Kohsaka, 2022) provides insights into this gap by presenting an experiment of the effects of fences and setbacks on honey bee flight height, as these are frequently set within the regulations of urban beekeeping. Since current measurements of flight heights of insects are still in progress, this chapter also provided methodological implications of using a 3D laser scanner, which is non-destructive, does not attach observers to the insects, and can accurately acquire a large amount of data in a short time, to localize the bees.

**Chapter 5** – Potential of Environmental DNA Analysis. Urban beekeeping is gaining attention in terms of various aspects including ecosystem diversity and genetic diversity of honeybees. Yet, the promotion of urban beekeeping lacks scientific evidence of the behavior of urban honeybee, which is a concerning issue. To provide scientific evidence, environmental DNA (e-DNA) analysis can be utilized to detect the detail of nectar sources. Identification of honey-source plants with the e-DNA analysis technique has been applied since around 2010. It has some advantages over the conventional pollen analysis, though, it is not yet fully verified that it can demonstrate a level of contribution of each honey-source plant accurately. In this regard, this chapter (Matsuzawa et al., 2020) presents the potential application of e-DNA analysis to urban beekeeping regulations, particularly in verifying the general trends of honey origins. The discussions presented in this chapter can be applied to other cases and contribute to accumulating the scientific evidence for making relevant policies of urban beekeeping.

**Chapter 6** – Conclusions. This chapter serves as the final concluding remarks based on the empirical analyses of urban beekeeping regulations and governance. Overall trends showed that urban beekeeping has six functions namely: Pollination, Biological conservation, Pest control, Safety, Apicultural products, and Community formation.

Globally, though there are an increasing numbers of countries with developed regulatory items of urban beekeeping, not many are based on scientific evidence. In Japan, there are no legal rules for urban beekeeping identified, and the governance of general beekeeping is weak, making it difficult to collect the information necessary for proper governance. There is a need to establish evidence-based rules that correspond to the six functions of urban beekeeping. In Japan, it would be effective to formulate ordinances and guidelines at the prefectural level and, if necessary, guidelines by NGOs. Future studies could also look into socio-ecological contexts of urban beekeeping such as examining the potential aspects of collaborations among different stakeholders in the context of pollinator conservation, biodiversity monitoring, and management practices.