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Problems And Opportunities Of The Beekeeping System In Uzbekistan

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Annotation. This article explores the current status and development potential of beekeeping in Uzbekistan, focusing on its regional, climatic, and agro-economic dimensions. Beekeeping has gained strategic importance in the country, with the establishment of the "Uzbekistan Beekeepers Association" in 2017, which led to key reforms such as tax exemptions, soft loans (UZS 36 billion via Aloqabank), and technology introduction. In 2023, Uzbekistan produced 31,500 tons of honey a 16% increase from the previous year. Meanwhile, in 2020, production stood at 21,410 tons. However, average honey yield per hive remains low, below 20 kg.

Despite favorable natural conditions, many Uzbek beekeeping enterprises still rely on outdated practices, lacking modern technologies such as biomonitoring systems, AI-assisted hive diagnostics, and GIS mapping tools. Regional analysis shows that mountainous and southern zones are optimal for beekeeping, while deserts require artificial forage systems and adapted bee strains. The article emphasizes the need for a science-based, region-specific strategy that incorporates modern technology, supports rural income, and enhances Uzbekistan's position in the global honey market.

Keywords: Beekeeping in Uzbekistan, Honey production, Climate change, Regional development, Pollination services, Agricultural innovation, Biomonitoring, FAO statistics, Rural livelihoods, Apiculture technology, Nectar flow, Environmental sustainability, Central Asia, GIS in agriculture, Apicultural economy.

Introduction. Beekeeping in Uzbekistan plays a crucial role in the country's agroeconomic development, particularly in its central regions where ecological diversity and agricultural intensity converge. The sector is significantly influenced by Uzbekistan's wide-ranging natural and climatic zones including mountainous, desert, oasis, and steppe areas which create both opportunities and challenges for apiculture development.

Recognizing its economic and ecological potential, both the population and political leadership of Uzbekistan have identified beekeeping as a priority agricultural direction. A major institutional step was the establishment of the "Uzbekistan Beekeepers Association" in 2017, which catalyzed substantial support mechanisms. These included the introduction of preferential loans (36 billion UZS through Aloqabank), the elimination of customs duties for apiculture-related equipment, the adoption of modern beekeeping technologies, and a tenfold increase in honey export volumes reaching 10 tons.

According to national statistics, Uzbekistan produced 31,500 tons of honey in 2023 a 16% increase compared to the previous year. In 2020, honey production stood at 21,410 tons. This continuous upward trend contributes not only to rural economic development but also to national food security and biodiversity preservation.

The aim of this research is to analyze the regional structure and climatic-agrarian determinants of beekeeping development in Uzbekistan, identify current constraints, and provide geography-based recommendations. Since 2016, over 12,000 entrepreneurial entities have become active in the apiculture sector. However, average honey yield per colony remains low less than 20 kg indicating issues in productivity and technology diffusion.

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Figure 1. Study of the local flora, water and climatic conditions for bee colony placement (Buka district, Tashkent region, 2022–2023).

According to the Food and Agriculture Organization (FAO), honey production in Uzbekistan reached 14,700 tons in 2022, marking a 4.5% rise from 2021. Meanwhile, ReportLinker analytics forecasts that honey consumption in the country, estimated at approximately 7,000 tons in 2021, will increase significantly by 2026, with expected domestic and export demand ranging between 14,200 and 16,900 tons. However, the Central Asian region, including Uzbekistan, is among the most vulnerable to the adverse effects of global climate change. Rising temperatures, abnormal heatwaves during spring and summer, and declining precipitation levels are disrupting the flowering cycles of plants and nectar secretion, directly impacting bee behavior and honey yield. For example, FAO data (2022) notes that Uzbekistan's average summer temperature has increased by 1.5°C over the past decade, reducing nectar productivity and overall hive efficiency.

In desert and semi-desert zones, limited vegetation cover leads to a severely restricted forage base. Productive beekeeping in these regions is only possible under conditions of intensive management, supplemented by scientific monitoring and adaptive practices. Currently, most beekeeping farms in Uzbekistan operate using traditional, labor-intensive methods. Many producers still rely on basic portable hives, manual extraction tools, and oral transmission of knowledge. The adoption of modern technologies such as biomonitoring devices (real-time sensors for hive temperature, humidity, and honey reserves), digital management platforms, genetic selection techniques, drones, AI-based monitoring, and Geographic Information Systems (GIS) remains extremely limited.

Globally, countries like the United States, Germany, Canada, and Australia have already implemented these technologies. For instance, BeeHero (USA) and Apic.ai (Germany) utilize AI and IoT to monitor hive health, pollination efficiency, and honey quality. According to a 2023 FAO report, farms implementing smart technologies reduced bee mortality by 28% and increased honey yields by 40% on average.

Uzbekistan's diverse flora, up to 260 sunny days per year, and its mix of mountain, desert, and steppe zones create ideal conditions for apiculture. In 2023, honey production reached 31,500 tons, reflecting strong domestic and export potential. However, this potential remains underutilized due to climate change (average summer temperature increased by 1.5°C over the past decade), technological backwardness, limited scientific-practical integration, and inadequate compliance with international quality and export standards.

Regional analysis shows that Uzbekistan's mountainous and southern provinces (e.g., Surkhandarya, Kashkadarya, Fergana Valley) have the most favorable natural-geographic conditions for beekeeping. In contrast, steppe and oasis zones (e.g., Syrdarya, Navoi) require intensive modernization, while desert regions

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(e.g., Karakalpakstan, Bukhara) demand artificial forage systems, climate-adapted bee strains, and protective infrastructure. Beekeeping is not only an economic activity but also an essential ecosystem service. According to FAO estimates, more than 70% of global crop species depend on insect pollination primarily by bees which directly impacts food security, biodiversity, and sustainable agriculture.

In Tashkent Region, especially in districts like Bostanliq, Parkent, and Zangiota, diverse landscapes and flora provide excellent opportunities for rural families to engage in beekeeping as a supplementary or even primary income source. Unfortunately, the high-value apitherapy products such as honey, royal jelly, bee venom, propolis, and pollen remain underutilized in pharmaceutical and dietary industries. Therefore, beekeeping in Uzbekistan must be strategically developed based on regional characteristics, scientific integration, technological modernization, and ecological awareness to ensure economic growth and public health benefits.

Table 1.

Regional characteristics of effective beekeeping development (Tashkent region, 2023-2024).

№	Beekeeper	Regional Location	Number of Bee Colonies	Income Obtained (UZS)	Main Floral Resource	Type of Hive Used
1	Rustamov A	Buka	40	50 million	Acacia, wild herbs	Wooden traditional
2	Jumaev R	Piskent	46	58 million	Fruit trees, cotton flowers	Modern modular hive
3	Alimov B	Bekabad	50	42 million	Field crops, willow trees	Wooden traditional

In addition to technological underdevelopment, another major challenge facing Uzbekistan's beekeeping sector is the lack of structured education and capacity building. There are limited vocational or higher education programs that offer specialized training in apiculture, bee biology, disease control, and apitherapy. In comparison, countries such as Germany, Slovenia, and New Zealand offer certified beekeeping courses at both academic and vocational levels, ensuring that producers have access to scientific knowledge and innovative practices. For instance, the University of Ljubljana (Slovenia) offers one of the world's most advanced apiculture education programs, which has become a model for integrating sustainable beekeeping into national agricultural development strategies.

Another crucial gap in Uzbekistan is bee disease surveillance and health monitoring. Global apiculture is under threat from diseases such as Varroa destructor, Nosema spp., and American foulbrood, which have led to the collapse of entire bee colonies in various regions. In Uzbekistan, disease monitoring is sporadic and reactive rather than proactive, largely due to the absence of diagnostic laboratories, trained veterinary entomologists, and molecular testing facilities. By contrast, countries like the Netherlands and the UK have national bee health programs supported by advanced laboratories and field surveillance networks, which allow for early detection and biosecurity management.

Furthermore, climate change is emerging as a critical stressor. Increased frequency of droughts, shifting flowering periods, and extreme temperatures have disrupted bee foraging behavior, colony development, and nectar availability. Research by the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) suggests that pollinator decline driven by climate change could reduce global crop production by up to 23%. For Uzbekistan, this poses a dual threat: a decline in honey production and reduced yields of pollinator-dependent crops such as melons, almonds, apples, and cotton.

The absence of structured market channels and certification mechanisms also hinders the development of the industry. Most beekeepers in Uzbekistan sell their honey in informal local markets, often without any quality control or branding. This limits their access to high-value export markets in the EU, East Asia, and the Gulf, where organic, traceable, and residue-free honey is increasingly demanded. According to ITC

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(International Trade Centre) statistics, the global honey market was valued at $9.6 billion in 2023, with premium organic honey commanding prices up to 3-4 times higher than conventional varieties. Uzbekistan, with its organic flora and low pesticide usage in mountainous areas, could potentially become a regional leader in high-quality honey exports provided proper certification, processing, and packaging infrastructure is established.

Additionally, the role of women and youth in beekeeping remains underutilized. In many rural areas, beekeeping could be a gender-inclusive and low-barrier entry point into entrepreneurship. In Ethiopia and India, donor-funded programs have empowered thousands of rural women to operate small-scale apiaries, significantly increasing household income and community resilience. A similar approach in Uzbekistan supported by microloans, cooperative models, and training could yield substantial social and economic dividends.

Conclusion. Beekeeping in Uzbekistan holds significant promise as a catalyst for sustainable rural development, biodiversity conservation, and food security. Despite the country's rich floral diversity and favorable agro-climatic conditions, the sector remains constrained by technological underdevelopment, limited disease monitoring, inadequate training infrastructure, and insufficient integration into international markets. Climate change further exacerbates these challenges by affecting flowering patterns and pollinator health.

To unlock the full potential of apiculture, Uzbekistan must adopt a science-based and regionally adapted development model that leverages modern technologies, builds human capacity, and aligns with global quality and sustainability standards. Strengthening research, education, and market systems, while promoting gender-inclusive and youth-oriented beekeeping initiatives, will be key to transforming the industry into a competitive and ecologically responsible pillar of the national economy. With coordinated policy support and investment, beekeeping can become a strategic driver of Uzbekistan's green and resilient future.

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