

# Exploration and Practice of Collaborative Talent Cultivation Model for Urban Horticulture under the Background of Smart Agriculture

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**Abstract:** This paper discusses the development characteristics of urban horticulture under the background of smart agriculture, as well as the application of artificial intelligence technology in it. It analyzes the importance of highly skilled talents in urban agriculture in the era of smart agriculture and their cultivation pathways and practices. It proposes measures such as building multi-level practical teaching platforms, implementing the “Enjoy Horticulture” series of high-quality activities, and establishing the “1234” applied talent training model to cultivate high-quality talents that meet the development needs of modern urban horticulture industry. Taking Beijing University of Agriculture and other universities as examples, the paper analyzes the practical cases and effects of the urban horticulture discipline’s industry-education-research collaborative talent training model, which has reference significance for further improving and perfecting the urban horticulture industry-education-research collaborative talent training plan.

**Keywords:** Agricultural modernization; Smart agriculture; Urban horticulture; Industry-education-research collaboration; Talent cultivation

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## 1. Introduction

The third plenary session of the 20th Central Committee of the Communist Party of China emphasized the vigorous development of smart agriculture, while urban horticulture, as an important component of agricultural modernization, has also attracted much attention. In today’s world, technological advancements are occurring at an unprecedented pace. With the development of artificial intelligence technology worldwide, smart agriculture has become a new engine for promoting the development of urban horticulture. As an integral part of the urban green ecosystem, urban horticulture will leverage modern information technologies such as artificial intelligence, agricultural robots, the Internet of Things, and big data to achieve precise management, efficient production, and quality enhancement<sup>[1]</sup>. Against this backdrop, the discipline of urban horticulture is also facing

the challenges of transformation, upgrading, and high-quality development. To cultivate high-quality talents who meet the development needs of the modern urban horticulture industry, it is particularly important to explore and practice industry-education-research collaborative talent training models. Through close cooperation between the industry, education, and research institutions, technological innovation, talent cultivation, and the transformation of scientific research results are promoted to meet the development needs of the modern urban horticulture industry, providing strong talent support for the construction of an agricultural powerhouse.

## **2. Background and significance of urban horticulture industry-education-research collaboration**

### **2.1. Development trends of smart agriculture**

Smart agriculture, through the integrated application of modern information technology, has achieved intelligent management of the agricultural production process. It not only enhances agricultural production efficiency and quality but also reduces resource consumption and environmental pollution, promoting sustainable agricultural development. With advancements in artificial intelligence and life sciences, an increasing number of innovative ideas and technologies are being applied to smart agriculture, revolutionizing the traditional, weather-dependent agricultural model and significantly enhancing production methods and efficiency in the modern era. The integration of smart agriculture with modern information technology is driving the digitalization, intelligentization, and networking of agricultural production. Similarly, its integration with life sciences is advancing the efficiency of new crop variety innovation and improving the precision of crop growth and development regulation throughout the entire process<sup>[2,3]</sup>. Technologies such as 5G, the Internet of Things, big data, artificial intelligence, and high-precision sensing are being applied to smart agriculture on an increasingly extensive and profound scale. Against this backdrop, the urban horticulture industry is also undergoing transformation and upgrading, striving for high-quality development to meet the demands of this new era.

### **2.2. Characteristics and talent needs of urban horticulture**

Urban horticulture, as an integral part of modern agriculture, is highly market-oriented and technologically dependent<sup>[4,5]</sup>. With the acceleration of urbanization and the increasing consumer demand for high-quality agricultural products and integrated agricultural, cultural, and tourism services, the demand for intelligent upgrades and high-quality talent in urban horticulture has become increasingly urgent. These talents are required not only to possess solid professional knowledge but also to have an innovative spirit and practical abilities to cope with market changes and new technological challenges.

Modern urban horticulture has distinct characteristics: (1) Multifunctionality: Urban horticulture not only provides food and nutrients but also serves to sustain and improve the environment, significantly reducing urban noise and air pollution, and making residents' lives more comfortable and secure. (2) Intensive management: Urban horticulture is a highly facility-based model that intensively cultivates crops and adopts vertical planting and year-round production methods. (3) Integration of technology and innovation: Urban horticulture combines modern agricultural development theories, Internet of Things technology, facility production technology, and industrialized business models, emphasizing the application of technology in horticulture. (4) Green space creation: Urban horticulture creates green spaces in cities, which helps improve air quality, reduce pollution, and mitigate the urban heat island effect. (5) Integration of agriculture, culture, and tourism: Urban horticulture, as a carrier, promotes the integrated development of urban and rural areas. It allows people to appreciate the beauty of natural ecology, enriches the cultural connotations of rural revitalization, activates the economic vitality of

rural development, and enhances people's cultural pride and sense of happiness in life.

The urban horticulture industry actively introduces technological innovation to improve production efficiency, product quality, and social benefits. The application of smart greenhouses, automated irrigation systems, and drone technology makes horticultural production more intelligent and efficient. In light of this, higher demands are placed on the talent needed for urban horticulture. (1) Interdisciplinary education and practice: Urban horticulture students need to master not only the basic knowledge of facility horticulture, cultivation, breeding, plant physiology, etc., but also a certain amount of artificial intelligence science, big data science, engineering, and other professional directions' core course theories and operational skills. It is required that horticulture talents keep pace with technology to adapt to the development and changes in the era of smart agriculture. Emphasizing the integration of this interdisciplinary knowledge, the cultivation of innovative thinking, and the recognition and protection of the value of agricultural cultural heritage helps better adapt to the development needs of the urban horticulture industry. (2) Integration of industry, education, and research: The cultivation of urban horticulture talents needs to be closely integrated with the industry front line. Through industry-education-research cooperation, students can practice and intern in large enterprises and institutions of modern urban agriculture to understand the needs of the industry front line and integrate the agricultural scientific research advantages of schools. (3) Innovative consciousness and ability: Urban horticulture talents need to have enthusiasm and passion and must possess the ability to explore learning and lifelong learning. They should be able to conduct comprehensive analysis and innovative practice within the field of horticulture, promoting the development of the industry.

Therefore, educators should follow the outcome-based education (OBE) philosophy <sup>[6]</sup>, grasp the development trends of the times, keep pace with the times, and achieve the goal of cultivating young talents with a sense of national pride and love for agriculture, strong capabilities in strengthening and revitalizing agriculture, and an open and progressive international perspective <sup>[7]</sup>.

### **2.3. Significance of industry-education-research collaboration**

Industry-education-research collaboration refers to the establishment of close ties between the industry, education, and research institutions to jointly undertake project research, technological development, and transformation, and share resources and outcomes <sup>[8]</sup>. This cooperative model is of significant importance in the context of smart agriculture.

- (1) Promoting technological innovation: Through industry-education-research cooperation, the practical needs of the industry, the theoretical knowledge of academia, and the research capabilities of institutions can be effectively integrated to jointly explore, study, and solve practical problems, thereby driving continuous innovation in agricultural technology.
- (2) Accelerating the transformation of scientific research results: Industry-education-research cooperation can rapidly transform academic research findings into productive forces, promoting the industrialization and commercialization of scientific and technological achievements, and providing strong support for the practical application of smart agricultural production technology.
- (3) Cultivating high-quality talent: Through industry-education-research cooperation, students can learn and master professional knowledge in practice, enhance their ability to solve practical problems, and at the same time, understand the latest industry trends and market demands. This prepares them to embrace the trend of agricultural intelligence and achieve the national strategy of strengthening and revitalizing agriculture with strong skills.

### **3. Exploration of urban horticulture industry-education-research collaborative talent cultivation model**

#### **3.1. Building multi-level practical teaching platforms**

To meet the demand for high-quality talent in the development of the urban horticulture industry, multi-level practical teaching platforms can be established, including off-campus contracted practical teaching bases, high-level talent cross-training programs, and international talent cultivation pathways.

**Establishing off-campus contracted practical teaching bases:** By hiring off-campus practical teaching instructors and jointly formulating training plans, students' ability to apply professional knowledge to solve practical problems can be strengthened. This cooperative model allows students to gain a deep understanding of the actual operations of enterprises, market demands, and key issues, improving the targeting and quality of students' future employment. It also clarifies the key industry challenges that universities need to address.

**High-level talent cross-training programs:** Research institutions cooperate with each other to carry out high-level talent cross-training programs. By implementing projects such as the "Practical Training Plan" and the "Dual Training Plan," students' research and innovation abilities are enhanced, laying a solid foundation for further studies. These programs allow students to exercise their innovative thinking and problem-solving skills in scientific research practice, laying a solid foundation for future academic research and career development.

**International talent cultivation pathways:** Schools collaborate with foreign universities to carry out high-level talent cross-training programs and China-foreign joint training programs. By building international talent cultivation pathways, urban horticulture talents with an international perspective and thinking are cultivated. These programs enable students to understand the development trends and market demands of the international horticulture industry, improving their cross-cultural communication skills and international competitiveness.

#### **3.2. Implementing the "Enjoy Horticulture" series of activities**

Leveraging the scientific research resources, extension practice experience, and professional storytelling spirit of the experimental demonstration stations (bases), students' sense of belonging, identity, and pride in horticulture can be enhanced through cultural influence and infection, integrating professional ideological education into practical activities. According to specific seasons, the latest scientific research achievements of the experimental demonstration stations (bases) are shared with all teachers and students in the form of "Scientific Research Achievement Sharing Season." By showcasing and promoting the latest scientific research achievements, students' interest in learning and innovative spirit are stimulated, while promoting the transformation and application of scientific research results.

#### **3.3. Establishing the "1234" applied talent cultivation model**

**Establishing a "1234" applied talent cultivation model centered on job capability training:** This model integrates two core methods—school-enterprise cooperation and work-integrated learning—and organizes the curriculum into three categories: horticultural plant production, artificial intelligence, and agribusiness management. Furthermore, it emphasizes four types of collaboration to ensure comprehensive talent development: industry-education collaboration, learning-research collaboration, research-teaching collaboration, and learning-application collaboration. This framework aims to align education with industry demands, enhance practical skills, and promote innovation and adaptability among students.

**Integrating enterprises into education:** By bringing enterprises into the school and schools into enterprises, an "industry-education integrated" practical teaching platform is created. Internships and practical training are organically combined with local enterprise production, forming a school-enterprise interactive model that

integrates training with internships and internships with employment.

**Optimizing curriculum structure:** Based on industry demands and talent cultivation goals, the curriculum structure is optimized by setting up a series of courses such as special plant production in urban horticulture, facility agriculture, artificial intelligence, big data analysis, and agribusiness management. The combination of theory and practice is emphasized to enhance students' comprehensive qualities and practical abilities.

**Strengthening faculty team building:** A faculty team that is sufficiently large, reasonably structured, interdisciplinary, and integrated with industry, academia, and research is built. Teachers' professional literacy and teaching levels are improved by hiring off-campus practical teaching instructors and inviting industry experts to give lectures.

**Promoting the transformation of scientific research results:** Scientific researchers are encouraged and supported to be bold in innovation, supporting the transformation of scientific research results into productive forces and promoting industrial development and technological progress.

## **4. Practical cases and effectiveness of urban horticulture discipline's industry-education-research collaborative talent cultivation model**

### **4.1. Exploration of urban horticulture talent cultivation model at Beijing University of Agriculture**

Since the establishment of the horticulture major in 1957, Beijing University of Agriculture has, in line with the strategic positioning of the capital city and the objective need for the construction of a world-class harmonious and livable city, gradually formed a distinctive talent cultivation model for modern urban agriculture through more than 60 years of exploration and practice. This model provides strong talent support for the rural revitalization strategy and the modernization of Chinese agriculture<sup>[9]</sup>.

**Construction of practical teaching platforms:** Beijing University of Agriculture has cooperated with multiple enterprises and research institutions to establish various types of collaborative practical teaching platforms. For example, in cooperation with companies such as Capital Agribusiness Group, Shunxin Agricultural, and Cuihu Agricultural, off-campus contracted practical teaching bases have been established, and off-campus practical teaching instructors have been hired to jointly formulate training plans, enhancing students' abilities to apply professional knowledge to solve practical problems. High-level talent cross-training projects have been carried out in cooperation with research institutions such as the Chinese Academy of Sciences and the Chinese Academy of Agricultural Sciences. International talent cultivation pathways have been built in cooperation with foreign universities such as the Royal Agricultural University in the UK.

**Curriculum system and teaching model reform:** Beijing University of Agriculture has reformed the curriculum system and teaching model of the urban horticulture major. By optimizing the curriculum structure, increasing practical teaching segments, and introducing cutting-edge industry knowledge, the quality of course teaching and students' interest in learning have been improved, guiding college students in "Internet Plus" innovation and entrepreneurship project practices. Teaching models such as case teaching and project teaching have been adopted to cultivate students' innovative and practical abilities.

**Scientific research achievement transformation and technological innovation:** Beijing University of Agriculture focuses on the transformation of scientific research achievements and technological innovation. By cooperating with enterprises on scientific research projects and applying for patents, scientific research achievements have been transformed into productive forces, promoting industrial development and technological progress. Additionally, the university actively introduces and cultivates high-level talents,

strengthens the construction of scientific research teams, and enhances the capacity for scientific and technological innovation.

#### **4.2. Exploration of urban horticulture talent cultivation model at other universities**

Other universities are also actively exploring collaborative talent cultivation models for urban horticulture disciplines that integrate industry, education, and research. For example, Nanjing Agricultural University integrates “fruit, vegetable, flower, tea” common knowledge courses, offers cutting-edge interdisciplinary courses, and develops teaching courses covering pre-harvest, post-harvest, processing, and sales aspects of horticulture. They compile and revise textbooks, integrate bioinformatics and artificial intelligence technologies into traditional teaching, and promote the transformation of scientific research results and technological innovation by establishing industry-education-research cooperation bases and conducting scientific research project cooperation with enterprises. Zhejiang A&F University relies on in-campus practical teaching platforms, off-campus modern glass greenhouses, and modern agriculture and forestry science and technology parks to build off-campus teaching practice bases and introduce cutting-edge industry knowledge, thereby enhancing students’ urban horticulture innovation and practical abilities. These cases have reference significance for further improving and perfecting collaborative talent cultivation plans for urban horticulture.

### **5. Conclusion and outlook**

The collaborative talent cultivation model for urban horticulture disciplines under the background of smart agriculture is an effective model for talent cultivation. It can promote technological innovation, accelerate the transformation of scientific research results, and promote the modernization and upgrading of agriculture. By building multi-level practical teaching platforms, implementing high-quality “Enjoy Horticulture” series activities, and establishing a “1234” applied talent cultivation model, high-quality talents that meet the development needs of modern urban horticulture can be cultivated. In the future, with the continuous development of technology and the transformation and upgrading of the urban horticulture industry, the collaborative talent cultivation model will play an increasingly important role. At the same time, it is also necessary to continuously explore and practice new cooperation models and methods to adapt to the future development needs of the modern urban horticulture industry, to better serve agricultural intelligent production <sup>[10]</sup>, improve people’s quality of life, and contribute to the national agricultural modernization process.

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The authors declare no conflict of interest.



## References

- [1] Hu Y, Zhao T, Guo Y, et al., 2023, 100 Essential Questions for the Future of Agriculture. *Modern Agriculture*, 1(1): 4–12.
- [2] Pang Y, Marinello F, Tang P, et al., 2023, Bibliometric Analysis of Trends in Smart Irrigation for Smart Agriculture. *Sustainability*, 15: 16420.
- [3] Gzar DA, Mahmood AM, Al-Adilee MKA, 2022, Recent Trends of Smart Agricultural Systems Based on Internet of Things Technology: A Survey. *Computers and Electrical Engineering*, 104: 108453.
- [4] Edmondson JL, Cunningham H, Densley Tingley DO, et al., 2020, The Hidden Potential of Urban Horticulture. *Nature Food*, 1(3): 155–159.
- [5] Sashika MAN, Gammanpila HW, Priyadarshani SVGN, 2024, Exploring the Evolving Landscape: Urban Horticulture Cropping Systems—Trends and Challenges. *Scientia Horticulturae*, 327: 112870.
- [6] Yu GB, Sheng YY, Li CX, 2022, The OBE Concept Aids in the Cultivation Model of Horticultural Discipline Talents and the Optimization of Curriculum Teaching, *New Curriculum Research Magazine*, “Exploration of Curriculum and Teaching Reform under the ‘Double Reduction’ Policy” Fifteenth Collection, Heilongjiang Bayi Agricultural University, 2.
- [7] Zhou C, 2023, Xi Jinping Replies to the Students of China Agricultural University Science and Technology Small Courtyard, *Xinhua News Agency*, May 3, 2023.
- [8] Gong S, Li L, 2024, Research on Innovation and Entrepreneurship Education Reform in Local Colleges and Universities under the Background of Industry-Education Integration. *Journal of Contemporary Educational Research*, 8(11): 23–27.
- [9] Tie Z, Zhang LP, 2023, Beijing University of Agriculture Highlights the Characteristics of Urban Agriculture and Forestry in Its Educational Programs. *Green China*, 23: 60–63.
- [10] Steed G, Ramirez DC, Hannah MA, et al., 2021, Chronoculture, Harnessing the Circadian Clock to Improve Crop Yield and Sustainability. *Science*, 372(6541): eabc9141.

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