

# Research on Innovative Pathways for Talent Training Models in Civil and Hydraulic Engineering Master's Programs at Agricultural Universities

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**Abstract:** Under the background of serving the development of new-quality productive forces today, the demand for talents is also increasingly diversified. The cultivation of master's degree postgraduates majoring in civil and hydraulic engineering in agricultural colleges and universities is facing new opportunities and challenges. The development of new-quality productive forces puts forward higher requirements for talents. Students not only need to have solid professional knowledge and skills, but also need to have innovation ability, practical ability and comprehensive quality. As an important base for cultivating professional talents in the agricultural field, how agricultural colleges and universities can explore a talent cultivation model suitable for master's degree students majoring in civil and hydraulic engineering to meet the needs of serving the development of new-quality productive forces has become an urgent problem to be solved at present.

**Keywords:** Agricultural colleges; Civil and Hydraulic; Engineering talent cultivation

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## 1. Introduction

The Third Plenary Session of the 20th Central Committee of the Communist Party of China emphasized deepening education, technology, and talent development systems reforms. Higher education plays a crucial role in talent cultivation and scientific innovation, driving the development of new productive forces. These forces emerge from technological breakthroughs, the innovative allocation of production factors, and industry transformation, focusing on improving total factor productivity and advanced innovation. Agriculture, a key sector for national economic development, faces significant opportunities with new productive forces and

the rural revitalization strategy. Modern agriculture requires traditional knowledge, advanced engineering, information technologies, and management skills. Agricultural universities' master's programs in hydraulic and civil engineering must focus on training talents to support high-quality agricultural development, contributing to rural revitalization.

Traditional education in civil and hydraulic engineering often focuses on theoretical knowledge, neglecting practical and innovative skills. With emerging technologies like Building Information Modeling (BIM), Geographic Information Systems (GIS), cloud computing, big data, artificial intelligence (AI), 3D printing, Internet of Things (IoT), and robotics, the field faces rapid transformation. These technologies not only advance the industry but also raise the bar for talent competencies. To address the challenges of homogenization in education, agricultural universities must integrate resources, reform training models, and enhance innovation and practical skills. Aligning education with industry needs is crucial for fostering high-quality talent capable of driving agricultural growth and rural revitalization. This article explores how the talent cultivation model for hydraulic and civil engineering master's programs can better align with industry demands in the context of new productive forces.

## **2. The current situation and challenges of master's talents in civil and hydraulic engineering at agricultural universities**

The essence of international competition in the new era lies in the competition of comprehensive national strength, with innovative talents as the core under the backdrop of new quality productive forces. Cultivating such talents is essential to mastering core technologies, gaining international competitiveness, and advancing industrial prosperity. Since 2017, the emergence of concepts like "new engineering," "new agriculture," and "new medicine" has marked a strategic reform in education aimed at nurturing high-quality innovative talents aligned with national needs. Agricultural universities play a pivotal role in this effort, particularly in civil and water conservancy programs, which are critical to rural revitalization and agricultural modernization.

Xi Jinping's 2019 guidance emphasized cultivating new talents who "know and love agriculture," setting a direction for agricultural universities. The modernization of agriculture and rural revitalization require interdisciplinary collaboration and the integration of science, engineering, agriculture, and social sciences to solve complex problems. Current master's degree programs in civil and water conservancy are evolving to address these demands, emphasizing interdisciplinary courses, practical teaching, and industry-academia integration to foster innovation and practical abilities <sup>[1,2]</sup>.

However, challenges remain. Agricultural universities face shortages of high-level teaching staff and research teams, insufficient experimental facilities, and a misalignment between curricula and industry needs. Addressing these issues involves recruiting talent, upgrading equipment, and refining curricula to align with market demands <sup>[3]</sup>. In contrast, foreign universities excel in interdisciplinary cooperation, project-based teaching, and fostering environmental and sustainable development awareness. Their practices in green building materials and resource optimization offer valuable lessons for domestic institutions to improve talent cultivation models <sup>[4-7]</sup>.

## **3. The connection between new quality productive forces and talent cultivation**

### **3.1. The connotation and characteristics of new quality productive forces**

New quality productive forces differ fundamentally from traditional productive forces, achieving a qualitative

leap through scientific, technological, managerial, and institutional innovation. These forces represent an advanced state of productivity that departs from traditional economic growth patterns, characterized by high technology, efficiency, and quality. Aligned with new development concepts, they consist of “high-quality” laborers, “new-medium” labor means, and “new-material-quality” labor objects. Anchored in strategic emerging and future industries, their goal is high-quality development to meet the demands of the new era, economy, and industries<sup>[2]</sup>. The core distinguishing feature of new quality productive forces is their reliance on scientific and technological innovation, which drives their development. Key characteristics include:

- (1) Innovation-driven: Scientific and technological innovation is the primary engine propelling these productive forces.
- (2) Green, intelligent, and efficient: Emphasis is placed on resource conservation, environmental protection, and the integration of intelligent technologies to enhance efficiency and product quality.
- (3) Integrated development: They merge multiple technologies and industries, such as information technology with manufacturing and biotechnology with agriculture.

New quality productive forces leverage cutting-edge technologies like digitization, networking, and intelligence to enhance production efficiency and create new industries and business models. These forces enable precise resource allocation through advanced data analysis, boosting productivity and economic growth. Emphasizing high-quality, customizable, consumer-driven outcomes, they meet diverse market demands and stimulate the growth of emerging industries. The cultivation of innovative talent is key to transforming technological breakthroughs into tangible productivity, ensuring sustained advancement of these forces.

### **3.2. New quality productive forces and the development of education.**

In September 2023, General Secretary Xi Jinping, during his inspection in Heilongjiang, emphasized the integration of scientific and technological innovation, the development of strategic emerging industries, and the acceleration of new quality productive forces. He highlighted the importance of industries such as new energy, materials, advanced manufacturing, and electronic information in driving development<sup>[8,9]</sup>. This aligns with the ongoing scientific revolution and industrial transformation, positioning new quality productive forces as central to China’s strategic development and national rejuvenation. New quality productive forces represent a leap in productivity, driven by high efficiency and quality through technological innovation, supported by high-level talent, and underpinned by digitalization, intelligence, and sustainability<sup>[10]</sup>. Unlike traditional forces, they focus on innovation, digitalization, and high-quality outcomes, with scientific innovation at their core. These forces emphasize reducing environmental impact while achieving social, economic, and ecological benefits through sustainable practices.

Research on new quality productive forces mainly explores their theoretical foundations and practical applications. Theoretical research examines their characteristics and internal logic, while applied studies focus on how they foster high-quality education and innovation. Marxist productivity theory underscores the importance of labor, means, and objects of labor, with education playing a key role in upgrading these elements, transforming simple labor into specialized labor and driving scientific innovation. Education has historically been crucial for productivity growth. For example, Germany’s research universities during the Second Industrial Revolution contributed to economic growth through technological breakthroughs. Modern studies show that knowledge capital significantly influences national economic development. Education not only supports technological advancements but also facilitates knowledge reproduction, fostering innovation and the development of new

quality productive forces. Thus, education and scientific innovation jointly drive sustainable economic and societal progress.

### **3.3. The impact of new quality productive forces on civil engineering and water conservancy**

New quality productive forces, characterized by high technology, efficiency, and quality, are transforming civil engineering and water conservancy. High technology drives scientific and technological innovation, with advancements like big data, artificial intelligence (AI), and the Internet of Things (IoT) revolutionizing the planning, design, construction, and management of water conservancy projects. High efficiency is evident in optimizing resource allocation and reducing costs. For instance, advanced construction technologies and management models can shorten construction timelines, improve project quality, and lower resource consumption. High quality emphasizes delivering projects that not only meet functional needs, such as flood control and irrigation, but also prioritize ecological sustainability and environmental protection.

These productive forces foster technological innovations, such as digital twin water conservancy technology, which enables real-time monitoring, early warning systems, and optimized project management through digital modeling. They also drive industrial upgrades, with the adoption of eco-friendly materials advancing green and intelligent water conservancy construction. Additionally, they promote innovative business models like the Public-Private Partnership (PPP) model, which attracts private investment to enhance efficiency and quality in project execution. For example, the “Yulonghao” manned submersible has improved dam inspection accuracy and efficiency, ensuring safer water conservancy operations.

## **4. Requirements of new quality productive forces for professional master’s degree talents in civil engineering and water conservancy**

New quality productive forces emphasize scientific innovation, collaboration, and sustainable development. Professional master’s degree talents in civil engineering and water conservancy must possess the following traits:

- (1) **Interdisciplinary ability:** Professionals should not only grasp civil engineering and water conservancy but also fields like information technology (IT), environmental science, and materials science. For example, intelligent construction requires knowledge of computer science and automation.
- (2) **Innovation ability:** Graduates must be capable of developing new solutions and technologies in engineering practice, such as advanced water resource management and ecological restoration in water conservancy projects.
- (3) **Practical application ability:** Students must apply theoretical knowledge to solve real-world problems, gaining practical experience through engineering projects to strengthen their problem-solving skills.
- (4) **Teamwork ability:** Professionals must collaborate effectively with experts from diverse fields. In water conservancy projects, civil, water conservancy, and environmental engineers must work together.

To meet the demands of new quality productive forces, the talent cultivation model must evolve. The civil engineering and water conservancy industries require interdisciplinary, innovative talents with a capacity for continuous learning. Agricultural colleges, with their strong resources and faculty, are well-positioned to innovate. Through industry partnerships and practical experience, they can equip students with the skills needed to meet market demands and enhance employability. Reforms in agricultural colleges are essential for adapting to industry changes and improving national competitiveness.



## **5. Innovative measures for talent cultivation in civil engineering and water conservancy at agricultural colleges**

To innovate the talent cultivation model for professional master's degrees in civil engineering and water conservancy, agricultural colleges should focus on three key measures:

- (1) Curriculum and teaching innovation: The curriculum should combine foundational theories with advanced technologies, incorporating interdisciplinary courses like environmental science and IT to enhance students' interdisciplinary skills. A small-class, individualized teaching model should be adopted, with a strong emphasis on practical training through industry partnerships and off-campus internships, allowing students to apply theory in real-world projects.
- (2) Industry-university-research integration: Agricultural colleges should strengthen collaboration with enterprises and research institutions through joint projects, labs, and research and development (R&D) centers. These partnerships will foster innovation, accelerate research application, and provide students with opportunities to develop creativity and problem-solving skills through research activities and innovation contests.
- (3) Quality assurance and evaluation: Colleges must establish strong quality assurance systems, set clear talent development objectives, and diversify assessment methods, including papers, project reports, and practical evaluations. Tracking graduate employment and employer feedback will help refine the curriculum to better align with industry needs.

By implementing these measures, agricultural colleges can enhance the quality of talent development in civil engineering and water conservancy, supporting industry progress and boosting national competitiveness.

## **6. Conclusion and prospect**

This study explores the innovation of the talent cultivation model for professional master's degrees in civil engineering and water conservancy in agricultural colleges and universities to support the development of new quality productive forces. It clarifies the critical role of these degree programs in this context, analyzing the current talent cultivation situation and proposing specific measures for improvement.

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## **Author contributions**

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