WHIOCE PUBLISHING PTE. LTD.
PROVIDING FIRST-CLASS SCIENTIFIC INFORMATION FOR TOP SCHOLARS

2025 Volume 3, Issue 6
Lecture Notes in Education, Arts, Management and Social Science
ISSN(Online): 2705-053X

Exploration Paradigm of the Teaching and Research System for Land Science and Technology under the "Four-in-One" Layout Oriented to New Agricultural Sciences

Mingjie Shi [1,2,3], Hongqi Wu [1,2,3], Xinjun Wang [1,2,3], Shichao Cui [1,2,3]

[1]College of Resources and Environment, Xinjiang Agricultural University, Urumqi 830052, Xinjiang, China
[2]Key Laboratory of Soil and Plant Ecological Processes in Xinjiang, Urumqi 830052, Xinjiang, China
[3]Xinjiang Soil Big Data Engineering Technology Research Center, Urumqi 830052, Xinjiang, China

Abstract: Against the backdrop of new agricultural sciences construction, it is crucial to build a teaching and research system for land science and technology that meets the needs of the new era. This paper focuses on the "Four-in-One" layout concept (synergetic development of teaching, scientific research, practice, and application) and conducts in-depth exploration into the innovative paradigm of the teaching and research system in the field of land science and technology. The study proposes that the core of the teaching and research system should be closely centered on the key concept of comprehensive land management in the whole region, especially serving the national major strategic needs—the planning, implementation, and monitoring & evaluation of projects for the integrated protection and restoration of mountains, rivers, forests, farmlands, lakes, grasslands, and deserts. To this end, the system focuses on developing three core curriculum directions: 1. Application of geographic information systems (GIS) and remote sensing technology, which provides spatial information support for the investigation, dynamic monitoring, and precise management of land resources in the whole region; 2. Territorial spatial planning, which focuses on optimizing the pattern of territorial spatial development and protection, supporting the overall coordination and sustainable utilization of all elements in the whole region; 3. Eco-hydrology, which deeply explores the mutual feedback mechanisms among water, soil, vegetation, and ecosystems, providing a scientific basis for land ecological restoration, water resource management, and the improvement of ecosystem services. By integrating theoretical teaching, cutting-edge scientific research, project practice (especially projects related to mountains, rivers, forests, farmlands, lakes, grasslands, and deserts) and social service applications in these three directions, this study aims to build a land science and technology teaching and research system with clear goals, cutting-edge content, distinct practice orientation, and adaptability to the development needs of new agricultural sciences. It provides an effective path for cultivating compound land science and technology talents with systematic thinking, practical ability, and innovative spirit, and serves the national strategies of rural revitalization, ecological civilization construction, and modernization of territorial spatial governance. This paper can provide certain references for educational reform, curriculum setting, and practical teaching of new agricultural sciences.

Keywords: New agricultural sciences; Land science and technology; Educational reform; Curriculum setting; Talent cultivation

Online publication: July 26, 2025

1. Introduction

The proposal of the concept of New Agricultural Science (i.e., modern agricultural science and technology) aims to respond to the national agricultural modernization development strategy and promote the innovation of agricultural science and technology. With the rapid development of information technology, land science and technology, as an interdisciplinary subject, has been widely applied in the agricultural field. Land science and technology not only involves basic spatial data collection, processing and analysis technologies, but also is closely related to various fields such as agriculture, environmental protection, and climate change [1-3].

The construction of New Agricultural Science is an important strategy in China's agricultural modernization process, which aims to cultivate high-quality agricultural talents adapting to the development of the new era through educational reform. With the increasing social demand for agricultural science and technology as well as management talents, the goal of New Agricultural Science is mainly to realize the efficiency, sustainability and intellectualization of agricultural production. In this context, Geographic Information System (GIS), as an important technical means, its application in the major of Land Science and Technology has become increasingly important. GIS can not only provide the collection, analysis and visualization of spatial data, but also play a positive role in promoting the management of agricultural resources, farmland planning and environmental protection.

At present, China's agricultural development is facing many challenges, including resource shortage, environmental pollution and climate change. The solution to these problems depends on scientific decision support, and GIS is an important tool to provide such support. Therefore, integrating GIS into the education of New Agricultural Science can effectively improve students' practical ability and innovative thinking, and provide technical support for the development of modern agriculture.

Combined with the current needs of agricultural modernization, it is necessary and urgent to carry out research on land science and technology education. Previous studies have pointed out that integrating ideological and political education and the intersection of agricultural science theoretical knowledge into the courses of Land Science and Technology can better serve the needs of the construction of New Agricultural Science [4-5]. At the same time, some studies have emphasized that the practical teaching reform of 3D GIS courses needs to be combined with the background of New Agricultural Science to meet the needs of the era for compound talents [6].

To sum up, studying the education of Land Science and Technology under the background of New Agricultural Science is not only an exploration of talent training mode, but also a positive response to the development of China's agricultural modernization. By deeply analyzing the current situation and challenges of land science and technology teaching, this paper puts forward a four-in-one teaching system construction mode of "ideological and political education, foundation, frontier, and application", aiming to improve the teaching quality and scientific research level of land science and technology in agricultural colleges and universities, and promote the comprehensive development of New Agricultural Science.

2. Integration of the new agricultural science background with the major of land science and technology

The core task of the new agricultural science is to promote the integrated innovation of agricultural science and technology, and drive the sustainable development of agriculture through the power of science and technology. As a discipline related to spatial data and information processing, land science and technology has been widely applied in various fields such as agricultural planting, disaster early warning, and environmental monitoring. With the rapid development of smart agriculture, the application fields of geographical information science are constantly expanding, which provides rich teaching materials and research directions for agricultural colleges and universities.

Against the backdrop of the new agricultural science, the teaching of land science and technology in agricultural colleges and universities should not only focus on the imparting of disciplinary knowledge but also pay attention to cultivating students' innovative thinking and ability to solve practical problems. By combining land science and technology with agricultural practices, students can apply the knowledge they have learned in real agricultural production scenarios, thereby improving their practical ability and technical level [7].

3. Integration of ideological and political education with professional education in land science and technology

Ideological and political education is not only a process of cultivating students' ideological and political qualities but also an important way to shape their sense of social responsibility and collectivism. As a highly technical discipline, land science and technology needs to integrate more ideological and political elements into the teaching process, such as national development strategies, social responsibilities, and environmental protection.

Integrating ideological and political education into the teaching of land science and technology can guide students to establish correct values and enhance their sense of mission for technological innovation. Specifically, national development strategies such as China's agricultural modernization and green agricultural development can be incorporated into teaching cases, enabling students to better understand the country's emphasis on agricultural science and technology while learning technologies, and stimulating their enthusiasm to contribute to the country's agricultural development.

4. Integration of fundamentals, frontiers, and applications in the teaching of land science and technology

Basic teaching, frontier research, and application-oriented teaching are three important dimensions of land science and technology teaching. This system focuses on building three core curriculum directions: 1. Application of Geographic Information System (GIS) and Remote Sensing (RS) technologies, providing spatial information support for nationwide land resource survey, dynamic monitoring, and precise management; 2. Territorial spatial planning, focusing on optimizing the pattern of territorial spatial development and protection, and supporting the overall coordination and sustainable utilization of all elements in the whole region; 3. Eco-hydrology, exploring the mutual feedback mechanism of water-soil-vegetation-ecosystem, providing a scientific basis for land ecological restoration, water resource management, and improvement of ecosystem services [8].

To improve teaching quality, these three dimensions must be organically integrated. In terms of teaching content, the integration of fundamentals, frontiers, and applications can be achieved through the design of curriculum systems; in terms of teaching methods, forms such as case teaching, project-driven learning, and experimental courses can be adopted to enable students to consolidate their knowledge in practice and pay attention to the latest developments in the discipline.

Against the backdrop of the new agricultural science, the goal setting of land science and technology courses should pay more attention to in-depth integration with agricultural science to meet the needs of modern agriculture for spatial data analysis and management. According to previous studies [9], the current GIS courses have deficiencies in the integration of ideological and political education and the "feelings for agriculture, rural areas, and farmers", and the theoretical system is not closely intertwined with agricultural science knowledge. Therefore, the reconstruction of course content is particularly necessary [10-11].

In curriculum setup, more agricultural-related practical cases should be introduced to enhance students' understanding of the application of GIS in agriculture. For example, by analyzing practical cases such as precision agriculture, soil management, and crop monitoring, students can be helped to master the specific application scenarios of GIS technology in agriculture [12-13]. At the same time, combined with literature research, the curriculum should set up corresponding practical links to encourage students to collect, analyze data, and make decisions in real agricultural environments, thereby truly transforming theoretical knowledge into practical ability. Previous studies have found that aiming at the problems in the principle courses of land science and technology, such as insufficient integration of ideological and political education and “feelings for agriculture, rural areas, and farmers”, loose connection between the theoretical system and agricultural science knowledge, and lack of practical training content, a curriculum content reconstruction plan was proposed. The plan aims to improve the teaching quality of the courses and students’ comprehensive quality, so as to serve the construction needs of the new agricultural science [14-15].

5. Construction of the “Four-in-One” teaching and research system for the land science and technology major at Xinjiang Agricultural University

5.1. The practical system of Xinjiang Agricultural University features distinct characteristics

Soil contact before enrollment: For four consecutive years, the “A Cup of Soil for Freshmen” activity has been carried out. Students collect soil samples from their hometowns, analyze the data, and the results are connected to Xinjiang’s soil big data platform, directly serving local agricultural production.

Soil recognition after enrollment: Relying on over 20 bases such as the Shaya Cotton Science and Technology Courtyard and the Jiashi Fresh Plum Science and Technology Courtyard under the Ministry of Education, students participate in practical projects like soil monitoring and land improvement. For example, students of the 2024 cohort used UAV remote sensing to complete a land use status survey and formulate vegetation restoration plans in a county-level project involving the integrated management of mountains, rivers, forests, farmlands, lakes, grasslands, and deserts.

Soil application upon graduation: Graduation designs are closely linked to practical needs. For instance, the 2022 graduates designed a combined scheme of “phytoremediation + soil leaching” for soil heavy metal pollution in mine restoration areas, which was adopted by local relevant departments.

5.2. In-depth integration of school-enterprise collaboration

An “industry-university-research” alliance has been jointly established with natural resources departments and ecological restoration enterprises. For example, in cooperation with Urumqi Hongdu Jiaye Biotechnology Co., Ltd., research and development of saline-alkali soil improvers are carried out, with students participating in production process optimization and field experiments. Meanwhile, a “Joint Research Center for Non-cultivated Land Utilization in Gobi Deserts” has been co-founded with Zhejiang University to explore the application of intelligent monitoring technology in land consolidation [16-17].

5.3. Implementation of the national student “A Cup of Soil for Freshmen” series of teaching and research activities

As reported by Xinjiang Daily (https://xjrb.ts.cn/index): Since 2021, the College of Resources and Environment of Xinjiang Agricultural University has carried out the “A Cup of Soil for Freshmen” social practice activity for four consecutive years. Based on the technical specifications of the Third National Soil Census, under the guidance of professional teachers, freshmen admitted to the College of Resources and Environment go into the fields, pick up shovels, and experience a day as “soil people”. They dig standard soil profiles, collect soil samples, conduct surveys on farmland production information and data, communicate with farmers, and comprehensively start their professional cognitive journey. So far, more than 600 students have participated in the “A Cup of Soil for Freshmen” survey and sampling activities. The sampling points cover over 300 counties and cities in 28 provinces, autonomous regions, and municipalities across the country, including Xinjiang, Henan, Shaanxi, Shanxi, and Gansu, with a total of 615 soil samples collected.

6. Conclusions and prospects

Based on the background of the new agricultural science construction, this study explores and constructs a land science and technology teaching and research system with the "teaching-research-practice-application" four-in-one structure. Guided by the core of comprehensive land management, this system is deeply integrated into the national major project needs of the integrated protection and restoration of mountains, rivers, forests, farmlands, lakes, grasslands, and deserts. By focusing on three curriculum directions—geographic information system and remote sensing, territorial spatial planning, and eco-hydrology—it realizes interdisciplinary integration and full-chain capability training. Geographic information systems and remote sensing technologies provide a spatial information base for dynamic monitoring of global resources and precise project management; territorial spatial planning courses strengthen the ability of overall coordination of global elements and spatial optimization decision-making; eco-hydrology reveals the interaction mechanism of water, soil, and vegetation, providing scientific mechanism support for ecological restoration. The three work together to significantly enhance students' practical and innovative abilities in complex land system governance.

To sum up, future directions should focus on the in-depth integration of land science and technology education with agricultural science, the targeted construction of various majors, the optimization of talent training systems, and the exploration of the application of new technologies. In-depth research in these directions can better promote the construction of new agricultural science and the development of agricultural modernization.

Disclosure statement

The author declares no conflict of interest.

References

[1] Chen H, Bai C, Li G, 2025, Practice and Exploration of Party Building Brand Creation in Colleges and Universities in the New Era under the Background of "Mass Entrepreneurship and Innovation" — A Case Study of School of Land Science and Spatial Planning, Hebei GEO University. Industrial and Science Tribune, 24(04): 251-254.

[2] Duan X, Gong W, Sun Y, et al., 2022, Land Use Change in Coastal Zone of Hainan Island and Its Impact on Temporal and Spatial Evolution of Carbon Storage. Bulletin of Soil and Water Conservation, 42(05): 301-311.

[3] Fu Z, Yang J, 2024, Ecological Environment Monitoring and Land Use in Midong District of Xinjiang Based on Remote Sensing Ecological Index. Central South Agricultural Science and Technology, 45(01): 142-148.

[4] Hu Z, Liu X, Zhang Z, et al., 2025, Review of Key Progress in Land Science Research in 2024 and Outlook for 2025—Sub-report on Land Engineering and Information Technology. China Land Science, 39(03):124-133.

[5] Lin J, Sun S, Liu F, 2022, Review of Key Progress in Land Science Research in 2021 and Outlook for 2022— Sub-report on Land Resource Utilization and Spatial Planning. China Land Science, 36(03): 116-126.

[6] Wu X, Yang Z, Tan S, et al., 2023, Research on Practical Teaching Reform of "3 + N" 3D GIS Course under the Background of New Agricultural Science. Journal of Smart Agriculture, 3(24): 141-144.

[7] Xie Z, Lin X, 2024, Exploration on Talent Training Mode of Land Resources Management Discipline under the Background of New Agricultural Science. Higher Agricultural Education, 2024(01): 65-73.

[8] Gao Y, Liu Y, Zhu D, et al., 2022, Research on Discipline Construction of Land Science and Technology Supported by Key Laboratories. Laboratory Science, 25(01): 179-182.

[9] Li T, Liu X, Wu X, et al., 2024, Reconstruction and Practice of "Four-in-One" Curriculum Content of Principles of Geographic Information System for New Agricultural Science. Journal of Higher Education, 10(34): 109-114.

[10] Wang Q, Yu X, Chen M, et al., 2025, Review of Key Progress in Land Science Research in 2024 and Outlook for 2025. China Land Science, 39(03): 99-110.

[11] Zhu D, Wu Y, Wang Y, et al., 2025, Review of Key Progress in Land Science Research in 2024 and Outlook for 2025—Sub-report on Land Management. China Land Science, 39(02): 126-136.

[12] Jia G, Lin W, Xu R, et al., 2022, Calculation and Analysis of SDG 15.1.2 Biodiversity Index Based on Remote Sensing: A Case Study of Yangtze River Delta Ecological Green Integration Development Demonstration Zone. Research of Environmental Sciences, 35(04): 1025-1036.

[13] Wang B, Ran Y, 2022, Comparison of Authenticity Verification Methods for Land Cover Remote Sensing Products. Remote Sensing Technology and Application, 37(01): 196-204.

[14] Hao Y, Zhang D, Hua L, et al., 2022, Curriculum Construction and Thoughts on "Introduction to Geographic Information Systems" for Pratacultural Science Major under the Background of "New Agricultural Science". Journal of Guizhou Education University, 38(12): 51-58.

[15] Hou T, Lv X, Zhang Z, et al., 2021, Discussion on GIS Classroom Teaching of Agronomy Major under the Background of New Agricultural Science. Education Informatization Forum, 2021(11): 41-42.

[16] Li Y, 2024, Reform and Practice of Blended Teaching in College Course "Modern Chinese"— A Case Study of Xinjiang Agricultural University. Writer World, 2024, (15): 89-91.

[17] Yang Z, Wang C, Du C, et al., 2024, Research and Practice on Teaching of Horticulture Major under the Background of Farming and Reading Education— A Case Study of Seedling Raising Practice in Horticulture Major of Xinjiang Agricultural University. Modern Horticulture, 47(09): 189-191 + 194.