УДК 378.6:631:502.3
DOI 10.58649/1694-9099-2026-2-35-46

Лю Цзинжун
Жогорку мектеп, Түндүк-Батыш педагогикалык университети, Ланьчжоу шаары, Ганьсу провинциясы, 730070, Кытай.
Лю Цзинжун
Высшая школа, Северо-Западный педагогический университет, г. Ланьчжоу, провинция Ганьсу, 730070, Китай.
Jing-rong Liu
Graduate School, Northwest Normal University, Lanzhou, Gansu 730070, China)

"АЙЫЛ ЧАРБА РЕСУРСТАРЫ ЖАНА АЙЛАНА-ЧӨЙРӨ" ИЛИМИЙ ДИСЦИПЛИНАСЫНЫН АЗЫРКЫ АБАЛЫ ЖАНА ӨНҮГҮҮ ЖОЛДОРУ: ГАНЬСУ ПРОВИНЦИЯСЫНЫН МИСАЛЫНДА

СОВРЕМЕННОЕ СОСТОЯНИЕ И ПУТИ РАЗВИТИЯ НАУЧНОЙ ДИСЦИПЛИНЫ «СЕЛЬСКОХОЗЯЙСТВЕННЫЕ РЕСУРСЫ И ОКРУЖАЮЩАЯ СРЕДА»: НА ПРИМЕРЕ ПРОВИНЦИИ ГАНЬСУ

CURRENT STATUS AND DEVELOPMENT PATHWAYS OF THE AGRICULTURAL RESOURCES AND ENVIRONMENT DISCIPLINE: A CASE STUDY OF GANSU PROVINCE

Кыскача мүнөздөмө: Дүйнөлүк климаттын өзгөрүшүнүн, жаратылыш ресурстарынын чектелүүлүгүнүн жана экологиялык абалдын начарлашынын таасиринин күчөшүнө карабастан, "Айыл чарба ресурстары жана айлана-чөйрө" илимий тармагы бир катар актуалдуу көйгөйлөргө туш болууда, анын ичинде илимий изилдөөлөрдү кайра багыттоо, адистерди даярдоо системасын өркүндөтүү жана изилдөө инфраструктурасын модернизациялоо. Бул изилдөө Ганьсу провинциясында бул тармактын азыркы абалын жана өнүгүү этаптарын комплекстүү талдоону камсыз кылат, анын түзүмдүк көйгөйлөрүн жана негизги чектөөлөрүн аныктайт, жаңы өнүгүү мүмкүнчүлүктөрүн карайт жана андан ары өркүндөтүү боюнча практикалык багыттарды сунуштайт. Тартипти андан ары өнүктүрүү мамлекеттик саясатка, каржылык колдоого жана университеттердин, изилдөө уюмдарынын жана өндүрүш тармагынын ортосундагы инновациялык кызматташуу механизмдерине негизделиши керек экендиги негизделген. Аймакта айыл чарбасын модернизациялоо жана экологиялык коопсуздукту чыңдоо үчүн бекем илимий негиз түзө турган тармакты экологиялык жактан багытталган, интеллектуалдык жана туруктуу өнүктүрүүгө өтүүгө өзгөчө көңүл бурулат.

Аннотация: В условиях усиливающегося воздействия глобального изменения климата, возрастающих ограничений природных ресурсов и ухудшения экологической обстановки научная дисциплина **«Сельскохозяйственные ресурсы и окружающая среда»** сталкивается с рядом актуальных задач, включая переориентацию научных исследований, совершенствование системы подготовки специалистов и модернизацию научно-исследовательской инфраструктуры. В настоящем исследовании проведен комплексный анализ современного состояния и этапов развития данной дисциплины в провинции Ганьсу, выявлены ее структурные проблемы и основные ограничения, рассмотрены новые возможности развития, а также предложены практические направления дальнейшего совершенствования. Обосновано, что дальнейшее развитие дисциплины должно осуществляться на основе государственной политики, финансовой поддержки и механизмов инновационного сотрудничества между университетами, научно-исследовательскими организациями и производственным сектором. Особое внимание уделяется переходу к экологически ориентированному, интеллектуальному и устойчивому развитию дисциплины, что позволит обеспечить прочную научную основу для модернизации сельского хозяйства региона и укрепления экологической безопасности.

Abstract: Under the combined pressures of global climate change, tightening resource constraints, and ecological degradation, the agricultural resources and environment discipline faces critical issues including

research direction restructuring, talent cultivation model innovation, and research platform upgrading. This study systematically reviews the current development status and stage-specific characteristics of the agricultural resources and environment discipline in Gansu Province, identifies structural problems and constraints, analyzes emerging opportunities, and proposes actionable development pathways. Future efforts should rely on policy guidance, financial support, and industry-university-research collaborative innovation mechanisms to promote the discipline's development toward green, intelligent, and ecological orientations, providing a solid disciplinary foundation for regional agricultural modernization and ecological security.

Негизги сөздөр: айыл чарба ресурстары жана айлана-чөйрө; илимий тармактын өнүгүшү; өнүгүү багыттары; Ганьсу провинциясы.

Ключевые слова: сельскохозяйственные ресурсы и окружающая среда; развитие научной дисциплины; направления развития; провинция Ганьсу.

Keywords: Agricultural Resources and Environment; Discipline Construction; Development Pathways; Gansu Province

1. Introduction

China, as the world's largest developing country and agricultural nation, faces agricultural resource and environmental problems of particular complexity and urgency. Decades of the extensive agricultural development model characterized by high inputs and high consumption has caused a series of ecological and environmental problems, such as soil erosion, groundwater overextraction, declining farmland quality, and intensifying agricultural non-point source pollution. In recent years, the Chinese government has successively proposed the "dual carbon" goals, the rural revitalization strategy, and the policy orientation of green agricultural development. These initiatives signal that Chinese agriculture is undergoing a profound transformation from the traditional high-consumption model to an ecologically sustainable mode(Jianbo SHEN et al., 2024). However, this transformation process faces multiple constraints, including lagging technology research and development, insufficient talent reserves, and inefficient mechanisms for converting scientific research achievements into practical applications(Denning & Glenn, 2025).

Domestic universities have undertaken various explorations in discipline construction and talent cultivation.Researchers have identified structural deficiencies in traditional training programs, including the tendency to emphasize theory over practice and insufficient interdisciplinary integration(Wang et al., 2025). Some universities have actively promoted practical education reforms. For example, Gansu Agricultural University has explored the educational concept of "three-education coordination and five-education integration" in its soil and water conservation and desertification control major. This initiative aims to cultivate professional talents adapted to national ecological security strategic needs. In addition, with the widespread application of information technologies such as big data and remote sensing in agriculture, related disciplines have gradually strengthened the cultivation of data analysis and technology application competencies in their curriculum design(Lokers et al., 2016).

Gansu Province serves as an important agricultural and ecological barrier in northwest China. The development of its agricultural resources and environment discipline carries significant strategic importance for regional agricultural transformation and the construction of ecological civilization. Systematically assessing the current development status of the agricultural resources and environment discipline in Gansu Province, identifying its strengths and weaknesses, and exploring discipline development pathways aligned with regional characteristics and national strategic needs carries significant practical necessity and theoretical value. Theoretically, this study deepens understanding of the discipline's inherent developmental laws and enriches the theoretical framework for regional discipline research in arid and semi-arid regions by integrating sustainable development theory with local agricultural resource endowments(Barthel et al., 2017).Practically, the findings provide a scientific basis for government departments to formulate discipline development plans, offer reference pathways for universities to optimize research directions and reform talent cultivation models, and accelerate the adoption of green and low-carbon agricultural technologies in alignment with national

strategic goals(Liu et al., 2024). Furthermore, this study provides experiential reference for discipline development in other ecologically vulnerable regions, demonstrating good regional adaptability and broader application potential.

Current Development Status

2.1 Discipline Construction and Research Directions

There are 18 first-level disciplines authorized to confer master's degrees and 23 first-level disciplines authorized to confer doctoral degrees in agricultural resources and environment in China, however, only Gansu Agricultural University has established this discipline in Gansu Province. The discipline in Gansu Province builds on the region's unique geographic and ecological conditions, has established core research directions in dryland agriculture, water-saving agriculture, ecological restoration, and sustainable resource utilization. Global research on sustainable agriculture has deepened considerably in recent years. Against this backdrop, the discipline has shifted from single-technology optimization toward systematic, interdisciplinary approaches(Velten et al., 2015; Liu et al., 2024). With the advancement of China's national ecological civilization strategy, the discipline has made notable progress in controlling agricultural non-point source pollution, soil improvement, and efficient water use.

Under the research framework of agricultural system diversity, Gansu Province has promoted vertical deep-rotary tillage technology and green high-yield cultivation techniques for dryland potatoes. These measures have effectively improved the productivity of medium- and low-yield farmland. They demonstrate the diverse pathways through which agricultural technologies can adapt to local conditions(Therond et al., 2017). In addition, high-activity soil conditioning agents to address the challenge of rapid fertility enhancement in newly developed high-standard farmland. These agents have been applied at scale. They have effectively improved farmland quality and laid a material foundation for regional agricultural sustainable development.

In terms of discipline construction, universities such as Gansu Agricultural University have developed relatively complete curricula and teaching practice mechanisms. Their programs cover soil and water conservation, desertification control, agricultural resources, and environmental science. Gansu Agricultural University has established a series of practical education standards for its soil and water conservation and desertification control program. The university emphasizes an educational philosophy of "three-education coordination and five-education integration." This approach addresses the strategic needs of national ecological security. Meanwhile, the discipline has actively promoted cross-fertilization with emerging fields such as ecological agriculture and circular agriculture. This integration drives the discipline toward greater systematization and comprehensiveness. Such developments align with the current consensus in international academia on expanding and integrating sustainable agricultural research(Clark et al., 2016; Acevedo et al., 2018).

Nevertheless, Gansu institutions still face considerable gaps in internationalizing their faculty and strengthening interdisciplinary integration capacity. Global agricultural higher education is shifting from knowledge transmission toward competency-based education that demands practical competence, interdisciplinary literacy, and systems thinking. Collaborative innovation mechanisms among research platforms remain at an early stage, and the level of international cooperation needs further improvement.

2.2 Faculty and Research Platforms

The agricultural resources and environment discipline in Gansu Province has assembled a faculty team with considerable experience in agricultural resource management, ecological restoration, and soil pollution control. At Gansu Agricultural University, for example, the soil and water conservation and desertification control program maintains a teaching and research team composed of professors, associate professors, and lecturers. This team provides basic support for practical education in the discipline.

However, from an international comparative perspective, agricultural higher education is undergoing a profound transformation. This transformation moves from knowledge transmission toward competency-based education. Agricultural extension and higher education now demand greater practical competence, interdisciplinary literacy, and systems thinking from professionals (Gorman & Monica, 2019; Suvedi et al.,

2018). Consequently, relevant institutions in Gansu Province still face considerable gaps in internationalizing their faculty and strengthening interdisciplinary integration capacity.

In terms of research platform development, Gansu Province has established multiple key laboratories and research centers in the field of agricultural resources and environment. Gansu Agricultural University hosts a Key Laboratory of Agricultural Resources and Environment. Its main research directions include agricultural non-point source pollution control, soil improvement, and efficient water resource utilization. In addition, Gansu Province has leveraged the research resources of universities such as China Agricultural University and Beijing Normal University to promote collaborative innovation in the discipline.

International experience shows that the effective transformation of sustainable agricultural university education requires fundamental changes to the education system. These changes include innovations in teaching methods, curriculum design, and industry-university-research cooperation models(Paola et al., 2016). Gansu Province's exploration in this direction remains at an early stage. The integration efficiency of its research platforms and the level of its international cooperation need further improvement.

2.3 Talent Cultivation Scale and Quality

In recent years, the scale of talent cultivation in Gansu Province's agricultural resources and environment discipline has steadily expanded. Nevertheless, the overall quality still exhibits structural weaknesses. In terms of program distribution, Gansu Province has approximately ten undergraduate programs in agricultural environmental science. By contrast, the relevant program offerings at vocational colleges remain relatively weak. This creates an unbalanced pattern characterized by "strong undergraduate education and weak vocational education."Regarding the curriculum structure, the allocation between theoretical instruction and practical training is suboptimal. A tendency to "emphasize theory over practice" is prevalent.

This situation stands in contrast to the development trends of international agricultural higher education reform. Research shows that the implementation of Competence-Based Education (CBE) in agricultural higher education directly affects graduates' professional competence. Cognitive differences between faculty and students regarding this educational model often constitute the main barrier to reform(Saadvandi et al., 2019). Recent research further identifies the core characteristics of an effective agricultural higher education system. These include competency-oriented curriculum design, teaching methods that strengthen practical training, and a cultivation mechanism that closely connects with industry demands.

Gansu Province has introduced models such as school-enterprise cooperation and work-study integration in its talent cultivation for this discipline. However, the systematic nature and depth of practical skills training remain insufficient. Related research emphasizes that practical skills training in agricultural education should permeate the entire cultivation process rather than be confined to concentrated internship periods before graduation (Deegan et al., 2016). Therefore, Gansu Province urgently needs to optimize its talent cultivation pathway for the agricultural resources and environment discipline. It must strengthen practical teaching and improve the alignment between talent cultivation and regional industry demands.

2.4 Research Outputs and Regional Contributions

Research outputs from the discipline have played an important supporting role in regional agricultural sustainable development. In terms of agricultural model innovation, Gansu Province has promoted diversified models, including water-saving agriculture, dryland farming, agritourism, and circular agriculture. These initiatives have advanced rural environmental governance and agricultural industrial upgrading. These practices correspond with international academic discussions on organic agriculture and sustainable agricultural models. Research demonstrates that organic agriculture holds significant environmental and food safety importance in the 21st century. It can provide effective technical pathways for sustainable agricultural development(Reganold et al., 2016; Meemken et al., 2025).

In terms of industrial contributions, Gansu Province has developed four hundred-billion-yuan industries (beef cattle, sheep, vegetables, and medicinal herbs), three fifty-billion-yuan industries (fruits, potatoes, and grain), and one thirty-billion-yuan industry cluster (seeds). These developments have driven the total output value of the agricultural industry chain above 600 billion yuan. They have significantly enhanced the resilience of the regional agricultural economy.

In the area of agricultural non-point source pollution control, Gansu Province has developed high-activity soil conditioning agents and promoted vertical deep-rotary tillage technology. These measures have effectively improved farmland quality. Related research indicates that controlling agricultural non-point source pollution requires systematic strategies. These include coordinated efforts in source reduction, process interception, and end-of-pipe treatment(Xue et al., 2020). Gansu Province's practical explorations in this field have provided a replicable model for agricultural non-point source pollution control in arid and semi-arid regions. Furthermore, the promotion and application of ecological agriculture and circular agriculture models have facilitated efficient utilization of agricultural resources and resource-oriented transformation of waste. They have driven regional agriculture toward green development.

Main Problems and Challenges

3.1 Insufficient Funding and Low Conversion Rate of Research Outputs

The agricultural resources and environment discipline in Gansu Province has long faced relatively insufficient research funding. This has become a key bottleneck constraining discipline development. The funding shortage affects not only the depth and cutting-edge nature of basic research but also limits the breadth of technology promotion and application. In the global agricultural research landscape, sustainable intensification of agriculture is widely recognized as the core pathway to address the dual challenges of food security and environmental protection. Its realization depends on adequate research investment and efficient innovation systems(R ockström et al., 2017). There is a clear gap between Gansu Province's research investment intensity and this requirement.

The low conversion rate of research outputs is equally prominent. Research findings in agricultural resources and environment typically require multidimensional synergy among technology extension, policy support, and market mechanisms to achieve effective transformation. Gansu Province exhibits significant weaknesses in this process. On the one hand, cooperation mechanisms between research institutions and enterprises remain underdeveloped. Stable and efficient industry-university-research collaboration platforms are lacking. On the other hand, the policy support system is incomplete. Incentive mechanisms and safeguard measures for research output transformation need strengthening.

International experience indicates that building agricultural technology innovation systems requires holistic consideration of the entire chain connecting scientific research, technology development, and extension application. A smooth pathway from the laboratory to the field must be established(Foley et al., 2011). Moreover, sustainable agricultural transformation involves complex interactions across technological, institutional, and social dimensions. Cross-sectoral and cross-domain collaborative governance mechanisms are needed to support this transformation (Boix-Fayos et al., 2023). In building its research output transformation system, Gansu Province urgently needs to draw on international advanced experience. It should establish diversified funding channels and efficient technology transfer mechanisms.

3.2 Brain Drain and Imbalanced Research Team Structure

High-level talent outflow remains significant, driven by relatively backward research environments, limited compensation, constrained career development space, and regional economic factors. At the same time, mechanisms for cultivating and recruiting young talent are inadequate, resulting in an imbalanced age structure in the research team that is "large at both ends and small in the middle." The team lacks young and middle-aged backbone members who can connect the senior and junior generations.

From an international perspective, the re-examination and reform of agricultural higher education has become a global consensus. Traditional agricultural education models face multiple challenges from changing industry demands, technological innovation, and sustainable development goals (LaCharite & Kerri, 2016). Against this backdrop, the talent dilemma of Gansu Province's agricultural resources and environment discipline reflects not only the constraints of regional economic development but also deep-seated problems in the agricultural education system and talent management mechanisms.

Research shows that building a competency-based agricultural higher education system requires clear professional competence standards, industry-aligned curricula, and flexible talent evaluation mechanisms(Saadvandi et al., 2024). Gansu Province's institutional development in these areas remains at an

exploratory stage. Furthermore, practical experience in agricultural extension higher education demonstrates that cultivating professional talents such as agricultural advisors requires strengthening systems thinking, interdisciplinary integration capacity, and practical experience accumulation(Gorman & Monica, 2019). Therefore, Gansu urgently needs to innovate its talent recruitment and cultivation mechanisms to enhance the endogenous momentum of discipline development..

3.3 Prominent Regional Agricultural Environmental Problems

3.3.1 Climate Change Brings New Challenges

Under the background of climate change, optimizing soil management strategies is particularly urgent. Research shows that climate-smart soil management can improve soil structure, enhance carbon sequestration capacity, and increase nutrient use efficiency. It can simultaneously achieve multiple goals, including food production, climate mitigation, and climate adaptation(Paustian et al., 2016). In addition, research on the response mechanisms of soil carbon sequestration to climate-smart agricultural practices shows that conservation tillage and organic matter addition can significantly increase soil organic carbon stocks(Bai et al., 2019). Although Gansu Province has undertaken substantial work in soil and water conservation and soil improvement, strengthening the scientific rigor of soil management in the face of climate change remains essential.

3.3.2 Water Scarcity and Low Utilization Efficiency

Water scarcity is a prominent problem in Gansu Province.According to the “2025 Gansu Water Resources Bulletin”reported, the province’s total water resources amount to only 27.668 billion cubic meters in 2025, representing 0.8% of the national total, with per capita water resources stand at 22% of the national average. The uneven spatial and temporal distribution of water resources further exacerbates the supply-demand contradiction. This poses a serious threat to agricultural production and ecological security. Agricultural practices that synergistically achieve food security, climate mitigation, and adaptation goals typically require integrated measures combining soil management, water resource management, and cropping system optimization(Smith et al., 2020). Gansu must strengthen technological innovation and policy support to address increasingly severe constraints.

3.4 Ecological and Environmental Pressures in Agricultural Production

Ecological pressures facing agricultural production in Gansu manifest primarily through agricultural non-point source pollution, improper agricultural waste disposal, and ecosystem degradation. Non-point source pollution stems from excessive chemical fertilizer and pesticide use, and despite measures to improve efficiency, control remains challenging due to traditional production inertia and limited farmer capacity to adopt new technologies(Xue et al., 2020).

Agricultural waste disposal is equally prominent. The collection, treatment, and recycling system for crop straw, livestock manure, and other wastes remains underdeveloped, leading to high treatment costs and significant environmental pressure. International research points out that the bioconversion and recycling of agricultural waste is a key link in achieving a circular bioeconomy. It involves diversified utilization pathways, including bioenergy, biomaterials, and biofertilizers(Sarangi et al., 2023). Gansu Province still has considerable room for improvement in technology research and development and industrial promotion in this field.

Development Opportunities and Policy Support

4.1 National and Local Policy Support

4.1.1 Rural Revitalization and Green Agriculture Strategy

The rural revitalization strategy drives agricultural and rural modernization. Its core purpose is to achieve high-quality agricultural development and comprehensive rural revitalization. In this context, green agriculture has become a critical pathway for agricultural transformation. Sustainable agriculture centers on achieving a dynamic balance among agricultural production, ecological environments, and socioeconomic systems(Velten et al., 2015). Green agriculture emphasizes resource conservation, environmental friendliness, and ecological sustainability. It promotes systemic transformation of agricultural production methods by reducing chemical fertilizer and pesticide inputs and by expanding organic and ecological farming models.

Gansu's unique resource endowments and constraints–including water scarcity, land degradation, and ecological fragility–make implementing green agriculture strategies particularly significant for the discipline.

4.1.2 Ecological Protection and "Dual Carbon" Goals

Ecological protection and the "dual carbon" goals present new strategic opportunities for the agricultural resources and environment discipline in Gansu Province. Gansu is located at the intersection of the Loess Plateau, the Inner Mongolian Plateau, and the Qinghai-Tibet Plateau. Its ecosystems are complex and diverse. The concept of "climate-smart soils" provides an important theoretical framework for agricultural carbon management research in Gansu. It emphasizes achieving synergistic goals of agricultural production, climate adaptation, and greenhouse gas emission reduction through soil management(Paustian et al., 2016).

4.2 Green Transformation of Agriculture and Smart Agriculture Development

The green transformation of agriculture and the development of smart agriculture constitute important research dimensions. Green transformation emphasizes the ecological friendliness and sustainability of agricultural production. Smart agriculture relies on information technology and intelligent methods to improve agricultural production efficiency and precision.Achieving sustainable agriculture requires the organic integration of theoretical innovation, methodological breakthroughs, practical exploration, and policy support(Liu et al., 2024).

4.3 Agricultural Circular Economy and Ecological Restoration Technologies

The agricultural circular economy and ecological restoration technologies represent important research fields. The core of the agricultural circular economy lies in achieving closed-loop resource utilization and the resource-based transformation of waste, reducing material loss and environmental emissions. The resource utilization of agricultural waste biomass is an important pathway for promoting the circular bioeconomy(Sarangi et al., 2023).The AgroCycle project research demonstrates that building an agricultural circular economy requires systematic advancement of technological innovation, industrial collaboration, and policy support(Toop et al., 2017) .

4.4 Agricultural Mechanization and Ecological Efficiency Improvement

Agricultural mechanization and ecological efficiency improvement constitute important research directions. Agricultural mechanization replaces labor inputs and optimizes operational processes. It can significantly improve agricultural production efficiency while reducing resource consumption and environmental load per unit of output.The concept of sustainable intensification emphasizes achieving dual goals of increased agricultural output and reduced ecological impact through technological progress and management optimization(R ockström et al., 2017).

Recommendations for Future Development Pathways

5.1 Optimization of Research Directions

5.1.1 Climate Change Adaptation Research

Climate change is exerting increasingly profound impacts on Gansu's agricultural systems, with extreme events including droughts, heat waves, and heavy rainfall posing systematic threats to production and food security(Anderson et al., 2020). Research priorities should include revealing agricultural ecosystem response mechanisms, clarifying crop-soil-atmosphere interaction patterns, and exploring adaptive strategies such as optimizing planting structures and promoting stress-resistant crop varieties. Mixed crop-livestock systems exhibit strong adaptation capacity under climate change(Thornton et al., 2015), offering valuable reference for developing integrated production models in Gansu. Strengthening agricultural meteorological monitoring and early warning systems will enhance the foresight of agricultural responses, aligning closely with the climate-smart agriculture framework(Lipper et al., 2014).

5.1.2 Strategies for Agricultural Resource Development and Utilization

Gansu Province possesses diverse agricultural resource endowments.Improving resource utilization efficiency of existing cropland is the core strategy for resolving the tension between food security and ecological protection(Foley et al., 2011). Research and practice should focus on the following areasdeveloping and promoting water-saving technologies such as drip and sprinkler irrigation. Deepening agricultural waste resource utilization through straw return and composting reduces non-point source pollution while improving

recycling rates. Sustainable land use has become a focal area of international academic attention(Aznar-Sanchez et al., 2019). In addition, Gansu needs to strengthen the optimal allocation of agricultural land resources and promote industrial transformation toward characteristic agriculture and high value-added agriculture.

5.2 Reform of Talent Cultivation Models

5.2.1 Three-Education Coordination and Five-Education Integration

The reform of talent cultivation models should adhere to comprehensive and coordinated development of moral, intellectual, physical, aesthetic, and labor education. Modern agricultural talent requires not only solid professional knowledge, but also competencies in problem-solving, critical thinking, and interdisciplinary collaboration(Saadvandi et al., 2019). At the moral education level, professional ethics and social responsibility education should be strengthened, as sustainable agricultural education promotes transformation of students' values and behavioral patterns (Paola et al., 2016). At the intellectual education level, curriculum design should be optimized to include courses on agricultural ecosystem analysis and pollution control. At the labor education level, practical skills training should be improved through field internships and technology extension programs(Deegan et al., 2016).

5.2.2 Training of Green and Low-Carbon Agriculture Talents

Agricultural carbon emissions from excessive chemical fertilizer and pesticide use constitute a prominent concern. Integrating sustainable development concepts throughout talent cultivation aligns with international calls for repositioning agricultural higher education(LaCharite & Kerri, 2016).Reforms should strengthen teaching of low-carbon technologies, including organic and ecological agriculture, as organic agriculture demonstrates significant carbon sequestration advantages(Meemken et al., 2025).Training in conservation tillage and other carbon sequestration technologies should also be enhanced to support the province's transition toward a low-carbon agricultural system.

5.3 Construction of Research Platforms

5.3.1 Interdisciplinary Collaborative Research Platforms

Agricultural resource and environmental problems involve multiple fields including ecology, environmental science, and information science. Interdisciplinary teaching enhances comprehensive thinking and problem-solving capabilities(Pauley et al., 2019), and breaking disciplinary barriers is key to agricultural innovation(Mckim et al., 2018). Gansu should build platforms integrating agriculture and ecological environment science, focusing on circular agriculture and carbon sequestration agriculture. Such platforms should incorporate artificial intelligence and big data technologies(Lokers et al., 2016), facilitating collaboration among universities, research institutes, and industry partners to accelerate knowledge translation.

5.3.2 Agrometeorology and Ecological Safety Research Platforms

Construction of monitoring networks for real-time farmland monitoring should be accelerated to provide a scientific foundation for discipline development(Anderson et al., 2020). These platforms should support early warning systems for extreme weather events and enable data-driven decision-making. Integration with national ecological monitoring networks will enhance spatial coverage and data quality for regional agricultural research.

5.4 Policy Support and Institutional Innovation

5.4.1 Low-Carbon Agriculture Compensation and Incentive Mechanisms

Effective policy incentives promote the adoption of climate-smart technologies (Lipper et al., 2014). Gansu should establish a multi-level and diversified low-carbon agriculture compensation system. Farmers who adopt low-carbon production models such as organic agriculture and ecological agriculture should receive appropriate economic compensation.A systematic study has shown that scientifically sound agricultural management measures can achieve multiple wins for food security, climate mitigation, and adaptation capacity(Smith et al., 2020). In addition, Gansu needs to improve the construction of agricultural carbon sequestration trading markets and explore pathways for realizing the value of agricultural carbon sequestration. This will provide sustainable economic incentives for green agricultural development.

5.4.2 Policy System for Green Agricultural Development

Improving green agriculture policy systems requires establishing evaluation mechanisms and ecological compensation systems(R ockström et al., 2017). By analyzing Common Agricultural Policy reform that agricultural policy formulation should fully consider the multiple objectives of ecological protection(Cuadros-Casanova et al., 2023). Policy evaluation mechanisms should be built to balance economic and ecological benefits.Based on this understanding, Gansu should advance the following institutional developments. First, establish a policy evaluation mechanism for green agricultural development. Regular assessments of policy implementation effectiveness should be conducted, and policy directions and priorities should be adjusted in a timely manner. Second, strengthen the publicity and promotion of green agricultural development policies to enhance farmers' green awareness and willingness to participate. Third, improve the agricultural ecological environment compensation system and strengthen coordination mechanisms between ecological protection and economic development. These measures will create a favorable policy environment for the development of the agricultural resources and environment discipline.

6. Discussion

6.1 Summary

This study systematically analyzed the development of the agricultural resources and environment discipline in Gansu Province from multiple dimensions. These include the evolution of research hotspots, talent cultivation systems, scientific research platform construction, and policy support mechanisms. Overall, research in agricultural resources and environment is showing a trend toward multi-dimensional, interdisciplinary integration and deep evolution. Sustainable agriculture research has shifted from a singular focus on production efficiency toward comprehensive consideration of economic, ecological, and social multidimensional objectives(Velten et al., 2015). This transformation is fully confirmed in the present analysis. From the identification and management of agricultural environmental problems to the resource utilization of agricultural waste, from the optimization of talent cultivation systems to the adjustment and innovation of policy mechanisms, related research has achieved notable progress at both theoretical and practical levels.

At the disciplinary value cognition level, the sustainable agriculture models embody the organic unity of multiple values. This includes the synergistic pursuit of economic efficiency, ecological integrity, and social equity(Gael et al., 2018). This understanding provides profound theoretical insight for the development of the agricultural resources and environment discipline in Gansu: disciplinary development should not be limited to technological innovation but must also attend to value-level guidance and reconstruction. In terms of talent cultivation, this study found that the agricultural resources and environment major still faces structural problems such as "emphasizing theory over practice" and insufficient university-enterprise collaboration. There are particularly notable shortcomings in cultivating high-level applied talent. The innovation in agricultural talent cultivation models plays a key role in achieving the dual goals of food security and environmental protection(Acevedo et al., 2018).Research in agricultural resources and environment also demonstrates significant policy-oriented characteristics. This requires that disciplinary development must actively align with national strategic needs. The discipline should find its positioning and leverage its strengths within major strategic agendas such as rural revitalization, ecological civilization construction, and the "dual carbon" goals.

6.2 Future Development Trends and Research Directions

In the future, the development of agricultural resources and environment will place greater emphasis on systematicity, synergy, and sustainability. The following main trends are anticipated:

First, climate change adaptation research will become a core issue for disciplinary development. It has been noted that climate change is exerting increasingly profound impacts on global agricultural systems(Anderson et al., 2020). Establishing scientifically effective adaptation mechanisms has become a primary task for agricultural research. As a climate change-sensitive region, Gansu should strengthen the research, development, and promotion of climate-adaptive agricultural technologies in the future. The province should build resilient agricultural systems and enhance the capacity of agriculture to respond to extreme climate events.

Second, climate-smart agriculture will become an important paradigm for agricultural development. The climate-smart agriculture framework proposed by Lipper emphasizes the synergistic goals of food security, climate adaptation, and greenhouse gas emission reduction.(Lipper et al., 2014) This concept will play an increasingly important guiding role in future agricultural policy formulation and technological innovation. Gansu should actively learn from international experience and combine it with regional realities to explore climate-smart agriculture development pathways with cold and arid characteristics.

Third, research on agricultural waste resource utilization will place greater emphasis on practical application needs. Industry-university-research integration should be promoted, and technology transfer processes should be accelerated. The research demonstrated that scientifically sound resource management measures can achieve synergistic advancement of multiple objectives(Smith et al., 2020). This provides scientific grounding for the development of the circular economy in Gansu agriculture.

Fourth, agricultural talent cultivation will place greater emphasis on cultivating comprehensive competencies and practical literacy. The research by Acevedo emphasized that future agricultural talent should possess interdisciplinary knowledge backgrounds, innovation capabilities, and a sense of social responsibility(Acevedo et al., 2018). These qualities will enable graduates to adapt to the diversified needs of sustainable agricultural development. This requires agricultural higher education to deepen teaching reform and build new talent cultivation models featuring industry-education integration and science-education collaboration.

Fifth, disciplinary development will place greater emphasis on interdisciplinary integration and international cooperation. The initiative by LaCharite points the direction for the transformation of agricultural higher education: re-examining the positioning and mission of agricultural education, and fully integrating sustainable development concepts throughout disciplinary construction and talent cultivation(LaCharite & Kerri, 2016). The agricultural resources and environment discipline in Gansu Province should actively integrate into the global agricultural science and technology innovation network. Through international cooperation, the discipline should enhance its competitiveness and influence.

In conclusion, the agricultural resources and environment discipline in Gansu Province stands at a critical juncture. Addressing the identified challenges while capitalizing on emerging opportunities will require coordinated efforts across research, education, and policy domains. By embracing interdisciplinary integration, climate-smart approaches, and the circular bioeconomy, the discipline can make substantial contributions to regional sustainable development while serving as a model for ecologically vulnerable regions worldwide.

References

1. Jianbo SHEN, Qichao ZHU, HOU Yong, Wen-Feng CONG, XU Wen, Jiuliang XU, Zhichao AN, Xiaoqiang JIAO, Kai ZHANG, Tianxiang YU, MA Lin, Oene OENEMA, William J. DAVIES, & Fusuo ZHANG. (2024). Agriculture Green Development in China: Insights and Advances. Engineering Agriculture, 11, 5-19.

2. Denning, & Glenn. (2025). Sustainable Intensification of Agriculture: the Foundation for Universal Food Security. Npj Sustainable Agriculture, 3(1).

3. Wang, Lingling, Zhang, Panpan, Chen, Li, Luo, Hui, Li, Jingsuo. (2025). Research on the Impact of Practical Teaching Quality in Chinese Agricultural Universities on Students' Behavioral Intention to Serve "agriculture, Rural Areas, and Farmers". Sustainability (2071-1050), 17(24), 10905. Lokers, Rob, Knapen, Rob, Janssen, Sander, Van Randen, Yke, Jansen, & Jacques. (2016). Analysis of Big Data Technologies for Use in Agro-environmental Science. Environmental Modelling & Software, 84, 494-504.

4. Barthel, R, Seidl, & R. (2017). Interdisciplinary Collaboration Between Natural and Social Sciences – Status and Trends Exemplified in Groundwater Research. Plosone, 12(1), e0170754.

5. Liu, Moucheng, Chen, Xin, Jiao, & Yuanmei. (2024). Sustainable Agriculture: Theories, Methods, Practices and Policies. Agriculture; Basel, 14(3).

6. Velten, Sarah, Leventon, Julia, Jager, Nicolas, Newig, & Jens. (2015). What Is Sustainable Agriculture? a Systematic Review. Sustainability, 7(6), 7833-7865.

7. Therond, Olivier, Duru, Michel, Roger-Estrade, Jean, Richard, & Guy. (2017). A New Analytical Framework of Farming System and Agriculture Model Diversities. a Review. Agronomy for Sustainable Development, 37(3).
8. Clark,William C.,Tomich, et al. Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR)(2016). Proceedings of the National Academy of Sciences,113(17): 4615-4622
9. Acevedo, Miguel F., Harvey, David R., Palis, & Florencia G.. (2018). Food Security and the Environment: Interdisciplinary Research to Increase Productivity while Exercising Environmental Conservation. Global Food Security, 16.
10.Gorman, & Monica. (2019). Becoming an Agricultural Advisor – the Rationale, the Plan and the Implementation of a Model of Reflective Practice in Extension Higher Education. The Journal of Agricultural Education and Extension, 25(2), 179-191.
11.Suvedi, Murari, Ghimire, Ramjee, Channa, & Ty. (2018). Examination of Core Competencies of Agricultural Development Professionals in Cambodia. Evaluation and Program Planning, 67(Apr.), 89-96.
12.Paola, Migliorini, Geir, & Lieblein. (2016). Facilitating Transformation and Competence Development in Sustainable Agriculture University Education: an Experiential and Action Oriented Approach. Sustainability, 8(12), 1243.
13.Saadvandi, Mahsa, Abbasi, Enayat, Farhadian, Homayoun, Zarafshani, Kiumars, Biemans, & Harm. (2019). Teachers and Students' Perception of Competence-based Education in the Agricultural Higher Education System (case of a Student Cooperative in Iran). The Journal of Agricultural Education and Extension, 25(4), 307-322.
14.Deegan, Donna, Wims, Padraig, Pettit, & Tony. (2016). Practical Skills Training in Agricultural Education-a Comparison Between Traditional and Blended Approaches. The Journal of Agricultural Education and Extension, 22(2), 145-161.
15.Reganold, John P., Wachter, & Jonathan M.. (2016). Organic Agriculture in the Twenty-first Century. Nature Plants, 2(2), 15221.
16.Meemken, Eva Marie, Qaim, & Matin. (2025). Organic Agriculture, Food Security, and the Environment. Annual Review of Resource Economics, 10(1), 39-63.
17.Xue, Lihong, Hou, Pengfu, Zhang, Zhiyong, Shen, Mingxing, Liu, Fuxing, Yang, & Linzhang. (2020). Application of Systematic Strategy for Agricultural Non-point Source Pollution Control in Yangtze River Basin, China. Agriculture, Ecosystems & Environment, 304(000).
18.R ockström, Johan, Williams, John, Daily, Gretchen, Noble, Andrew, Matthews, Nathanial, Gordon, Line, Wetterstrand, Hanna, Declerck, Fabrice, Shah, Mihir, Steduto ... Jimmy. (2017). Sustainable Intensification of Agriculture for Human Prosperity and Global Sustainability. Ambio - a Journal of the Human Environment, 46(1), 4-17.
19.Foley, Jonathan A, Ramankutty, Navin, Brauman, Kate A, Cassidy, Emily S, Gerber, James S, Johnston, Matt, Mueller, Nathaniel D, 'Connell O, Christine, Ray, Deepak K, West ... David PM. (2011). Solutions for a Cultivated Planet. Nature, 478(7369), 337-342.
20.Boix-Fayos, Carolina, Vente, & Joris De. (2023). Challenges and Potential Pathways Towards Sustainable Agriculture Within the European Green Deal. Agricultural Systems, 207, 103634.
21.LaCharite, & Kerri. (2016). Re-visioning Agriculture in Higher Education: the Role of Campus Agriculture Initiatives in Sustainability Education. Agriculture and Human Values, 33(3), 521-535.
22.Saadvandi, Mahsa, Abbasi, Enayat, Biemans, Harm, Zarafshani, Kiumars, Farhadian, & Homayoun. (2024). Identifying Characteristics of a Competence-based Agricultural Higher Education System: a Literature Review. The Journal of Agricultural Education and Extension, 30(2), 297-316.
23.Paustian, Keith, Lehmann, Johannes, Ogle, Stephen, Reay, David, Robertson, G. Philip, Smith, & Pete. (2016). Climate-smart Soils. Nature, 532(7597), 49.

24.Bai, Xiongxiong, Huang, Yawen, Ren, Wei, Coyne, Mark, Jacinthe, P ierre-Andre, Tao, Bo, Hui, Dafeng, Yang, Jian, Matocha, Chris. (2019). Responses of Soil Carbon Sequestration to Climate-smart Agriculture Practices: a Meta-analysis. Global Change Biology, 25(8), 2591-2606.
25.Smith, Pete, Calvin, Katherine, Nkem, Johnson, Campbell, Donovan, Cherubini, Francesco, Grassi, Giacomo, Korotkov, Vladimir, Le Hoang, Anh, Lwasa, Shuaib, McElwee ... Almut. (2020). Which Practices Co-deliver Food Security, Climate Change Mitigation and Adaptation, and Combat Land Degradation and Desertification?. Global Change Biology, 26(3), 1532-1575.
26.Sarangi, Prakash Kumar, Subudhi, Sanjukta, Bhatia, LatikaSaha, KoelMudgil, DivyaShadangi, Krushna PrasadSrivastava, Rajesh K.Pattnaik, BhabjitArya, & Raj Kumar. (2023). Utilization of Agricultural Waste Biomass and Recycling Toward Circular Bioeconomy. Environmental Science and Pollution Research, 30(4), 8526-8539.
27.Toop, Trisha A., Ward, Shane, Oldfield, Thomas, Hull, Maria, Kirby, Marie E., Theodorou, & Michael K.. (2017). Agrocycle – Developing a Circular Economy in Agriculture. Energy Procedia, 123, 76-80.
28.Anderson, Robyn, Bayer, Philipp E, Edwards, & David. (2020). Climate Change and the Need for Agricultural Adaptation. Current Opinion in Plant Biology, 56.
29.Thornton, Philip, K., Herrero, & Mario. (2015). Adapting to Climate Change in the Mixed Crop and Livestock Farming Systems in Sub-saharan Africa. Nature Climate Change.
30.Lipper, Leslie, Thornton, Philip, Campbell, Bruce M., Baedeker, Tobias, Braimoh, Ademola, Bwalya, Martin, Caron, Patrick, Cattaneo, Andrea, Garrity, Dennis, Henry ... Emmanuel F.. (2014). Climate-smart Agriculture for Food Security. Nature Climate Change, 4(12), 1068-1072.
31.Aznar-Sanchez, Jose A.Piquer-Rodriguez, MariaVelasco-Munoz, F.Manzano-Agugliaro Juan, & Francisco. (2019). Worldwide Research Trends on Sustainable Land Use in Agriculture. Land Use Policy, 87.
32.Pauley, Catlin M, Mckim, Aaron J, Curry, Kevin W, Mckendree, R Bud, Sorensen, & Tyson J. (2019). Evaluating Interdisciplinary Teaching: Curriculum for Agricultural Science Education. Journal of Agricultural Education, 60(1), 158-171.
33.Mckim, Aaron J, Pauley, Catlin M, Velez, Jonathan J, Sorensen, & Tyson J. (2018). Interdisciplinary Learning Opportunities in Agriculture, Food, Natural Resources, and Science: the Role of the Teacher. Journal of Agricultural Education, 59(2).
34.Cuadros-Casanova, Ivon, Cristiano, Andrea, Biancolini, Dino, Cimatti, Marta, Sessa, Andrea Antonio, Mendez Angarita, Valeria Yeraldin, Dragonetti, Chiara, Pacifici, Michela, Rondinini, Carlo, Marco Di, & Moreno. (2023). Opportunities and Challenges for Common Agricultural Policy Reform to Support the European Green Deal. Conservation Biology, 37(3), e14052.
35.Gael, Plumecocq, Thomas, Debril, Michel, Duru, Marie-Beno?T, Magrini, Pierre, Sarthou Jean, Olivier, & Therond. (2018). The Plurality of Values in Sustainable Agriculture Models: Diverse Lock-in and Coevolution Patterns. Ecology & Society, 23(1), art21.

Рецензент: к.филол.н., доцент Апаева С.Х.

УДК 378.4(510):94(510)
DOI 10.58649/1694-9099-2026-2-46-53

Ню Чэнчунь
Марксизм мектеби, Түндүк-Батыш педагогикалык университети, Ланчжоу, Ганьсу
Ню Чэнчунь
Факультет марксизма, Северо-Западный педагогический университет, Ланьчжоу, провинция Ганьсу
Niu Chengchun
School of Marxism, Northwest Normal University, Lanzhou, Gansu