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INSTITUTIONALISING RURAL DIGITALISATION IN AGRICULTURAL MANAGEMENT: A REVIEW OF POLICY, GOVERNANCE, AND SUSTAINABILITY IN CHINA'S RURAL TRANSFORMATION

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Abstract:

A large-scale, policy-driven reform in agricultural governance for developing countries is China's rural digitalisation plan. Integrate a review of previous studies and conduct a documentary case study of Beijing's rural and peri-urban areas to explore the institutionalisation path of rural digitalisation in agricultural management. Scopus, Web of Science, and the China National Knowledge Infrastructure (CNKI) were used to search for 36 peer-reviewed papers and policy documents published between 2019 and 2025, and then these were organised by theme. The three contents of this paper are: (1) The national policy system for digitalisation under the rural revitalisation plan; (2) Institutional barriers to implementation, including governance fragmentation, capacity deficits and digital exclusion; and (3) Technological and environmental results of digital transformation, such as enhanced productivity and green development. We find that China's Digital Rural Development Action Plan (2019–2025) and the 14th Five-Year Plan for Agricultural and Rural Modernisation have built a strong policy system, but successful institutionalisation requires closing multi-level coordination gaps, enhancing local administrative capacity, and ensuring inclusive digital access. The Beijing case shows that rural and semi-urban areas are under pressure to balance the speed of new-

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technology adoption with uneven institutional construction. Finally, we list the directions for future research: Longitudinal studies of institutional changes, cross-regional comparisons, and closer attention to the life experiences of rural stakeholders.

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Keyword:

Agricultural Management, Beijing, China, Digital Governance, Institutionalisation, Integrative Literature Review, Rural Digitalisation, Rural Revitalisation

Introduction

A major reform of rural governance in the 21st century is China's campaign to digitise the countryside. The Digital Rural Development Action Plan (2019-2025) released by MARA in 2019 did not add technology to the old system. Digitalisation has also been added to the new rural construction strategy recently (Tian et al., 2023). Two Goals set the plan. By 2025, the covered rural areas of broadband will exceed 70 per cent. Digital agriculture should account for at least 15% of the added value in agriculture (He et al., 2024; Luo et al., 2023). Behind these figures is a deeper change: away from the old model of input-intensive, small-plot agriculture in rural China, it is moving towards technology-enabled, integrated rural economies.

The distinctive feature of this policy direction is its institutional emphasis. Digitalisation in Beijing does not refer to the application of technology; instead, it is an institutional reform process that rearranges governance procedures, extension systems, infrastructure planning and cross-ministerial coordination (He et al., 2024). In the 14th Five-Year Plan for Agricultural and Rural Modernisation (2021-2025), the digital village model will be further promoted to drive agricultural and rural modernisation by enhancing productivity, narrowing the urban-rural gap, and promoting social equity (Zhao & Li, 2022). It is to be expected that the future sustainability of this alteration will be driven by institutions, not by new digital devices.

Yet high-level aspirations and on-the-ground execution frequently differ. Research has gradually uncovered various deficiencies in the policy design at the implementation level. Departmental fragmentation inhibits governance coordination. Institutional capacity is relatively high in the eastern coastal area compared with the interior. Rather than being reduced, the digital divide may simply manifest in a new form under technology (Luo et al.,

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2023; Fan et al., 2022). Beijing's rural and peri-urban areas provide a case study for the problems mentioned above. Beijing is a direct-controlled municipality of the central government and has excellent digital facilities; however, the institutions in the surrounding areas are not uniform. Thus, this joint effort will provide a reference point for examining the institutional embedding of digital agriculture in practice.

Three research questions guide this review. First, what policy system has been built to promote rural digitalisation, and how do these policies define the role of institutions? Second, what institutional deficiencies restrict implementation and expansion? Third, what technological and environmental results have been documented, and what do they show about sustainability? The structure of this paper is as follows. Next, we introduce the system of national policies and governance structure; identify institutional problems (fragmentation, lack of capacity, digital exclusion) and examine the technology-environment connection. A documentary case study of Beijing's rural and peri-urban areas provides a specific scenario for the above patterns. Finally, the paper presents the problems and future work of this study.

Review Methodology

In combination, the above several research methods are used to study the same set of conceptual issues (Whittemore & Knafl, 2005), namely quantitative research, qualitative research and document analysis. An integrated design was selected because the research questions concern institutional dynamics that cross-cut disciplinary literatures in agricultural economics, governance studies, information systems and rural sociology, and the relevant evidence base combines peer-reviewed scholarship with policy documents. A documentary case study of Beijing's rural and peri-urban areas is used to explore whether the general patterns in the literature can be realized in a specific institutional environment.

Literature search in Scopus, Web of Science and China National Knowledge Infrastructure (CNKI) was carried out. Combined search strings for the phenomenon ("rural digitalisation", "digital village", "digital agriculture", "e-agriculture") with terms for the setting ("China", "rural China", "Beijing") and the institutional dimension ("governance", "institution", "policy", "adoption", "sustainability"). Limit the search window to publications from 2019 to 2025 and include the implementation period of the Digital Rural Development Action Plan. The main policy documents, including the Action Plan itself, the 14th Five-Year Plan for Agricultural and Rural Modernisation and municipal digital agriculture plans, were collected from the official government website to supplement the scholarly collection.

The inclusion criteria required that the sources (a) addressed digitalisation in agriculture or rural governance with an explicit institutional, policy or adoption dimension; (b) concerned China or provided a comparative perspective directly relevant to the Chinese case; and (c) were peer-reviewed articles, scholarly book chapters or authoritative policy documents published between 2019 and 2025. Studies focusing only on the technical engineering aspects without institutional analysis, and studies without a focus on China or comparisons, were excluded. Screening by title and abstract, and then full-text examination, a final set of 36 sources was selected for analysis.

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Thematic Synthesis was used to organise the retained literature. The extracted contents were inductively coded and organised into three analysis themes that correspond to the research questions: policy framework and governance system; institutional problems; and technological and environmental results. For the documentary case study of Beijing, policy documents and published empirical studies on the rural and peri-urban districts of the municipality—including Yanqing, Miyun, Huairou, Pinggu, and Daxing—were triangulated to explore how multi-level governance dynamics shape the institutionalisation of digital agriculture. Therefore, the case will be used to present the general results of the review and is not considered an independent empirical study.

Reviewing Policy Frameworks: From National Strategy to Local Implementation

The Digital Rural Development Action Plan (2019-2025)

The first document for China's rural digitalisation plan was released by MARA in 2019 as the Digital Rural Development Action Plan. Its scope of application is far-reaching, covering broadband network construction, the digitalisation of large-scale agricultural production processes, the development of rural e-commerce platforms, and the construction of big data and AI-driven decision-making systems (Tian et al., 2023). Specific Goals in the plan are achievable. Rural Internet Coverage should be more than 70%. By 2025, digital agriculture will contribute to the value-added portion of the agricultural sector at least 15 per cent (He et al., 2024; Luo et al., 2023). The goals are far from the previous efficiency-constrained, marginal agriculture; instead, high-tech, integrated rural economies that are productive and globally competitive are being built.

The Action Plan is a demand of the institution, not one driven by technology. Structural reform of the governance machinery, support systems, extension services and rural infrastructure planning are all required (He et al., 2024). This whole-of-government approach shows that Beijing hopes to replace the traditional rural model with a digitally enabled, innovation-driven system of agricultural development. Empirical research has supported the institutionally oriented plan. Digitalisation can help boost agricultural production and environmental adaptability; thus, provinces with a relatively high digital foundation, such as Zhejiang and Jiangsu, have been leading the way (Ren, 2023; Deng et al., 2024). However, according to the above data, the benefits have not been distributed uniformly. They are based on the antecedent institutional and infrastructural readiness, thus requiring place-sensitive implementation strategies.

The 14th Five-Year Plan and the Digital Village Concept

Based on the Action Plan, the 14th Five-Year Plan for Agricultural and Rural Modernisation (2021-2025) will use the digital village as a key platform for improving rural production and the urban-rural integration of social modernisation for farmers (Zhao & Li, 2022). The plan will introduce digital technology in all parts of society, including precision agriculture, real-time logistics systems, intelligent rural management and agricultural risk assessment and management (Zhao et al., 2022). Rural development and sustainability should be based on new tools and new ways of organising, with the support of digital infrastructure and data-driven policymaking.

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The plan will promote social equity by advancing the cause of digital agriculture. First, it aims to close the digital divide between urban and rural areas to help disadvantaged groups in rural areas access information and services online (Yang et al., 2023). This direction is far from the previous rural modernisation efforts; they focused on mechanisation and were narrowly targeted. The new strategy is based on digital inclusion for long-term development of the knowledge economy (Hou et al., 2023). However, whether this equity-oriented view can be achieved depends on how well the local institutions can convert the national directives into context-appropriate measures, and this problem will be explored in detail in the following section.

Multi-Level Governance Architecture

Coordination at all levels of government and across multiple ministries is required to achieve the goal of rural digitalisation under this policy. The central government allocates funds and sets policies. Provinces and cities implement the policies. Their abilities differ significantly. Fragmentation of governance, a lack of interdepartmental cooperation and overlapping responsibilities have all hindered the development and institutionalisation of the digital initiative (Luo et al., 2023). Most of the construction work for smart farm technology is led by agricultural bureaus, and communication department staff are in charge of building the digital infrastructure. The split introduces coordination bottlenecks and thus delays adoption (Deng et al., 2024). Economic disparities between the eastern coastal area and the rest of China exacerbate the problem, resulting in uneven development of digital infrastructure and different levels of coverage, thus raising questions about the fairness of the digital transformation.

Institutional Problems in Rural Digitalisation

Governance Fragmentation and Coordination Deficiencies

Fragmentation of governance is also mentioned repeatedly in the literature. Actors in China's rural digitalisation include agricultural bureaus, communications departments, commerce ministries and local governments. Although they have overlapping mandates, the incentive systems and reporting lines are not always coordinated (Tang, 2021). Research in the Beijing-Tianjin-Hebei area shows that the cooperative innovation network is still weak, and thus the spread of digital agricultural practices across administrative boundaries is limited (Yi & Zheng, 2023). Without integrated databases, inter-ministerial task forces and performance-based funding formulas, the successful pilot projects are often isolated experiments rather than scalable institutional innovations (Zhang, 2025). Institutional theory can explain why. This fragmentation indicates deeper path dependencies in China's administrative system, and sectorial silos have long dominated rural governance and mechanisms for horizontal coordination have been underdeveloped (Zhang & de Roo, 2020).

Fragmentation has had a more significant effect in peri-urban areas, such as the rural and peri-urban districts of Beijing; although they are close to the national-level institution, they face considerable pressure. On the one hand, the districts have received policy attention and resource allocation; on the other hand, they are also subject to a complex vertical accountability system that limits local experimentation and adaptive learning. Based on the above studies, the effective institutionalisation should establish formal coordination mechanisms and foster informal norms of cooperation and knowledge sharing among departments (Sun et al., 2024).

The development of such norms is a long-term institutional change process that policy mandates alone cannot speed up.

Institutional Capacity and Digital Readiness

Fragmentation is not the only problem; other factors are also lacking. Digital readiness includes the construction of physical facilities, the development of talent, organisational learning, institutional support and financial resources. Research on county-level digital village pilots in China has shown that the configuration of digital infrastructure, human capital and institutional support interact in complex ways to produce different economic results (Xie et al., 2025). Districts with strong administrative capabilities can use digital tools to improve the efficiency of service delivery, agricultural extension and risk management; those with weak capabilities will be limited to pilot projects for system-wide application.

Another index of the digital transformation of rural areas is the level of digital literacy among rural residents. Research has shown that low digital literacy among older residents in rural areas is still a barrier to using good-infrastructure digital services (Zhang & He, 2022). Training and extension programmes for this problem are often not localised. They do not take into account the special agricultural practices, cultural backgrounds and institutional environments of the target communities (Xie et al., 2021). The result is a pattern of "technology without absorption capacity", where digital tools are introduced but not incorporated into local institutional practice. Based on the above results, capacity-building strategies should be adopted to address the problem of digital literacy deficiencies at all levels in government and other institutions by making continuous investments in human resources and organisational learning systems.

Digital Inclusion and Equity Concerns

The third principal institution is also unequal. Although the top-down policies have sought to narrow the urban-rural digital divide, new forms of exclusion have emerged in rural areas as a result of digitalisation. Research on the information poverty of rural China has identified several types of digital disadvantages: a lack of access to relevant content, an inability to evaluate digital information, and the absence of institutional channels for digital participation (Fan et al., 2022). Gender dynamics also add to the forms of exclusion. Rural women have some problems with participation in village governance via digital platforms (Chen et al., 2025).

The development of the digital economy and new-era urbanisation are bringing more problems to the countryside. Digitalisation can promote the rural-urban integration of the country by facilitating remote work and e-commerce. It will also promote rural out-migration and the hollowing-out of village institutions (Chen, 2025; Wang et al., 2024). Thus, the institutional problem is to construct digital-isation paths that strengthen the social fabric of rural communities, rather than weakening it. Therefore, the policy system should move beyond building infrastructure and address the structural problems that limit the application of digital tools by rural residents in inclusive rural development, such as land rights, rural finance and social security, etc.

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Technological and Environmental Dimensions

Digital Infrastructure and Agricultural Productivity

Many studies have found that digital infrastructure is positively related to agricultural production in recent years. Econometric analysis of provincial panel data indicates that the construction of broadband networks, Internet-of-Things based monitoring systems and digital decision-support platforms have promoted agricultural production and efficiency (Deng et al., 2024; Tian et al., 2023). All of the above studies have found that digital infrastructure is a general-purpose technology that can boost productivity through both direct application in farming operations and indirect effects such as improved market access, supply chain integration and risk management.

The productivity increases require the additional investment mentioned above. Research on digital village pilots shows that high county-level economic growth is associated with specific arrangements of digital infrastructure, human capital, institutional support and industrial structure, rather than infrastructure investment alone (Xie et al., 2025). The above factors are complementary, and thus institutional capacity serves not only to support the development of digital agriculture but also to drive and regulate it; it is with these institutions that the application of digital technology will be realized or hindered. Therefore, when designing policies, we should make full use of the investment in digital infrastructure to enhance governance capacity and the training system simultaneously, adapt institutions, etc.

Green Total Factor Productivity and Environmental Outcomes

Scholarly attention to the environmental aspect of rural digitalisation has gradually increased, and research on green total factor productivity (GTFP), which considers environmental adjustment in production efficiency, has begun. Research based on provincial panel data has provided strong evidence that digital infrastructure, broadband connectivity and IoT-based networks significantly improve GTFP, and the most prominent effects occur in provinces with higher digital potential (Deng et al., 2024; Cen et al., 2022). Based on the above analysis, digitalisation can increase agricultural efficiency and reduce ecological damage simultaneously, thereby promoting green industrialisation in agriculture.

Several mechanisms drive these environmental outcomes. First, precision farming optimises input use. Second, real-time monitoring systems reduce resource waste. Data-driven decision support adjusts production based on the environment (Dai et al., 2023; Chunfang et al., 2024). Research has also been conducted on applying digital technology to construct climate-resilient early warning systems and adaptive irrigation and crop selection based on environmental data (Peng et al., 2022; Wang et al., 2025). The above functions will help China achieve its dual-carbon objectives of peaking carbon emissions before 2030 and reaching carbon neutrality by 2060 (Cen et al., 2022; Zhong, 2023). Rural digitalisation, in this way, will also help achieve the national climate goals.

Sustainability and the Coupling of Digital and Green Development

Research is beginning to link the concepts of rural digitalisation and environmental protection in recent years. Research on the coupling coordination of the digital economy and rural

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revitalisation has found that areas with higher levels of coupled development also have better environmental results (Wang et al., 2023; Ma et al., 2025). This link requires institutional arrangements that can integrate the objectives of digital and environmental policies, and this problem also applies to other areas of rural governance outside of agriculture. "Digital green innovation" refers to the combination of digital technology and environmentally friendly innovation process, and it has recently been used as a theoretical basis to study this cooperation in agricultural high-end equipment manufacturing (Yin et al., 2022). To fully realise the potential of digital green innovation, institutions need to provide support in many rural areas at present, such as regulatory systems, financing channels and extension services.

A Comparison of the above shows that they differ. Research on agricultural and rural digitalisation in China and the European Union has pointed out both converging trends and divergent institutional paths (Zhong, 2023; Qin et al., 2022). Both contexts have the same problem of coordinating digitalisation and sustainability goals, but their governance structures, farmer characteristics and policy tools are not the same. The EU's Common Agricultural Policy promotes conditionality and environmental protection; China's method has relied more on state-led infrastructure construction and top-down policies. Different Institutionalisations of Digitalisation: In the EU, farmers' associations and market mechanisms have driven the process of digitalisation; in China, government programmes and administrative goals have been the main drivers. Based on the above comparison, there is no single best path to sustainable digital agriculture; instead, different institutional environments will promote the effectiveness of different combinations of policy tools, governance models and technology applications. Given the reform path of developing countries, the Chinese experience indicates that institution building should go hand-in-hand with infrastructure construction, and adaptable policies need to be designed for all regions in China.

The Beijing Case: Institutionalisation in Practice

Contextual Background and Case Approach

A documentary case study of the rural and peri-urban areas in Beijing is presented below. Based on policy documents, municipal digital agriculture plans, and published empirical studies of the rural and peri-urban districts in the municipality (including Yanqing, Miyun, Huairou, Pinggu, and Daxing), the general dynamics identified in the previous sections are illustrated in a specific institutional context. As a municipality directly under the central government, Beijing has cutting-edge digital facilities and is near the country's policy-making centres. The rural and semi-urban areas have diverse economic structures, different demographic characteristics and institutions at various levels, and are thus suitable for comparative studies in the same administrative area. The construction of the Beijing-Tianjin-Hebei region has generated both cooperative chances and competition in recent years for the rural districts (Yi & Zheng, 2023; Li et al., 2022).

Research in the Beijing area has examined all sides of rural development, including sustainable development drivers (Li et al., 2022), agro-climatic regionalisation for crop planning (Li & Gao, 2024), and peri-urban spatial transformation (Zhang et al., 2020). In short, the above research indicates that the rural and semi-urban areas of Beijing face the problem of balancing increased agricultural production with urbanisation, ecological protection demands and institutional pressures at all levels of governance.

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Multi-Level Governance Dynamics

Institutionalisation of digital agriculture in Beijing's rural and peri-urban areas operates under a multi-level governance system that includes national ministries, the municipal government, district-level bureaus, township administrations, and village committees. The two will be problems of vertical accountability and horizontal coordination, respectively. According to qualitative research and case studies, district-level officials face conflicting demands in responding to the national policy of rapid digitalisation under local conditions, such as farmers' lack of readiness, infrastructure deficiencies and budget constraints. As a result, the phenomenon of "constrained adaptation" has occurred: digital tools have been introduced formally, but their institutional embedding is partial and uneven.

Research in the framework of institutional theory has identified several factors affecting whether digital agriculture will be institutionalised in the districts of Beijing: the establishment or absence of cross-departmental task forces; coordination between digital initiatives and the existing agricultural extension system; capacity for cross-jurisdictional data sharing; and construction of feedback channels for adapting policies based on farmers' actual experiences. The above factors indicate that the general institutional literature focuses on the interaction of the regulatory, normative and cognitive pillars in promoting institutional change (Tang, 2021; Zhang, 2025). The Beijing case suggests that although regulatory pressure is high—such as mandates, funds, and goals—the normative and cognitive level—shared beliefs in the value of digital agriculture and professional identities incorporating digital literacy—remains weak; thus, institutionalisation is not deep.

Findings from the Case Literature

Although the case-study literature on Beijing's rural digitalisation is still developing, some results have been obtained. First, institutionalisation is not a linear process but an iterative one that includes cycles of adoption, adaptation, resistance and learning. Second, there are intermediaries in the process. Agricultural cooperatives, technology service providers and trained extension agents link policy requirements with the actual work at the farm level. Third, for the digital initiatives to be sustainable, they should be incorporated into the existing institutional routines rather than introduced as separate systems. Fourth, farmer agency refers to the capacity of rural stakeholders to adapt digital tools according to their own requirements, but it is often overlooked in the results of institutionalisation.

Discussion: Challenges and Future Directions

Based on the above studies, there are some general problems and research directions for the future. The first is governance. Rural digitalisation efforts must be coordinated across ministries and departments in China without increasing the number of administrative layers. Research suggests that integrated databases, inter-ministerial task forces and performance-based funding formulas are required but not sufficient (Zhang, 2025; Tang, 2021). They should bring changes in the culture of administration that promote cooperation rather than compliance. In the future, research can be conducted to foster such cultural changes by setting up training programmes, professional networks and leadership-development initiatives that strengthen cooperative capabilities in addition to technical skills.

The second is insufficient capacity. An uneven distribution of institutional and human resources in different areas will result in uneven dispersion of digitalisation risks. Research has shown that the areas with a higher digital potential have received more benefits, and those with a weaker capacity have fallen further behind (Deng et al., 2024; Xie et al., 2025). Future research should explore targeted capacity-building strategies: peer-to-peer learning networks, mobile extension services, context-adapted training curricula. A long-term study will be carried out to observe changes in the capacity over time and to determine whether the initial investments in human capital and institutional learning have generated compounding returns.

The third problem is inequity. According to the above research, digital inclusion is not automatic. Institutions must be designed intentionally and deliberately. Research on the information poverty, gender dynamics and tensions in rural-urban integration has found that both structural and technological problems in the policy system need to be addressed (Fan et al., 2022; Chen et al., 2025; Chen, 2025). In the future, intersectional and life-history research will be conducted to explore how digitalisation affects all groups of rural people, particularly those most vulnerable to exclusion. Comparative studies of the different regions in China and with other developing countries can provide more information on how institutional environments affect equity outcomes in digitalisation.

The fourth challenge is innovation ecosystems. According to the literature on rural innovation systems, the results of digitalisation are affected by the overall health of the innovation ecosystem, which includes research institutions, technology service providers, farmer cooperatives and financing mechanisms (Yin et al., 2022; Song, 2023). In the rural and semi-urban areas of Beijing, near universities and research institutions are ideal places for knowledge transfer; however, the institutional links connecting research results with actual applications by farmers are still lacking. Research on county-level agricultural innovation ecosystems has examined how lifecycle dynamics influence the development of these systems and provided support for the sustainability of digital initiatives (Hou et al., 2022). Future research will explore how to build a stronger rural innovation ecosystem to support the institutionalisation of digital agriculture, paying more attention to the role of intermediary organisations and the governance of knowledge flows among research, policy and practice communities.

Conclusion

This integrated review has compiled research results on the institutionalisation of rural digitalisation in agricultural management, performed a thematic synthesis of 36 studies and policy documents, and conducted documentary case studies of rural and peri-urban areas in Beijing. Based on the above analysis, China's policy system has provided an institutional platform for digital construction, with the "Digital Rural Development Action Plan" and the "14th Five-Year Plan" leading to top-down guidance for digital transformation rather than bottom-up development. According to the above studies, areas with high digital capabilities have performed well in both agricultural production and ecological environment protection. The literature also lists the problems. Governance fragmentation, uneven institutional capacity and digital exclusion have all worked against the goals of the policy.

The Beijing case shows the above phenomena more clearly. It is a new-era peri-urban area with new-era infrastructure but heterogeneous institutional support. Based on the above results, effective institutionalisation needs to address the normative and cognitive aspects of

institutional reform, such as shared values and professional identity. Regulative Pressure includes the requirement for policies and funds. For the readers of Global Academic Excellence, China's experience provides both learning points and warnings. Digitalisation of Agriculture shows some good results. Realisation requires long-term institutional work to build coordination, capacity and inclusion in conjunction with technology. In the future, research can be carried out longitudinally and comparatively, and lived-in experiences in rural institutional life under digital agriculture will also be studied.

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