Survey and Comparative Analysis of the Current Status of Institutional Repository Construction in Domestic Research Institutions and Universities: Post-Print

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Abstract

[Purpose/Significance] At the critical juncture where IR development has entered a stable period and is transitioning toward next-generation IR, this study reviews the construction history, current status, and challenges faced by IR in China, aiming to promote accelerated and in-depth development of IR in our country. [Method/Process] First, an empirical research method combining web surveys with telephone and email surveys was employed, targeting IRs in domestic universities and research institutes such as the Chinese Academy of Sciences and the Chinese Academy of Agricultural Sciences, to investigate and review the current development status of IRs nationwide; second, the survey results were comparatively analyzed according to the university system, research system, and overall situation, summarizing the achievements and problems in IR development. [Results/Conclusion] IR construction has achieved certain accomplishments, with the number of IRs under construction and planned continuing to increase, and resource scale growing substantially. However, IR development faces problems such as imperfect management policies, excessive access restrictions, unclear intellectual property rights, insufficient openness, and low self-archiving rates.

Full Text

Preamble

Investigation and Comparative Analysis of Institutional Repository Development in Chinese Research Institutions and Universities

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Abstract: [Purpose/Significance] At the critical juncture where institutional repository (IR) development has entered a stable period and is transitioning toward next-generation IR, this paper reviews the construction history, current status, and challenges facing IRs in China, aiming to accelerate and deepen their development. [Method/Process] This study first employs an empirical approach combining web surveys with telephone and email investigations, targeting IRs in domestic universities, the Chinese Academy of Sciences, the Chinese Academy of Agricultural Sciences, and other research institutions to systematically investigate the national IR development landscape. Second, the findings are comparatively analyzed across university systems, research systems, and the overall situation to summarize achievements and problems. [Result/Conclusion] IR construction has achieved certain accomplishments, with increasing numbers of IRs under construction or planned and substantial growth in resource scale. However, development faces challenges including imperfect management policies, excessive access restrictions, unclear intellectual property rights, insufficient openness, and low self-archiving rates.

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1 Introduction

Since the official release of the Budapest Open Access Initiative in 2002, open access has achieved remarkable progress. The past year has witnessed particularly rapid development in open access, with Europe's "Plan S" making the breaking of paywalls and immediate open access a focal concern across academia. As a crucial pathway for implementing open access, institutional repositories have, after more than a decade of continuous growth, reached considerable scale in both number and content, playing an active role in promoting open access to scholarly achievements. However, from the perspective of researchers' and the academic community's awareness, recognition, support, and utilization of IRs, they have yet to be fully integrated into the research and academic process and system. This is especially true as open access practices accelerate in both pace and depth, expanding toward open science, placing IRs at a critical transition point toward next-generation systems.

Developing IRs has long been an important form of achieving open access and a key channel for supporting the implementation of open access Plan S. Compared with developed countries in Europe and America, China's open access movement has lagged behind. Although China issued a position statement at the Berlin Open Access Conference in December 2018, explicitly supporting OA2020 and Plan S, no specific implementation measures have been introduced. Against the backdrop of deepening global open access and the vigorous rise of open science, conducting a comprehensive survey of China's IR development to review its construction history, current status, and challenges can help us reflect on past progress, identify shortcomings, summarize achievements and problems, and project future trends, thereby accelerating and deepening IR development in China.

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2 Research Methods and Data Sources

2.1 Data Sources

To comprehensively, systematically, and objectively present the full picture of IR construction and development in China and understand the overall construction status, this study investigates and analyzes the development status of IRs in Chinese university and research systems. Data were collected from the Chinese Academy of Sciences (CAS), Chinese Academy of Agricultural Sciences (CAAS), CHAIR (China Academic Institutional Repository Alliance), ROAR (Registry of Open Access Repositories), OpenDOAR, and university sources, forming a consolidated database for statistical analysis. Based on this data, a comprehensive, multi-dimensional review and analysis of IR construction and development in China were conducted from the perspectives of basic construction, policy development, and application status.

2.2 Research Methods and Process

The study first employed web surveys to collect IR information mentioned on university websites and in published literature, followed by telephone and email investigations to verify the existence of each IR. For IRs accessible via the internet, data were obtained through empirical web surveys combined with telephone and email verification. For IRs that could not be accessed online or did not provide external services, questionnaires, literature searches, and telephone/email surveys were used to investigate, verify, and supplement key data. Since both CAS and CAAS IRs operate within their respective IR alliance systems with timely maintenance and clear data, research institution IR data are more systematically organized than university data. According to the survey data, a comprehensive, multi-dimensional review and analysis of China's IR construction and development were conducted from the perspectives of overall profile, construction and service status, resource development, platform functionality and services, openness, policy norms, and alliance development.

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3 Data Analysis

3.1 Basic Construction Status of Domestic IRs

3.1.1 Service Status Comparative Analysis As of November 2019, China had a total of 325 IRs, including 166 in the university system, 152 in research institutes, and 7 in other systems. In terms of operational status, 287 IRs were running normally, 18 were under construction, and 20 had suspended services. Among those operating normally, the university system accounted for 131 IRs, the research system for 149, and other systems for 7. Only 209 IRs supported public internet access, comprising 92 from universities, 110 from research systems, and 7 from other systems. The specific service status is shown in [Figure 1: see original paper].

Among the 42 "Double First-Class" universities, 36 have established IRs, with 26 operating normally, 6 under construction, and 4 suspended. The construction status of IRs in "Double First-Class" universities is detailed in .

The university IR service status exhibits several patterns: (1) Many institutions whose library websites indicate IR presence have inaccessible links and cannot be reached by telephone or email, so these were excluded from the total count. (2) The survey found some IRs have shifted to internal access or even stopped services. For example, University of Electronic Science and Technology and Tongji University now only allow internal access, while East China Normal University, Ningxia University, Shihezi University, and Zhejiang University have confirmed service suspension. (3) A batch of special IRs were created by operators for institutional trials without actual institutional participation or recognition. For instance, VIP (a Chinese database provider) created IRs for Hunan Normal University, South China Normal University, etc., which were excluded from

this survey. (4) Some IRs have not been updated for extended periods. For example, Hunan University IR and Beijing University of Civil Engineering and Architecture IR have had no data updates since 2019, with minimal traffic and data volume. (5) Not supporting full-text public access and download is common in university IRs. (6) Among IRs supporting public access, many suffer from platform instability and cannot open properly.

The operational status of research system and other IRs is relatively clear. Among all 159 research institute IRs, all CAAS system and other system IRs operate normally and are publicly accessible. Among CAS's 114 IRs, 72 operate normally with public access, 39 with internal access, and 3 have suspended services.

3.1.2 Launch Time Comparative Analysis China's IR construction started later than abroad, with significant differences between university and research systems. Xiamen University built China's first IR in 2006, after which university IR development progressed relatively slowly for several years. The period from 2013-2018 saw faster growth, with 80 IRs completed and launched. In contrast, the research system IR construction demonstrated distinctive batch construction characteristics. CAS was the earliest research system to launch IR construction, beginning with pilot projects at the Institute of Mechanics and the National Science Library (now the National Science Library, Chinese Academy of Sciences) in 2007, scaling up in 2009, and completing construction and launch for most institute IR platforms by 2013. The CAAS system started later but progressed rapidly, beginning construction in 2017 and completing batch construction and launch for all CAAS system IRs by 2018. The timeline of China's IR construction development is shown in [Figure 2: see original paper].

3.1.3 Regional Distribution Comparative Analysis All provincial-level administrative regions in mainland China have established IRs, but development is unevenly distributed. As shown in [Figure 3: see original paper], Beijing, Shanghai, and Jiangsu rank top three in IR numbers, with their combined total accounting for over one-third of China's IRs. Eastern regions with higher economic development levels and the Hunan-Hubei area have more universities and research institutions, hosting 220 IRs (67.7% of the national total). Correspondingly, central and western regions have fewer universities and research institutions, relatively less developed economies, and fewer IRs (105 total, accounting for 32.3%). The regional distribution patterns of university and research system IRs are basically consistent with the overall distribution, showing similar imbalances.

3.1.5 Platform and Service Comparison (1) Platform Software Types. Domestic IRs predominantly use self-developed or third-party software platforms. Among publicly accessible IRs, research system IRs represented by CAS and CAAS all employ self-developed platforms, while among university

IRs, only Peking University uses a self-developed model, with the remaining 89 using third-party platforms. Third-party platforms provide mature functional suites with customization and data services, significantly lowering the technical threshold for IR construction and becoming the primary choice for increasing numbers of institutions. Only Xiamen University IR and Guangxi Minzu University IR use the open-source DSpace software. Major domestic third-party IR platforms include CSpace, Chaoxing, VIP, Tongzhouyun, Xi'an Zhixian, and Hunan Weidu, with their distribution shown in [Figure 5: see original paper].

(2) Platform Software Functions and Services. Despite differences in software platforms, core functions are essentially consistent across IRs, primarily including: knowledge asset deposit and management; discovery and utilization services; aggregation and open interoperability services for research outputs and related research entity data; personal academic homepages; statistical analysis; and visualization. A survey of each IR website, categorized by software type, reveals that all platforms provide basic services including knowledge asset deposit management, discovery and utilization, multiple organization and browsing methods, classification navigation, simple search, advanced search, and one-stop retrieval, plus user support functions such as citation, recommendation, collection, annotation, export, and analysis. Some IRs support data sharing, exchange, and integration with institutional research information systems to enable linked utilization and services.

To attract researchers, platforms like CSpace, Chaoxing, VIP, and Xi'an Zhixian have developed personal academic homepages providing services including personal profiles, research outputs, statistics, co-authors, research hotspots, and visual analysis. CSpace and VIP support exporting scholar analysis reports, while Tongzhouyun supports viewing scholar reports via WeChat QR codes and viewing RDA linked data formats. To gain leadership support, IRs have added disciplinary analysis functions to support university discipline evaluation and capacity building, with statistical analysis and visualization features supporting multi-scenario data analysis and multi-format report export in platforms like CSpace, VIP, Chaoxing, and Tongzhouyun.

Different IR platforms provide various personalized, fine-grained value-added and extended services. CSpace extensions include mobile device compatibility, news announcements, and academic discussion halls, focusing on user experience and knowledge sharing. Xi'an Zhixian includes services like academic journal recommendations, personal research assistants, and team research collaboration, emphasizing research management. Overall, most IR service functions have gradually shifted from information collection, storage, and display to supporting teaching, research management, and discipline construction, transforming IRs into daily venues for teaching and research activities.

3.2 IR Policy Development

Comprehensive policy frameworks are crucial for sustainable IR construction and operation. The international practice is to publicly release IR policies on IR platforms for stakeholder reference. The survey of publicly accessible IRs found 32 institutions publishing policies (30 universities and 2 research institutions). Note that IR platform policies exhibit template usage and identical content, largely because IR platforms provide generic policy frameworks. Whether these policies are formally approved by institutions was not further verified in this survey. Overall, few institutions have established and published IR policies, and management operations need further standardization.

3.2.1 University IR Policy Development Among 90 normally operating, publicly accessible university IRs, 30 (approximately 33%) provide policy information. Since some universities use identical policy templates, these were categorized together. Analysis revealed nine substantive policy types covering content policies, submission policies, preservation policies, full-text and metadata use policies, withdrawal policies, and privacy policies (see).

Current university IR policies face several issues: (1) Most lack institution-level policies, with policies issued by libraries or IR departments, resulting in insufficient implementation strength. (2) Data policies are unclear and incomplete. Most content policies vaguely state that users may freely obtain and use full-text works for personal learning and research non-commercial purposes, prohibit malicious bulk downloading, require citation information, and mandate formal permission from copyright holders for any commercial sales. (3) Few universities have incentive policies for depositing works, and no mandatory measures were identified. How to motivate scholars to deposit and openly share academic achievements in IRs remains a serious challenge. (4) Copyright policies are unclear. Most restrict depositors to current institutional members, with works submitted by authors themselves or authorized agents. Copyright is held by original authors or third parties, with authors bearing full responsibility for any infringement.

3.2.2 Research Institute IR Policy Development Compared with universities' relative lack of explicit open access policy statements, both CAS and CAAS have established institutional-level open access policies, providing favorable institutional guarantees for IR content development. In May 2014, CAS issued the "Policy Statement on Open Access to Papers from Publicly Funded Research Projects" [1], requiring researchers and graduate students in the CAS system to provide open access to research papers published in academic journals within 12 months of publication. CAAS issued a similar draft policy in July 2019. Both CAS and CAAS have also implemented measures supporting scientific data open sharing based on the national "Scientific Data Management Measures" [2-3], providing policy references for IR involvement in scientific data open sharing.

In specific IR implementation policies, CAS has issued a series of supportive policy frameworks: the "IR Construction Management Measures," "Public Education and Research Unit IR Content Deposit and Dissemination Rights Management Policy Guidelines," etc. In addition to institutional policies, research institute IRs provide detailed personnel incentive policies. For example, CAS IR construction is included in the annual research informatization evaluation indicators, with some institutes using it as the basis for annual research output statistics and rewards, and institute personnel columns built using IR personal homepage functions. CAAS IRs integrate research management, project application, and achievement evaluation through their research offices, linking IR development with research performance evaluation. These incentive policies have promoted IR development and researcher engagement to some extent.

3.3 Application Status of Domestic IRs

Due to the prevalence of internal access and non-public resource statistics, survey feedback data often contains vague expressions. Based on data from publicly accessible IRs, China's IRs have collected approximately 14 million research output records, primarily published papers, as shown in .

3.3.2 Full-text Collection Status Statistically available full-text research outputs exceed 2 million, accounting for 14.4% of total resources, with nearly 300,000 openly accessible full-text outputs representing just over 2% of total resources. Due to statistical access issues for some IR full-text quantities, actual figures are expected to be slightly higher. Based on IR full-text resource scale, IRs with open access and full-text availability can be categorized into five levels, as shown in .

Among all publicly accessible IRs, the top 10 by resource volume are shown in . Due to university scale and volume, the top IRs all belong to the university system.

For normally constructed and continuously operating IRs, full-text collection ratios and open-access ratios better reflect IR capabilities in full-text collection and service. Institutions ranking high in full-text collection ratio are shown in .

The data reveal that university IRs hold advantages in total resource volume but lag behind research institutes in open-access services. University IRs have low full-text collection rates, mostly under 50%, with many providing only links to original papers or even no full-text links at all. Only a few university IRs like Xiamen University, Chongqing University, and Guangxi Minzu University provide direct full-text downloads. Among the two major research systems with larger IR construction volumes, the agricultural IR alliance currently collects no full-text content, while CAS system IRs have made better progress in full-text collection and open-access services, with some institutes achieving 100% full-text collection and open-access rates, and most institutes exceeding 50% full-text collection rates.

3.3.3 Openness Level IR openness and internationalization are crucial for promoting institutional output open access and dissemination. This analysis examines openness from four perspectives: full-text openness, metadata harvesting capability, international registry and indexing, and multilingual interfaces.

(1) **Internet Accessibility.** Among 287 normally operating IRs (excluding those suspended or under construction), 209 (72.8%) support public internet access, while 78 (27.2%) support only institutional internal access. Among 131 normally operating university IRs, 92 support public access and 39 only campus access. Among 156 normally operating research system IRs, 117 support public access and 39 only internal access.

(2) **Metadata Open Harvesting.** The Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) is an application-independent interoperability standard for enhancing resource sharing scope and capability on the Web. Among publicly accessible IRs, 74 (36%) support OAI-PMH, including only two universities (Peking University and ShanghaiTech University) and 73 research institutes (mostly CAS-affiliated institutions) plus one other institution (Nanjing Hydraulic Research Institute).

(3) **Full-text Openness.** Among normally operating IRs, only 38 support full-text open access, accounting for 13.2% of all IRs. Further analysis of restricted full-text access reveals varying openness across resource types. Generally, only published journal papers are openly accessible, while theses, working papers, and other documents mostly provide only metadata. For example, the Institute for the History of Natural Sciences IR provides open access to journal papers but only metadata for theses.

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4 Discussion

4.1 Advantages of IR Alliance Management Models

Comparative analysis reveals that research systems benefit from IR alliance frameworks. Through shared policies, standards, technologies, and human resources, institutions can promote rapid IR construction in an intensive manner. IR alliances represented by CHAIR, the CAS IR Grid, and the Agricultural IR Alliance have played significant roles in organizing and promoting IR construction in Chinese universities and research systems through appropriate cooperation mechanisms, co-constructed standards, and shared technical resources. As a joint service model, IR alliances build networked IR services through interoperability and data sharing among member IRs, fully leveraging knowledge aggregation and network effects to greatly enhance promotion, service effectiveness, and application impact.

CHAIR has significantly promoted university IR development through shared standards, free software platforms, and technical support services, sparking a wave of university IR construction. However, it can advance further compared

with research institute IR alliances. First, CHAIR's participating institutions represent a small proportion of the overall university IR scale and need expanded coverage. Second, member IRs also suffer from low normal operation and open access rates. CHAIR's platform currently registers 50 university IRs [5], but only 30 (60%) operate normally, with only 19 supporting open access and 11 (42.8% of operational IRs) providing only internal access.

At the global turning point in IR development, China's IR alliances urgently need updated concepts and innovative models to continue promoting upgrades toward open science environments. Current Chinese IR alliances basically adopt distributed models, ensuring high autonomy for each member IR, allowing institutions to independently establish, operate, and maintain their IRs to showcase research characteristics and capabilities. However, this relatively single distributed model has limitations: (1) Each member faces relatively high participation costs requiring dedicated funding, personnel, and technical resources, hindering growth of smaller academic IR members; (2) Member IRs exhibit inconsistencies in software selection, metadata standards, and data collection criteria. Next, major alliances in universities and research systems should strengthen cooperation, form united actions in securing national policy support, and systematically plan continuous open access and open research culture promotion activities.

4.2 Comprehensive Management Policies and Service Systems as Guarantees

University IR data management policies mostly adopt unified templates provided by software and issued by libraries, with most lacking publicly available institution-level IR policies, creating uncertainty for sustainable development after IRs transition from project tasks to routine operations. Most IR content and copyright policies are unclear, leaving authors uncertain whether they can deposit final versions and what usage rights they can grant readers, while institutions are unclear about their authority to provide open access. Additionally, most Chinese IRs are library-led, many managed by technical departments or resource construction departments, with few assigning dedicated personnel for management and operation. However, IR operation and service are highly technical, resulting in most IRs being unable to guarantee stable 24/7 access, with dead, empty, and broken links being very common.

Comprehensive IR policies represent institutional-level support and commitment to knowledge asset management and services, defining boundaries and embedded relationships between IRs and institutional applications, and providing policy support for meeting institutional knowledge management needs and defining processes. To secure national-level policy support, funding agencies should issue mandatory measures while research institutions introduce incentive policies, creating resonance across three dimensions. Simultaneously, China should clarify national copyright regulations, learn from international CC licensing practices, reference domestic and international university IR copy-

right handling regulations, and collect copyright and self-archiving policies from publishers and databases to formulate practical management policies and service systems.

4.3 Expanding Resource Types and Strengthening IR Resource Development

Survey results indicate that data development has become a bottleneck and even a risk factor for IR construction. While IR numbers and total resources are increasing, resource development shows polarization. Both research and university system IRs generally suffer from low resource availability, primarily focusing on retrospective collection of formally published journal and conference papers, with insufficient depth and breadth. Overall full-text availability rates are low, and restricting full-text access is the norm for Chinese IR services.

IR resource development should expand beyond formally published textual resources to include unpublished grey literature, non-text multimedia resources, and tacit knowledge, where IRs' true value and significance lie. New directions involve both integrating external resources ("outside-in") and focusing on promoting internal resources ("inside-out"), building services for forwarding OA publications data, such as JISC Publications Router and CAS's OA paper forwarding service system iSwitch, for automatic monitoring and collection of institutional publications and theses.

IRs should leverage resource and platform advantages to become disciplinary service platforms providing personalized, professional knowledge services. Two approaches are recommended: (1) Align with research data management needs, supporting policy and process embedding, organizational models, and literature association services, enabling IR linkage with major scientific facilities to serve facility, literature, data, personnel, and project information association and organization. (2) Expand manageable research knowledge objects and content types to include scientific data, graphics, images, audio-video, 3D objects, and other non-text research content, supporting data association with related entities, tracking and updating research outputs, project output association reporting, and semantic integration management of scientific data and related knowledge. Some IRs have already integrated into the entire research management process, embedding into disciplinary services to provide more precise knowledge services for researchers.

4.4 Eliminating Unnecessary Access Restrictions and Strengthening Open Access Implementation

Most Chinese university IRs provide conditional access, restricting full-text downloads primarily to campus IP ranges, focusing more on centralized institutional knowledge asset management and preservation than on knowledge diffusion and sharing. Chinese IRs provide multiple access levels: (1) Unrestricted full-text download (e.g., most CAS IRs); (2) Partial unrestricted full-text down-

load (e.g., Shandong University IR and some CAS institutes); (3) Browse-only without download; (4) Full-text links only without browsing or download; (5) No external services whatsoever.

Unnecessary access restrictions hinder IRs from enhancing institutional research visibility and impact, show insufficient attention to international integration and application, and reduce IR usability and availability. To improve, unnecessary access restrictions should be eliminated and different open measures provided based on resource attributes and author needs. For publicly or semi-publicly published works like journal papers, conference papers, and academic monographs, full-text restrictions can be reasonably lifted by referencing copyright law or obtaining author authorization. For grey literature like theses and internal training materials that are temporarily not for public release, metadata openness with restricted full-text access can be adopted.

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5 Conclusion

This paper investigates the overall status of IRs in Chinese mainland research institutions and universities, analyzing basic construction, policy development, and application status, identifying areas for improvement and proposing solutions to provide references for IR development. Overall, China has achieved certain accomplishments in IR construction. In 2019, the overall scale continued growing, with increasing numbers of IRs under construction or planned. China's total IR count now ranks among the world's top 10, with substantially expanded resource scale and gradually improving service effects. However, Chinese IRs still have great development potential. Most universities have not yet built IRs, and only 17 of 42 "Double First-Class" universities have established them. Existing IRs need improvement in resource development levels and service functions. IR development faces persistent unresolved issues including imperfect management policies, excessive access restrictions, unclear intellectual property rights, insufficient openness, and low self-archiving rates, as well as new challenges in the new stage of international repository development, such as collection management of diverse and complex open science content, active integration and dynamic interoperability, and machine-intelligent content services.

At this stage, IRs' functions extend beyond managing and disseminating institutional digital resources to playing deeper roles in promoting open knowledge sharing, competing for discourse power in scholarly communication, and providing technical and research support. IR development needs to adopt supply-side thinking to adjust functional and service construction goals, enhance effective knowledge and service supply capacity, become a useful resource system and technical platform, eliminate "backward capacity," terminate ineffective applications and services, create new supply, and lead new demand. Management and service systems should be improved with strengthened content resource development, focusing on researcher needs as the core starting point. Drawing

from enterprise data middle platform concepts, IRs should become institutional academic data middle platforms, integrating into researchers' workflows to serve as integrated management centers for research information and knowledge and as part of researchers' daily work routines. Looking forward, IRs should leverage the accelerating open access and open science movements to enhance application service value and user experience from multiple perspectives: becoming intelligent open knowledge infrastructure for institutions, supporting open access platforms for digital scholarship, and integrating into and supporting open science processes to play an irreplaceable role in promoting and supporting digital scholarship and open science development.

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Author Contributions

Zhang Ling: Responsible for data acquisition, outline, and drafting; Zhu Zhongming: Responsible for revision; Kou Leilei: Responsible for text revision; Yao Xiaona: Responsible for data investigation.

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Abstract: [Purpose/significance] At the important node of IR development entering a stable period and in the transition to the next generation of IR, this paper reviews the construction process, status quo and challenges of institutional repository in China, so as to achieve the purpose of accelerating and deepening the development of IR in China. [Method/process] First, it adopts the empirical research method combining the network survey method and telephone and email survey methods, and takes domestic universities, Chinese Academy of Sciences, Chinese Academy of Agricultural Sciences and other scientific research institutes as the survey object to investigate the development status of the national IR; second, the survey results are comparatively analyzed across the university system, scientific research system and the overall situation to summarize IR development achievements and problems. [Result/conclusion] Some achievements have been made in IR construction. The number of IR under construction and to be built is increasing, and the resource scale is increasing greatly. However, there are some problems in the development of IR, such as imperfect management policies, excessive access restrictions, unclear intellectual property rights, insufficient openness and low self storage rate.

Keywords: Institutional Repository; scientific research institutions; universities; construction status

Note: Figure translations are in progress. See original paper for figures.