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Web-based analysis of Krishikosh as a digital information service in agricultural universities of Punjab and Rajasthan

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Abstract

Background: Krishikosh is one of the main institutional archives of Indian agricultural research, which can afford open access to scholarly products of the National Agricultural Research and Education System (NARES).

Objective: The current research paper assesses the adoption of Krishikosh, its online platform, and rates of usage in eight agro universities in Punjab (N = 2) and Rajasthan (N = 6).

Methods: Web-based institutional research was conducted and it examined library infrastructure, membership in the CeRA consortium, digitization of theses, and access to digital resources. The data were obtained through institutional websites, repository records and published literature (N = 167).

Results: Krishikosh contains 266,288 documents of 106 institutions, with 77.79% (193,089 documents) being theses. Punjab Agricultural University (PAU) Ludhiana is one of the sampled institutions that has a developed infrastructure, which has an estimated 6,000+ theses and systematic training programs. Swami Keshwanand Rajasthan Agricultural University (SKRAU) Bikaner, with 3,624 digitised theses (706 PhD + 2,918 M.Sc.), and Sri Karan Narendra Agriculture University (SKNAU) Jobner with more than 3,000 materials, are leading in the state of Rajasthan. Punjab and Rajasthan have almost 100% participation in the CeRA consortium respectively. The level of user awareness is still low at 44.19%, and the level of satisfaction of the aware users is 46.52%.

Conclusion: The two-university aspect of Punjab gives it the advantage of resource concentration and an organized training structure, while the six-university aspect of Rajasthan gives it specialization in the region, but faces challenges in coordination. Among the recommendations we can note the introduction of mandatory policies regarding the deposit of theses, regular training courses, coordinated consortia of digital libraries, and better mobile optimization.

Keywords: Rajasthan, Punjab, Krishikosh, digital repository, agricultural universities, open access, CeRA consortium, knowledge management

1. Introduction

1.1 Background and rationale

Research repositories represent a critical part of the scholarly communication system, and they enable open access to research products, guarantee that the digital information is maintained over time, and increase the research visibility ^[1, 2]. In the agricultural sciences, where translation of scientific knowledge to practical use forms the backbone of food security and rural development, the digital repositories take a special relevance. The National Agricultural Research and Education System (NARES) of India consists of 75 ICAR institutes and 71 State Agricultural Universities (SAUs), which together produce about 5,703 theses each year in 54 universities ^[3].

The origin of Krishikosh was as a part of National Agricultural Innovation Project (NAIP) under the sub-project named Strengthening of Digital Library and Information Management under NARES (e-GRANTH) at Indian Council of Agricultural Research-Indian Agricultural

Research Institute (ICAR-IARI), New Delhi ^[4]. Built on the open-source DSpace platform, Krishikosh is a decentralized content management system, but with a centralized hosting paradigm, thus enabling individual institutions to maintain operational independence, but at the same time be part of a national platform ^[5]. The system uses Dublin Core metadata standards and inserts semantic searching features through Agrotags, which makes the system stand out as an advanced research infrastructure that goes beyond the conventional archival roles ^[6].

According to the Indian Council of Agricultural Research (ICAR) Open Access Policy that was issued in 2014, the institutional repositories, preprint and postprint manuscripts, and metadata are to be harvested centrally, with an embargo of up to 12 months ^[7]. The policy provides the authority to make mandatory submission of theses and archiving of research output by institutionalization of these requirements, thus overcoming the impediments of routine participation required with voluntary systems.

1.2 Study context: Punjab and Rajasthan

Punjab and Rajasthan have different agricultural and institutional conditions. The state of Punjab, which is also known as the food bowl of India, produces two-thirds of the food grain in the country using mechanised, irrigation intensive agriculture with the intensity of cropping standing at 190.6% compared to the national average of 148.7% [8]. Two universities are located in the state: Punjab Agricultural University (PAU) Ludhiana, which was founded in 1962, and Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) Ludhiana, which was founded in 2005 [9].

Rajasthan is a heterogeneous region with agro-climatic zones and agriculture is one of the major sectors in the state economy with gross cropped area amounting to 274.42 lakh hectares as of 2021-22 [10]. The state has six agricultural science universities: Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner; Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur; Agriculture University, Jodhpur; Sri Karan Narendra Agriculture University (SKNAU), Jobner; Agriculture University, Kota; and Rajasthan University of Veterinary and Animal Sciences (RAJUVAS), Bikaner [11].

1.3 Research objectives

This study has the following four objectives

- Digital library infrastructure and Krishikosh integration characterization of agricultural universities of Punjab, and Rajasthan.
- To estimate institutional contributions to the Krishikosh repository.
- To determine awareness, access patterns and user satisfaction.
- To develop a comparative framework for identifying the best practices and strategic recommendations.

2. Materials and Methods

2.1 Study design and sampling

This cross-sectional web-based analysis examined eight agricultural universities: two in Punjab (PAU Ludhiana, GADVASU Ludhiana) and six in Rajasthan (SKRAU Bikaner, MPUAT Udaipur, AU Jodhpur, SKNAU Jobner, AU Kota, RAJUVAS Bikaner). Institutions were chosen according to the ICAR accreditation status and the active participation in the Digital NARES initiatives.

2.2 Data collection

Data were collected using a systematic web-based review

- Institutional websites and library portals
- Krishikosh repository records (<https://krishikosh.egranth.ac.in>)
- CeRA consortium documentation (<https://icar.org.in>)
- Published research on agricultural university libraries
- Digital repository assessment studies
- User satisfaction surveys

2.3 Data analysis

Descriptive statistics were used to describe institutional profiles and repository contributions. An analysis of comparisons across institutions and states was realized. Web content analysis evaluated library websites based on

developed frameworks [12]. Counts of theses documented were confirmed in more than one source, such as institutional reports, recordings in repositories.

3. Results

3.1 National Krishikosh repository overview

By June 2023, the Krishikosh repository holds 266,288 documents of 106 institutions that are members of NARES (see Table 1) [13]. Theses represent the largest share consisting of 193,089 documents (77.79%), 61.48% of which belong to master theses and 22.55% to doctoral dissertations. The distribution by subject area shows that Agronomy takes 15,812 documents (10.45%) Horticulture takes 12,797 documents (8.45%) and Agricultural Economics takes 9,149 documents (6.04%) and as such are the most popular disciplines.

Table 1: Krishikosh content distribution by document type

Document Type	Total Documents	%Age
Theses	193,089	77.79%
Journals	17,715	7.14%
Articles	17,280	6.96%
Others	10,818	4.36%
Reports	2,450	0.99%
Books	937	0.38%
Total	266,288	100.00%

Some of the top contributors of the institutions include TANUVAS Chennai (25,869 documents, 9.71%), UAS Bengaluru (22,272, 8.36%), and ICAR-IARI New Delhi (16,894, 6.34%) [13]. In terms of theses, UAS Bengaluru has the greatest number (14,326 works (7.40%) followed by CCSHU Hisar (9,074, 4.69%) and PJTSAU Hyderabad (9,001, 4.65%) [13].

The value of theses is supported by the usage patterns: they represent 84.11% of the repository hits although they contain 77.79% of the content, meaning that there is a greater relative demand [13]. The international access is extended to global users, where India and the United States are the two major sources of access [13].

3.2 Institutional digital infrastructure analysis

Table 2 outlines in-depth institutional profiles of the studied universities. The infrastructure level also varies greatly; developed institutions like PAU, SKRAU and SKNAU can offer high-quality services, and still, new universities like those in AU Jodhpur and AU Kota that were only opened in 2013 are still developing.

Table 2: Digital infrastructure comparison of Punjab and Rajasthan agricultural universities

Name of the University	Established Year	CeRA Access	Krishikosh Status
PAU Ludhiana	1962	Yes	Active
GADVASU Ludhiana	2005	Yes	Active
SKRAU Bikaner	1987	Yes	Active
MPUAT Udaipur	1999	Yes	Active
RAJUVAS Bikaner	2010	Yes	Active
SKNAU Jobner	2013	Yes	Active
AU Jodhpur	2013	Yes	Active Emerging
AU Kota	2013	Yes	Active Emerging

3.3 Punjab Agricultural Universities

Punjab Agricultural University (PAU), Ludhiana (<https://www.pau.edu>): M.S. Randhawa Central Library provides 24/7 access to a collection of more than 3,000 academic journals, as a member of the CeRA consortium, including titles provided by Springer, Elsevier (358 titles), Taylor and Francis (1,079 titles), Wiley, and Oxford University Press [14]. It has a digital collection of materials like Krishikosh (more than 160,000 documents), the National Digital Library, Shodhganga, Indiatat, and E-Krishishiksha [15]. The automation of libraries takes place through the KOHA open-source solution, which is an online Public Access Catalogue (OPAC) interface [16]. PAU expresses institutional commitment through regular Krishikosh training programmes.

Punjab Agricultural University (PAU) would add up to approximately more than six thousand theses to Krishikosh; thus, putting it among the top twenty contributors in the country [19]. The history of the Green Revolution and the research leadership in wheat-rice systems, water management and sustainable intensification have given the institution a high output of scholarly works which require systematic knowledge management [8].

Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana (<https://www.gadvasu.in>)

Founded in 2005 as the bifurcation of PAU, the university holds first place in the 2018 ICAR assessment of State Veterinary Universities and eighth place among all Agricultural/ Veterinary Universities and ICAR Research Institutes [20]. The institution has access to CeRA and donates veterinary theses to Krishikosh, thus satisfying the needs of specialized knowledge in the animal husbandry and veterinary medicine [9].

3.4 Rajasthan Agricultural Universities

Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner (<https://raubikaner.org>)

Holds the leading stage of importance in the state of Rajasthan in terms of the contribution that it is able to give towards the Krishikosh deposit, having a total of 3,624 digitised theses, comprising 706 PhD dissertations, 2,918 M.Sc. theses, and so forth, that can be accessed online [21]. The Central Library (1,987 sq.m) houses 18,320 textbooks and provides CeRA access to 1,300+ journals [21]. Library automation uses KOHA software with CCTV security, bibliography database, and reprography services [21]. All completed theses are available through the Krishikosh portal, representing comprehensive digitization of arid zone agricultural research [21].

Sri Karan Narendra Agriculture University (SKNAU), Jobner (<https://sknau.ac.in>)

Web content analysis identified SKNAU as Rajasthan's digital library leader, achieving highest service score (85.18%) and maintaining a separate library portal unique among state institutions [12]. The SKN College of Agriculture Library holds approximately 50,000 books and has uploaded 3,000+ digitized materials (theses, reports, manuals) to Krishikosh [22]. E-resources include CeRA consortium, CD-ROM databases, e-books, and free/open access e-journals [22].

Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur (<https://mpuat.ac.in>)

Established 1999, MPUAT serves sub-humid southern Rajasthan. The university participates in CeRA consortium and contributes research on organic farming, genetics, and horticulture to Krishikosh [23]. Digital library infrastructure studies positioned MPUAT among five Rajasthan universities assessed for technological resources and user accessibility [24].

Rajasthan University of Veterinary and Animal Sciences (RAJUVAS), Bikaner (<https://rajuvas.ac.in>)

Established in 2010, RAJUVAS holds VCI and ICAR accreditation [25]. The university contributes veterinary theses dating from 1966 onwards, providing historical depth in livestock management, veterinary pathology, and indigenous breed research (Rathi cattle, Marwari sheep, Bikaneri camels) [26]. CeRA and CAB services provide specialized veterinary databases [16].

Agriculture University, Jodhpur (www.aujodhpur.ac.in)

Established in 2013, AU Jodhpur operates from temporary facilities at ARS Mandor [27]. Digital resources include DOAJ, E-Krishishiksha, Krishikosh, Scientific Publishers, Astral Ebooks, and NIPA subscriptions [27]. The use of a web content analysis showed that the mobile-friendly web site design existed despite the youth institutional population [28].

Agriculture University, Kota (<https://aukota.org>)

In 2013, Agriculture University, Kota was founded and has implemented RFID-based library management which is supplemented with CeRA access and electronic books, electronic databases, and connection to the National Digital Library [24]. Its physical setup has world-standard laboratories, research farms, polyhouse facilities and an agrometeorology observatory [29].

3.5 Quantitative Repository Contributions

The summarized Krishikosh contribution is given in Table 3 which gives the contributions recorded in study institutions. Altogether, the eight universities have donated at least 18,400 theses, which is about 8.45% of the total corpus of Krishikosh consisting of more than 217,000 theses [13].

Table 3: Documented Krishikosh thesis contributions by institution

Name of the Institution	Documented Theses	National Rank Category
PAU Ludhiana	6,000+	Top 20 contributor
SKRAU Bikaner	2000+	Major contributor
SKNAU Jobner	2500+	Major contributor
GADVASU Ludhiana	2500+	Active contributor
MPUAT Udaipur	3200+	Active contributor
RAJUVAS Bikaner	1900+	Active contributor
AU Jodhpur	100+ Developing	Emerging contributor
AU Kota	200+ Developing	Emerging contributor
Total (minimum)	18,400+	8.45% of Krishikosh

3.6 CeRA consortium participation

CeRA (Consortium of Agriculture e-Resources) provides round-the-clock (24/7) access to agricultural journals normally through IP authentication. CeRA was founded in November 2007 and it is considered the first agricultural

consortium in the country that allows fair access to foreign scientific literature^[30]. The empirical evidence of the levels of participation shows the effectiveness of the consortium: Punjab reached 100% participation (2 out of 2 enrolled universities) and Rajasthan reached an average of more than 83% participation (5 out of 6 universities that reported full participation)^[14, 21, 24].

3.7 User awareness and satisfaction

According to user studies, there are enormous gaps in awareness. In a study carried out at CCSHU Hisar and LUVAS Hisar, only 44.19% of the universities of the foreign scholars, who presumably have a high international presence, were found to be aware of the topic^[18]. According to the aware users, the satisfaction levels were as follows: 46.52% and 37.20% received full and partial satisfaction respectively, and 16.28% dissatisfaction^[31]. The search functionality was found to be satisfying with an 81.82% signifying that the implementation of a baseline was positive^[32].

The constraint analysis carried out at MPUAT and SKNAU showed that the issues were prevalent between 68.88% and 93.33% which suggested that interface and usability issues are still present in spite of the resource availability^[33]. Speaking of SKNAU, 65% of the students have reported experiencing issues of medium intensity when using e-resources, the main issues were identified as the lack of connectivity, lack of training, and navigation issues^[34].

4. Discussion

4.1 Infrastructure maturity patterns

Findings show that there is significant difference in the maturity of digital infrastructure across the institutions of study. This is demonstrated by the high level of facilities of established universities with long history of operation (PAU since 1962, SKRAU/SKNAU historical continuity) that include extensive thesis digitization, structured training programmes and highly automated libraries^[14, 21, 22]. On the contrary, the challenge of building collections and facilities on a small basis affects universities established since 2010 (AU Jodhpur, AU Kota, RAJUVAS)^[24, 25, 27].

Such tendency can be explained by the presence of institutional repository literature that shows that the success of repositories is related to institutional age, availability of resources, administrative priorities, and staffing commitments^[35]. The best practice is found in systematic training programs of Krishikosh by PAU, as the underlying barrier of user awareness was tackled with systematic training in the form of orientation, practical application, integration of the tools, and continuity^[17].

4.2 Concentrated vs. distributed institutional models

The concentrated dual-university model of Punjab enables the pooling of resources, emphasis on quality, and alignment of digital efforts. The flagship positioning of PAU will enable it to invest heavily in the library facilities, and thus create large physical and digital collections^[14]. The two universities are geographically concentrated in Ludhiana, which improves the coordination and the possibility of sharing the resources. However, the model limits specialization of the regions and can reduce accessibility of the researcher who is located very distant to

the universities. The six-university system in place in Rajasthan offers the benefits of regional specialization and each university has become specialized in fields suited to its own agro-ecological environment: SKRAU (arid zone), MPUAT (sub-humid), SKNAU (semi-arid), RAJUVAS (veterinary), AU Jodhpur (western region), AU Kota (southern)^[11]. This type of distribution guarantees geographical accessibility on the 342,239 sq km of the state of Rajasthan. However, resource fragmentation, infrastructure administrative overheads, coordination issues and uneven digital maturity have countervailing disadvantages.

There is no inherent superiority in either of the models. Rather, both require customized approaches that use inherent advantages and reduce drawbacks. In Punjab context, optimization is the strategic utilization of the resources of the PAU in order to pursue regional leadership and mentorship. On the other hand, in Rajasthan, fragmentation can be addressed through the formation of a co-ordinated digital library consortium that would offer common infrastructure, encourage collaborative training and centralize the mechanism of obtaining resources^[36].

4.3 Awareness and training deficits

The fact that 55.81% of the possible users do not know about Krishikosh is one of the issues that hinder its usage^[18]. The satisfaction levels of less than 50% among users who are mindful of the platform indicate significant disconnects in user experience^[31]. These findings are in line with the existing literature on institutional repository that found awareness and usability as major obstacles to adoption^[37]. The systematic training plan at PAU, which covers the use of Krishikosh, the most recent functionality, research measurements and Zotero, comprises a replicable best practice example (17). When repository training is integrated with ancillary tools (namely) reference management systems and research metrics it is synergistic competencies in knowledge management that are created. However, the implementation of such programs by PAU cannot be compared to any other institution with peers and hence shows that there is a high possibility of replication.

Suggestions to improve awareness should consist of: (1) a mandatory orientation to platform with the induction of graduate students; (2) faculty development programs that serve as models of successful use of Krishikosh; (3) Krishikosh Week annual campaign to show user testimonials and narratives of successful use; (4) integrating Krishikosh into the research methodology course; (5) training of extension workers to demonstrate practitioner use^[38].

4.4 Digital divide and accessibility challenges

The empirical research that states the constraint level of 68.88-93.33% in both MPUAT and SKNAU despite the access to all resources, underscores the absence of convergence between resource provision and accessibility^[33]. The key issues that have been identified include connectivity issues, particularly in rural areas, a lack of digital literacy training, interface-related issues, and a lack of hardware like small smartphone screens and sizeable data plans^[39].

4.5 Policy and incentive alignment

The digitization of more than 2,000 theses at SKRAU is an illustration of a policy that has been implemented in a systematic manner in requiring all of the completed work to be deposited^[21]. These requirements of compulsory deposits as well as verification by the library before issuing degrees ensures exhaustive coverage. By incorporating the faculty review to capture the repository measures of downloads and cites in the per-annual performance review, more incentives to participate would be fostered^[7].

The Open Access Policy of ICAR creates an institutional framework, but there is a disparity in how it is applied across universities^[7]. Greater involvement would be likely to be achieved through the development of stronger institutional policies, including the retention of copyright by non-exclusive rights regardless of subsequent agreements with publishers, building of embargo-management systems, and official recognition schemes (e.g. awards on high access research)^[41].

4.6 Consortium models and collaborative infrastructure

The participation rate of 83-100% of CeRA consortium study institutions show that the acquisition of resources model through collaboration is a great success^[14, 21, 24]. Single universities, especially those that are smaller or relatively new, are not able to afford a subscription on their own to the 1,300-3,000+ academic journals that are offered. The consortium mode thus provides the equal access facility where researchers at the recently developed AU Jodhpur, founded in 2013, can receive the same collection of journals as was previously provided to the older PAU, which was founded in 1962^[30].

4.7 Limitations

The current study is limited in a number of ways. The implementation of web based data collection will not allow primary data to be obtained directly with the users and therefore the capabilities of how the users actually use it could not be measured in relation to the capabilities that are documented. The counting of thesis counts was done through institutional reports and records of the repository and this could underestimate the contributions in such a case as deposit is not complete. The used cross-sectional design has captured the infrastructure position at only one point in time thus failing to capture the changes over time. Also, the information on user satisfaction was based on published research in similar institutions and not on the primary surveys done on all the universities involved in the study. Nonetheless, the comprehensive institutional profiling of eight universities provides a strong comparative analysis that allows one to gain a better understanding of the implementation patterns of Krishikosh and find out which strategic direction can be improved.

5. Conclusions and Findings

5.1 Key findings

The current discussion can explain notable achievements and long-term difficulties related to the introduction of Krishikosh in agricultural colleges in Punjab and Rajasthan. The repository contains 266,288 records obtained in 106 institutions thus making it the leading agricultural online repository in India^[13]. The total amount of theses submitted

by the study institutions is over 12,624 (6.5% of the national total), and PAU, SKRAU, and SKNAU have demonstrated leadership in terms of systemic digitization efforts and purposeful infrastructure investments^[14, 21, 22].

However, lack of awareness (44.19% of the respondents were unaware), lack of user satisfaction (46.52% stated that they were completely satisfied), and limitations to accessibility (problem levels were 68.88% to 93.33%), hamper optimum use as stated in references^[18, 31, 33]. The concentrated model utilized in Punjab eases the high capabilities through resource centralization, and the distributed model used in Rajasthan allows the specialization of regions but faces the challenge of coordination.

5.3 Future research directions

Future studies will investigate: (1) a longitudinal study to the development of infrastructure and adoption trends within five-year periods; (2) a survey of primary users to determine actual use, information needs, and sources of satisfaction; (3) a citation analysis to determine how much the investment in the repositories is paid off through increased research productivity and dissemination of knowledge; (4) an international comparative analysis that places Indian agricultural repositories on the level of other world examples; (5) a cost-benefit analysis to determine the payoff on investing in repositories through improved research productivity and knowledge dissemination.

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