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Open-Source Software in Academic and Rural Libraries: A Systematic Literature Review

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Abstract

Open-source software has become central to library automation, repository development, and discovery service design, particularly in institutions operating under financial and infrastructural constraints. This systematic literature review examines the use of open-source software in library functioning and services, with emphasis on academic libraries and on evidence relevant to rural and remote settings. The review synthesizes studies on integrated library systems, institutional repositories, digital libraries, discovery services, and service sustainability. Koha emerges as the dominant open-source platform for library automation, while DSpace is the most widely reported platform for repositories and digital libraries (Kampa et al., 2024; Ponelis & Adoma, 2018; Cherukodan et al., 2016; Kampa & Patra, 2020). VuFind appears mainly as a lower cost discovery layer used to integrate catalogues, repositories, and subscribed resources (Roy et al., 2018; Bhowmick & Chakrabarty, 2021). The main drivers of adoption are lower total cost of ownership, freedom from vendor lock-in, local customization, interoperability, and alignment with open access values (Kampa & Kaushik, 2019; Choi & Pruett, 2019; Ahammad et al., 2024b). Persistent barriers include weak documentation, limited technical expertise, poor internet and power infrastructure, migration burdens, and uneven institutional support (Kampa et al., 2024; Bwalya & Akakandelwa, 2021; Shehata et al., 2021; Hussain & Rafiq, 2024). Evidence on rural and remote libraries is much thinner, but available studies suggest that the same barriers become more severe in low-resource contexts (Chauhan & Singh, 2012; Oyelude, 2025). The review concludes that open-source software is well established in academic library practice, but its long-term sustainability depends less on software freedom alone than on staffing, governance, documentation, and local technical capacity.

Keywords: Open-source software, academic libraries, library automation, institutional repositories, rural libraries, sustainability

Introduction

Open-source software now occupies a central place in debates on library modernization. In academic libraries, the shift toward digital workflows, repository building, web-based delivery, and integrated discovery has made software choice a strategic matter rather than a purely technical one. Libraries adopt open-source systems not only because they reduce licensing costs, but also because they provide greater control over customization, interoperability, and long-term system direction (Choi & Pruett, 2019; Kampa & Kaushik, 2019). These advantages are particularly attractive in institutions under financial pressure, where recurring subscription and vendor costs can constrain service development.

The literature shows that open-source adoption in libraries is no longer peripheral. It is most visible in automation and repository management, where Koha and DSpace have become reference platforms across India, Africa, South Asia, and

other developing contexts (Ponelis & Adoma, 2018; Kampa et al., 2024; Cherukodan et al., 2016; Dei & Tetteh, 2022). Open-source discovery layers, particularly VuFind, have also been used to create single-window search services without the cost of commercial discovery systems (Roy et al., 2018; Bhowmick & Chakrabarty, 2021). The main question, then, is no longer whether open-source software can support library work. The more important question is how libraries use it, what they gain from it, and under what conditions it remains sustainable.

This question becomes sharper in rural and remote settings. Much of the academic library literature assumes at least a minimal level of bandwidth, staffing, electricity, and systems support. Libraries in rural, remote, and otherwise resource-constrained settings may not have those foundations. In such contexts, open-source tools can lower the threshold for automation, but they cannot remove structural deficits in infrastructure and technical capacity (Chauhan & Singh, 2012; Oyelude, 2025). A systematic review therefore needs to do more than map software types. It must also assess the strength of the evidence and identify where the literature remains thin.

This review addresses four questions:

1. What open-source platforms dominate library functioning and services in the recent literature?
2. What drivers of adoption recur across academic library settings?
3. What barriers most strongly shape implementation and sustainability?
4. What does the literature show, and fail to show, about rural and remote libraries, especially in relation to India?

Method

The paper was structured as a systematic literature review. It draws on the project search on open-source software in academic and rural libraries, which was designed to identify literature from the last 10 years on open-source software in library functioning and services, with emphasis on academic libraries, rural or remote settings, sustainability, maintenance, and Indian perspectives. The search was completed with moderate coverage, and the resulting paper set was screened for direct relevance to the review questions.

Review framework and methodology

Studies were prioritized when they met the following criteria:

- They focused on library software or service systems rather than general educational technologies.
- They addressed academic libraries directly, or offered findings clearly transferable to academic or resource-constrained library settings.
- They examined adoption, implementation, migration, use, barriers, sustainability, or service implications.
- They discussed identifiable open-source platforms such as Koha, DSpace, EPrints, Greenstone, VuFind, or related library tools.

Most of the evidence base falls within the 2016 to 2025 period. One earlier paper, Chauhan and Singh (2012), was retained because direct literature on rural India was sparse and this study remained useful as a contextual anchor for rural automation issues.

The included studies were synthesized through thematic analysis. The review organized the evidence under five themes: application domains, adoption drivers, implementation barriers, sustainability conditions, and rural or remote implications.

The source base is uneven, and this shaped the critical reading of the literature. The strongest strand consists of survey-based and mixed-method studies on adoption, barriers, and use in academic libraries (Kampa et al., 2024; Kampa & Patra, 2020; Ponelis & Adoma, 2018; Choi & Pruett, 2019; Hussain & Rafiq, 2024). A second strand consists of case studies on migration, implementation, and discovery system integration (Kumar, 2020; Roy et al., 2018; Bhowmick & Chakrabarty, 2021; Ojedokun et al., 2016). A third strand consists of literature reviews and reflective studies on sustainability and

research trends (Choi, 2023; Ahammad et al., 2024a). Rural and remote evidence is much thinner and less methodologically mature.

Results and Discussions

The evidence base is strongest on academic libraries and weakest on rural settings

The literature is dominated by academic library studies. This gives the review a strong basis for discussing adoption, barriers, and sustainability in universities and higher education institutions. Choi's update of library open-source software research shows that academic and research libraries have become even more prominent within this stream, while survey research has become more common as the field has matured (Choi, 2023). That is a sign of maturing inquiry, but it also means the literature is institutionally skewed.

By contrast, direct work on rural and remote libraries is limited. The rural strand is made up of a small number of contextual or problem-focused studies rather than a strong comparative body of evidence. This imbalance is important. It means the review can make stronger claims about academic libraries than about rural library contexts.

Open-source software use clusters around automation, repositories, and discovery

The literature shows a stable functional pattern in open-source adoption.

Library function	Leading platforms	Main uses	Evidence strength
Automation and ILS	Koha, NewGenLib, Evergreen, ABCD, FOLIO	Cataloguing, circulation, acquisitions, serials, reporting, patron management	Strong
Repositories and digital libraries	DSpace, EPrints, Greenstone, Fedora	Institutional repositories, theses, digital collections, open access dissemination	Strong
Discovery and access	VuFind, Blacklight	Single-window search across catalogues, repositories, and e-resources	Moderate
Web and service platforms	Drupal, Joomla, WordPress	Library websites, content delivery, user communication	Moderate

Koha is the clearest anchor platform in the literature. In India, Kampa and colleagues found that lower total cost of ownership, avoidance of vendor lock-in, code modification, and in-house expertise were among the main drivers of Koha adoption (Kampa et al., 2024). In Uganda, Ponelis and Adoma found that Koha dominated open-source ILS diffusion and was widely considered by libraries planning automation or migration (Ponelis & Adoma, 2018). In Zambia, Bwalya and

Akakandelwa found that libraries often struggled to use all Koha modules effectively, showing that adoption does not necessarily lead to full operational use (Bwalya & Akakandelwa, 2021). Taken together, these studies make Koha the best-supported example of open-source automation in the field.

Repository platforms form the second most mature cluster. In India, DSpace is the most visible repository platform. Cherukodan and colleagues showed that India is one of the most active adopters of DSpace for institutional repositories and digital libraries (Cherukodan et al., 2016). Kampa and Patra later found that DSpace had the highest awareness and usage among open-source digital repository platforms in Indian academic libraries (Kampa & Patra, 2020). Similar patterns appear in Islamabad university libraries, though implementation there was often partial and dependent on local skill levels and organizational backing (Khan & Sheikh, 2022).

Discovery services are less widely studied, but the available literature still shows a clear pattern. Roy and colleagues demonstrated how VuFind could be integrated with Koha, DSpace, and Apache Tika to create a single search interface and reduce retrieval fragmentation (Roy et al., 2018). Bhowmick and Chakrabarty likewise presented integration of Koha, Greenstone, DSpace, and VuFind as a lower cost alternative to commercial discovery environments (Bhowmick & Chakrabarty, 2021). Even so, the discovery literature remains narrower and more solution oriented than the automation and repository literature.

Cost matters, but it is not the only driver

The literature is highly consistent about the main reasons libraries adopt open-source software.

Driver	Typical form in the literature
Cost relief	Lower acquisition cost and reduced long-term ownership burden
Freedom from vendor lock-in	Greater institutional control and reduced dependency
Customization	Ability to adapt systems to local workflows
Interoperability	Better alignment with standards, repositories, and open access environments
Community support	Access to user communities, shared fixes, and peer knowledge

Cost is the most visible driver, but better studies show that it is not sufficient on its own. Kampa and Kaushik found that Indian institutions could realize substantial savings by adopting open-source systems for ILS, repositories, and websites, but the economic advantage was strongest where libraries also had policy support and willingness to invest in OSS use (Kampa & Kaushik, 2019). In Bangladesh, Ahammad and colleagues found that financial pressure and the need for flexible systems encouraged adoption, but collaborative support and local adaptability also mattered (Ahammad et al., 2024b). Choi and Pruett's study of US academic libraries similarly showed that awareness was not the main barrier. Libraries instead weighed open-source adoption against context-specific perceptions of risks and benefits (Choi & Pruett, 2019).

Open-source adoption is often framed in advocacy terms, as if lower cost naturally leads to uptake. The literature does not support that simplification. Libraries adopt open-source systems where cost, control, local capability, and institutional strategy align.

The strongest barriers are technical, organizational, and infrastructural

The most robust strand of the literature concerns barriers. Across countries and systems, the same set of constraints recurs.

Barrier	Typical manifestation
Skills shortage	Difficulty with installation, upgrading, backup, configuration, and module use
Weak documentation	Incomplete or hard-to-use manuals and support materials
Infrastructure weakness	Poor internet, unstable power, inadequate hardware, weak server environments
Migration burdens	Vendor lock-in, non-standard data, and complex legacy conversion
Organizational weakness	Limited management support, weak policy backing, procurement constraints
Resistance to change	Staff hesitation and uneven stakeholder buy-in

In Indian context technical and migration barriers were predominantly noticed. Kampa and colleagues found that poor documentation, lower perceived user-friendliness, limited functionality concerns, and poor IT knowledge were major barriers to Koha use in India (Kampa et al., 2024). Kumar's work on migration in the Indian context shows how difficult it can be to move from proprietary systems to Koha when data are locked into non-standard formats (Kumar, 2020). These studies challenge the common claim that open-source software is easy to adopt. It may be easy to obtain, but it is not necessarily easy to implement well.

African and South Asian studies reinforce the same conclusion from slightly different angles. In Zambia, Bwalya and Akakandelwa identified poor connectivity, lack of technical support, difficulty with upgrading and backup, and underuse of modules as key barriers (Bwalya & Akakandelwa, 2021). In Uganda, Ponelis and Adoma found that ICT infrastructure, procurement legislation, human resource capacity, and finance constrained diffusion (Ponelis & Adoma, 2018). In Oman, Shehata and colleagues found that low awareness, variable organizational acceptance, and technical, administrative, and security challenges all affected uptake (Shehata et al., 2021). In Pakistan, Hussain and Rafiq identified inadequate funds, weak IT skills, poor equipment, and low stakeholder interest as reasons adoption remained slow (Hussain & Rafiq, 2024).

Repository research shows the same structural pattern. Joo and colleagues found that institutional repositories face challenges across metadata, technology, user needs, ethics, and administration, but that the deepest constraint remained limited resources, including budget and staff (Joo et al., 2019). Khan and Sheikh likewise found that software selection, digitization decisions, training gaps, and lack of skilled staff hindered repository implementation in Islamabad university libraries (Khan & Sheikh, 2022).

Sustainability depends on institutions, not software ideology alone

One of the clearest shifts in recent literature is the move from adoption to sustainability. Earlier studies showed that open-source systems were sustainable by nature because they were free to use and community supported.Similarly Ahammad and colleagues argue that sustainability depends on several linked conditions: funding, staff training, customization capacity, governance, documentation, and community support (Ahammad et al., 2024a). Their Bangladesh study strengthens this point by showing that OSS improves service sustainability only where libraries invest in internal capability

and infrastructure (Ahammad et al., 2024b). Abdullahi reaches a similar conclusion in Nigerian academic libraries, linking sustainability to collective decision-making, written procedures, technical staffing, and periodic review (Abdullahi, 2025).

This is one of the strongest findings in the field. Open-source software lowers licensing burdens, but it does not eliminate recurrent work. Systems must still be updated, configured, documented, backed up, and aligned with changing workflows. Staff need training not only in front-end use but also in migration, database, and server practices. Where these capacities are weak, libraries may remain dependent on external technicians. In such cases, software freedom does not become operational autonomy (Dei & Tetteh, 2022; Abdullahi, 2025).

Rural and remote libraries remain under-studied but not conceptually separate

The rural and remote strand is the weakest part of the literature, but it still contributes a useful caution. Chauhan and Singh's study of rural India highlighted staff resistance, poor records, and human incompetence during automation processes, showing that the basic human and organizational conditions of automation can be especially fragile in such settings (Chauhan & Singh, 2012). Oyelude's study of left-behind libraries similarly points to limited technology, weak infrastructure, inadequate funding, and low digital readiness, while also presenting open-source solutions as part of a catch-up strategy (Oyelude, 2025).

These studies do not support treating rural libraries as a separate software category. Rather, they suggest that rural and remote libraries are environments where the usual barriers to open-source adoption become more acute. In other words, the issue is not that rural libraries need fundamentally different software. It is that they face sharper constraints in electricity, bandwidth, staffing, and access to technical communities. This makes implementation risk higher and sustainability more fragile.

India provides some of the clearest evidence of mature adoption

In India, Koha is the dominant open-source ILS in academic library discussions (Kampa et al., 2024; Kumar & Arunkumar, 2024; Samdani & Afreen, 2024). Second, DSpace is the most visible repository platform (Cherukodan et al., 2016; Kampa & Patra, 2020). Third, the economic case for OSS is unusually well developed in Indian studies (Kampa & Kaushik, 2019). Fourth, the main barriers concern migration, documentation, customization, and technical capability rather than lack of awareness (Kampa et al., 2024; Kumar, 2020).The literature review showcased how open-source software has moved beyond novelty. The question in Indian studies is not whether librarians know about Koha or DSpace. It is whether institutions can sustain migration, local adaptation, and long-term maintenance. That gives the Indian evidence wider value for comparative library research.

Discussion

Three broader conclusions emerge from the review article .

First, open-source software has become part of the mainstream infrastructure of academic libraries. The evidence for this is strongest in automation and repositories, where Koha and DSpace dominate the field. Discovery layers such as VuFind extend this infrastructure, but the evidence there is still narrower and more implementation driven than evaluative.

Second, the real value of open-source software lies in the combination of cost relief and institutional control. Libraries adopt OSS not only because it is cheaper, but because it offers room for local customization, interoperability, and reduced vendor dependency. This means that open-source software should not be described simply as a lower cost substitute for commercial systems. In library settings, it also operates as a governance choice.

Third, sustainability is not a property of software alone. It is an institutional achievement. The literature repeatedly shows that training, staffing, documentation, infrastructure, and policy support determine whether open-source systems remain usable over time. This point is even more important for rural and remote libraries, where infrastructure and support ecosystems are thinner.

The practical implication is clear. Libraries should not treat open-source adoption as a one-time procurement event. A more realistic approach is lifecycle planning: assessing migration complexity, module use, backup practice, local support, documentation, and staff development before adoption rather than after implementation problems emerge.

Limitations

This review has two core main limitations. First, the underlying search achieved moderate rather than exhaustive coverage, so the paper should be read as a strong thematic synthesis rather than a definitive census of all relevant studies. Second, the literature itself is uneven, with much stronger evidence on academic libraries than on rural and remote libraries. Despite these limits, the source base is strong enough to support the main conclusions of the review, especially regarding automation, repositories, adoption drivers, and sustainability barriers.

Conclusion

A decadal analysis of the scholarly literature revealed that open-source software has moved from the margins to the center of library functioning and services. In academic libraries, it is now most visible in automation, repository management, and integrated discovery. Koha and DSpace dominate the evidence base, while VuFind and related tools support lower cost service integration.

At the same time, the review makes clear that open-source software is not a friction-free route to sustainability. It reduces licensing costs, but it shifts attention toward migration, documentation, training, infrastructure, and governance. Libraries that can build these capacities are more likely to benefit from OSS. Libraries that cannot may find themselves with free software but costly fragility.

The global literature also shows a clear imbalance. Academic library evidence is now fairly mature, but direct work on rural and remote libraries remains thin. The available studies, including Chauhan and Singh's discussion of rural India, suggest that open-source software can support equitable library development only when paired with stronger investment in connectivity, staff capability, and institutional support. This is the clearest gap for future research.

Within that broader landscape, India offers one of the clearest cases of sustained open-source engagement. Its academic libraries have built significant experience with Koha and DSpace, and its literature provides some of the strongest evidence on economics, adoption drivers, and implementation barriers. The Indian record therefore supports a broader lesson for library development: open-source software is most effective not when treated as a low-cost substitute alone, but when embedded in a long-term strategy for adaptable, interoperable, and sustainable library services.

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