**Digital preservation Strategies in the Federal University Libraries in the North West Nigeria**

 **By**

 **Aisha Jimada**

 **Kashim Ibrahim Library Ahmadu Bello University, Zaria**

**shatuindo@gmail.com**

 **Rhoda Wusa Goshie**

 **Federal University of Technology Library, Minna**

**Mamawusa.77@gmail.com**

 **Jibril Attahiru Alhassan**

 **Federal University of Kashere Library, Gombe**

**jalhassan@fukashere.edu.ng**

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*Abstract*

*Digital preservation involves those activities that are carried out in libraries to protect their information resources that are born digital or those converted from analogue to digital form from loss and deterioration and to ensure long-term access to it despite the current changes in technology. This paper investigates the types of information resources digitized, the strategies used by the federal university libraries in North West Nigeria to preserve them so that they will remain accessible for use and reuse and the challenges facing it .Continuous access to digital information remain difficult even after they are preserved. A qualitative research method was adopted for the study; a purposive sampling technique was adopted and a structured interview was the instrument used to collect data for the study. The responses from the respondents were analyzed descriptively using tables. The result of the findings showed that theses, dissertations, preprint and post print journals are the common information resources digitise and preserved while refreshing and technology preservation are some of the strategies use , external hard drive is the storage media use . Erratic power is one of the challenges facing digital preservation. Based on the findings, the study concluded that digital preservation of information resources is carried out in the digitization unit of the libraries studied. Digitised resources are preserved in external hard discs, servers and most importantly in Institutional repositories. The paper recommended among others sensitization of Academic staff on the importance of uploading; normalization strategy should be adopted, proper maintenance of storage media should be adopted, use of cloud storage and adequate fund should be provided and policy should be developed*

*Key Words: Digital, Digitization, Information, Preservation, Resources and Strategies*

The emergence of Information and Communication Technology (ICT) has given birth to records that exist in digital forms and it has also changed the way information resources are preserved , accessed and used in the university libraries Information is not only stored in large amount but also for quick access, use and retrieval for the present, future and long term reuse. The rate at which digital information resources is generated and created keeps increasing daily in archives, organizations, libraries, institutions and government agencies and due to the increase their management becomes a problem in the area of access, storage preservation and retrieval for use.

Digital preservation is a set of processes and activities that are carried out to ensure that information in the library stored in digital formats remain accessible for as long as possible these can only be achieved through strategies such as digital reformatting, data migration, refreshing, emulation, replication , normalization ,technology preservation and metadata attachment. These strategies of preservation are taken due to the rapid and constant changes in software, hardware and media deterioration such as DVDs and CDs, preservation of digital information need constant intervention and attention due to the rapid changes in technology which is a stumbling block for preserving digital information. Digital preservation involve activities that stabilizes and protects digital resources in forms which are retrievable, readable and useable over time, it could be seen as the conservation of all born digital materials such as email, theses , projects dissertations , websites and electronic files or those converted from analogue to digital. Digital preservation refers to all the actions needed to maintain access to digital materials beyond the limits of media failure or technological change. . The reason for digital preservation in the library is to ensure that information resources are preserved for future generation access, use and re-use, it therefore becomes necessary to find a way of preserving them so that their originality is not lost.

Digital preservation consists of the strategies aimed at ensuring the continued accessibility of digital materials; it involves finding ways to re-present what was originally presented to users by a combination of software and hardware tools acting on data. To achieve this requires digital objects to be understood and managed at four levels: as physical phenomena; as logical encodings; as conceptual objects that have meaning to humans; and assets of essential elements that must be preserved in order to offer future users the essence of the object. Digital preservation strategies are methods used to preserve the integrity of digital objects so that they can easily be retrieved and used continuously even with the changing technology (Mathew & Sambo, 2014). Digital preservation is a strategic and continuous process of keeping and maintaining the accessibility, authenticity and longevity of digital records. It involves the identification of resources to be preserved, long-term storage and protection of records against myriad threats (Anyaok& Echedom, 2018).According to UNESCO (2011), the most significant threats to digital continuity concern loss of the means of access.

Digital preservation is important because it protects information resources against deterioration, prolong its usability, it makes information resources survive life time, allows worldwide accessibility of information and it serves as a backup.

Information resources in the libraries includes online data base, encyclopedia, textbooks, e-text books, journals, theses, dissertations, maps, reports, documents and conference proceedings that are used to promote teaching learning and research . Digital information resources are information in form of text, images, graphics, videos and audio which can be accessed through the use of computer. Nwabueze and Oghentega (2015) stated that digital information resources are information in softcopy that can be accessible through the use of computer and corresponding ICT tools.

Digitization in the library regardless the type of library is the process of converting information resources (local contents) includes theses, conference proceedings, inaugural lecture recordings and pictures from analogue to digital form. Digitisation is the conversion of printed materials into electronic format, protect them and enable access to many users at the same time. Parviainen et al, (2017) affirm that digitisation is the conversion of analogue information resources such as text, images, and video into a digital form. Digitization offers imperative benefits for institutions, it contributes to the conservation and preservation of heritage and scientific resources, it creates new educational opportunities; inspire tourism; and provides ways of refining access by the citizen to their patrimony. Nur et al (2018), affirm that the likely benefit of digitisation to organisations is that informational materials can be accessed from any location, capacity to transfer images within structured workflow, assisting processing, better integration, save space and increase productivity”.

Digitization regardless of the type of library is the process of converting information resources (local contents) includes theses, conference proceedings, inaugural lecture recordings and pictures from analogue to digital form. Parviainen et al, (2017) affirm that digitisation is the conversion of analogue information resources such as text, images, and video into a digital form. Digitisation offers imperative benefits for institutions, it contributes to the conservation and preservation of scientific resources, and it creates new educational opportunities; inspire tourism; and provides ways of refining access. The process of digitization involve te submission of materials in to the library from various departments within the institution, these include theses, dissertation, projects, inaugural lectures and conference proceedings.

* Conversion: conversion takes place after the collected information materials are checked and certified ready for conversion. Library staff proceeds to convert the print resources through scanning.
* Editing: Editing entails image enhancement processes such as cropping, resizing, rotating, etc. Scanned documents are saved in flash drives and further transferred to other computer systems where they are subjected to editing. The library staff uses the GIMP software to edit scanned documents.
* Metadata: digitized materials are assigned metadata to facilitate quick access and retrieval, metadata describes other data in that it makes finding necessary information easier.
* .Storage: When documents have been certified web ready, they are saved in folders with appropriate file naming conventions and stored in the computer hard drive or external storage(such as external hard disk and flash drives) for upload to the institutional repository

**Statement of the Problem**

The role of the university library is to acquire process, store, preserve and disseminate information resources in print and non-print format to support teaching, learning and research for present and future use. The advent of ICT has changed the way information resources are preserved, accessed and retrieved in the world. Digitisation was introduced into the libraries to preserve, allow continuous access, use, re-use, ease retrieval and to protect records from deterioration. However, it has been difficult to enable continuous access to digital resources in many Nigerian university libraries which may be due to certain management and infrastructural challenges. A study by Atanda (2017) discovered that libraries in Nigeria are faced with the challenge of lack of stable strategies in the preservation of their digital materials Gbaje (2011) stated that digital information will cease to be available without proper management and intervention. This situation presents an ineffective and inefficient digital preservation system leading to limited access, loss of information and delay in accessing information, and it is against this backdrop that this study will be carried out to find out why it so in federal university libraries in northwest Nigeria.

**The Objectives of the Study**

1. To identify the types of information resources digitized and preserved in the Federal University

Libraries in North West Nigeria

1. To establish the strategies use to ensure continuous access to the digitized resources in the Federal University Libraries in North West Nigeria
2. To find out the types of storage media used to preserve digital information resources in the Federal University Libraries in North West Nigeria.
3. To find out the challenges facing digital preservation in the Federal University Libraries in North West Nigeria.
4. To propose recommendation to guide digital preservation strategy in the Federal University Libraries in North West Nigeria.

**Literature Review**

Okeke et al (2015) affirmed that Academic libraries are digitizing their materials because they know the importance and continuing value of library resources for learning, teaching, research, scholarship, documentation, and public accountability. Senturk (2014) in a paper titled “effective digitisation in archives in Turkey” submitted that one of the methods used by archivists to protect and ensure the usage of their records is through digitisation because it provides maximum usage and protection of the records. The paper stated that digitisation should be carried out by experts and also should be preplanned to ensure successful implementation.

Omer (2017) stated that electronic theses, dissertation and books are some of the most frequently preserved and used items in the institutional repository in the university of Khartoum library.

Nneji (2018)stated that the reasons for digitisation in the library is for preserving endangered collections and allow wider access to the research output of the university community, provide timely information and promote interlibrary cooperation. Council of Canadian Academics (2015) stated that some factors that contribute to the success of memory institutions in the present digital age were the enactment of digital policies, effective leadership, human resources capabilities, collaborative culture, management support, technical standards and copyright intellectual property.

Seifi et al (2015) stated that refreshment is a strategy where information is copied from a deteriorating, or outdated storage media such as CD ROM or DVD to a newer one, it is carried out to avoid loss of information. Bhatt (2018) suggested that continuous innovation and research efforts in current storage technologies are required to lessen the impact of storage shortage in digital libraries and to allow emerging storage technologies to advance further.

Data is stored in the cloud in known locations with a specific community of consumers who share the same concerns. According to Adu (2015), this may be operated by one or more of the organisations in the community, a third party or some combination of them. For many organisations the cloud represents an attractive mode of preserving their digital records. According to Thibodaux (2014) opportunities for using the cloud are as follows:

* Cost savings.
* Reduced pressure on ICT departments to provide the ever increasing storage capacity.
* Access to services outside the normal office environments.
* Better collaboration with geographically dispersed users.
* Potential opportunities for greater automation of record keeping as part of business.
* More time for ICT personnel to devote to other issues where server maintenance and related tasks are lessened.

Emulation is the process of replicating the functionality of an obsolete system; it is an approach that uses one computer device or software programme to imitate the behaviour of another device to obtain the same results. Emulation is considered a better technique for preserving digital objects that are complex, since some of their information maybe lost during migration to new formats. Adu (2015) also argues that, “emulation operates on the environment of an object, trying to simulate the original environment that the object needs”. Though emulation delivers the most authentic possible rendition of a digital object, critics argue that it can be a very complex strategy to implement since it requires not only the preservation of the original objects but also detailed knowledge of the original systems. According to Jimada (2013) replication involves creating duplicate copies of data on one or more system, data that exist as a single copy in one location is vulnerable to technology failure, alteration and environmental disaster. Digital data is more likely to survive if it is replicated in several locations.

The preservation strategies stated by UNESCO in their charter (2003), for preservation of digital materials in data carriers/ storage media are:

* Let the institution, government, organization, individual etc. decide on the format that will be accepted for preservation. If possibly, negotiate with producers to use widely accepted standards and to provide adequate documentation
* . Store media / data carriers in appropriate conditions
* Copy data to more stable media and make backup copies, using good quality media
* Store data securely, including offsite storage for backup if possible
* Check data for errors regularly
* . Establish a data refresh regime suited to the life of the media
* Record information that will be needed to provide short term access – the identity of the material, access requirements, passwords
* Retain necessary access equipment and software, maintaining hardware and protecting software within license arrangements
* Plan to pass the digital materials to another suitable care taker, that is, liaising with other institutions who have similar interest or responsibilities or experience in preserving or managing the kind of materials that you are interested in and seek guidance and mentoring
* Alternatively, find ways to adequately reflect the material in a stable non digital form (such as printing out).

Migration is the transferring of data to newer system environments and may include conversion of resources from one file format to another or from one old operating system to another so that the resources remains fully accessible and functional. It is one of the mostly used approaches as it focuses on files and seeks to keep digital objects on current and new media formats. And it is useful whenever an operating environment, hardware and software change (Gbaje 2013, Lowry and Nduna 2015).

Metadata is information that characterizes another information resource by listing its attributes especially for purposes of identifying, retrieving, managing and preserving that resource. Accessibility and usability of content in the digital preservation environment are enhanced through the creation and management of preservation metadata (Corrado and Moulaison 2014). According to Adu (2015) Preservation metadata is categories as follows:

* Technical metadata- which gives a description of the physical attributes of digital objects particularly for preservation and rendering.
* Management or administrative metadata- which establishes the authenticity, rights, ownership and provenance of the digital object.
* Discovery metadata- which helps to locate, access and use digital content in the long term.

Technological obsolescence is caused by continuous upgrade in operating system, programming language application and storage media due to commercial interest. The devices, software and formats used to store information are often designed for obsolescence; corporations that design these hardware and software design them with a shelf life in order to ensure the sales of latest upgrades and model (Reyes, 2013)

Onyinye (2013) stated that absence of legislation ,policy, standards and strategy is a preservation challenge in Africa because legislators and policies makers are not aware or conversant with requirements for digital preservation , they make laws that inadequately cover or completely ignore digital preservation issues,

Mesanye & Ngulube (2019) stated that Academic libraries in South Africa are affected by changes in the digital environment, lack of institutional commitment and participation, lack of established digital preservation standards, policies and processes, inadequate resources, lack of skills and training, inadequate collaboration efforts and partnership, lack of funding and technological obsolescence are some of challenges faced in an effort to preserve their digital content. The study proposed a conceptual model for preservation of digital resources in the academic libraries studied mapped with the open archival information system reference model. Pandey & Kumar (2020) revealed that most digitisation projects face obstacles such as inadequate funding, lack of national digital preservation policy, absence of technical infrastructures for digitisation project, lack of a national standard for digital preservation and absence of technical infrastructure.

The devices, software and formats used to store information are often designed for obsolescence; corporations that design these hardware and software design them with a shelf life in order to ensure the sales of latest upgrades and models (Reyes 2013). Technological obsolescence poses the greatest risk to digital records as the rapid pace of technology (Baker, 2014).This could be as a result of constant changes in hardware and software.

Anyaogu (2014) stated that inadequate funding remains a crippling problem because the cost of making new purchases of digital technology and its maintenance is a drawback for those struggling to stay with budget allocations. Joseph, Wang & Ondukariuki (2018) confirmed that the obstacles facing digitisation are; inadequate budget allocation needed to purchase ICT equipment’s and training of personnel involved in the digitisation project, most of the projects run behind schedule, outdated ICT equipment (hardware and the software which could lead to poor image capture), lack of technical expertise and bureaucracy.

UNESCO (2003) stated the following measures to be used for preserving digital collection which is supported by Nworie (2019) include:

* Placing the digital materials in a safe place like in racks, vaults, shelves etc.
* Using structured metadata and other documentation to facilitate access
* Protecting the integrity and identity of data
* Choosing appropriate means of providing access in the face of technological change by refreshing the documents in the hardware, migration, replication, emulation, transparency, diversity which includes sharing of resources and forming of consortium with other academic institutions, audit, sloth etc.
* Management preservation programmes should be put in place to achieve their goals in cost effective, timely, holistic, proactive and accountable ways.

These strategies as strongly believed if they are properly put in place will enable digital materials in the library to survive threats and changes in technological hardware and software.

Furthermore, Gbaje (2011) carried out a study titled, “Digital preservation strategies: a case study of Nigerian national information centre”, and the aim was to find out the digital preservation strategies and structures put in place for the implementation of the strategies adopted. A case study and qualitative methodology was adopted. Data were obtained through semi-structured questionnaire from fifteen (15) staff that were in charge of digitization and digital preservation units of three centres studied. From the findings of the study, migration among others was the most popular digital preservation strategy adopted and no structure was put in place to assess digital objects for preservation action.

**Methodology**

The qualitative method was adopted for the purpose of this study; the population of the study covered all the seven (7) federal university libraries in North West Nigeria these university only university libraries with digitization units were selected and their total population of was selected and their total population was (768) staff. The subjects of the study were the staff of the digitization unit who were (26) in number and were therefore purposively selected to form the sample for the study. The study is limited to only federal universities in North West and the reason for this is because most of the state universities are located in the rural area. The structured interview was the instruments used to collect data for the study; the data collected was organized, tabulated and discussed thematically.

**Results and Discussions**

**Table: 1 Information Resources Digitized and Preserved**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Types of Information Resources | Kashim Ibrahim Library Ahmadu Bello University Zaria | Bayero University Library Kano | Abdullahi Fodio Library Usman Dan Fodio University Sokoto | Federal University Library Dutsinma University Library Dutsinma |
| Thesis  | ✓ | ✓ | ✓ | ✓ |
| Dissertation | ✓ | ✓ | ✓ | ✓ |
| Seminar Papers | ✓ | X | X | X |
| Inaugural Lecture  | ✓ | X | X | X |
| Reports | X | X | X | X |
| Past Question Papers | X | X | X | ✓ |
| Preprint and post print Journal  | ✓ | X | ✓ | X |
| Undergraduate Project | X | X | X | ✓ |
| Conference Proceedings | ✓ | X | X | X |
| Arabic and Islamic manuscripts | X | ✓ | X | X |

**Key:** X = Not Available ✓= Available

The findings from table 1 indicated that theses, dissertations are the most popular information resources digitized and preserved in all the university libraries studied. This is because they are the scientific output of research published by the academic community and allowed to be digitized and preserved in line with the policies. In addition to theses and dissertation, Kashim Ibrahim Library incorporate both conference papers seminar papers, preprint and post print journals. It was discovered that Kashim Ibrahim Library in addition to the other resources mentioned preserve central bank annual reports books, agricultural research collection and compendiums. The university library Kano in addition to the theses and dissertation digitize and preserve Arabic manuscripts, while Abdullahi Fodio library incorporate preprint and post print journal as part of their information resources and finally University library Dutsinma incorporate digitized undergraduate project. It was discovered during the interview that none of the university library studied digitize and preserve inaugural lectures. This implies that all the libraries studied that do not digitize and preserve all the different categories of digital information resources will not be able to meet the needs of users in the academic environment. The finding is in agreement with Omer (2017) who stated that electronic theses, dissertations and books are some of the most frequently preserved and used items of repository collections in the university of Khartoum library.

**Table: 2 Strategies for Preservation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Strategies | Kashim Ibrahim Library Ahmadu Bello University Zaria |  Bayero University Library Kano | Abdullahi Fodio Library Usman Dan Fodio University Sokoto | Federal University Library Dutsinma |
| Refreshing | ✓ | X | ✓ | X |
| Normalization | X | X | X | X |
| Migration | X | X | ✓ | X |
| Emulation | X | X | ✓ | X |
| Technology Preservation | ✓ | ✓ | X | X |
| Restoration | ✓ | X | X | X |
| Backup System | X | X | X | ✓ |
| Encapsulation | ✓ | X | X | X |
| Replication | X | X | X | X |
| Reliance on Standard | X | X | X | X |

Key: X = Not Available ✓= Available

The findings in table 2 revealed that the most popular preservation strategy adopted for digitization is refreshing and technology preservation. Kashim Ibrahim library and Abdullahi Fodio library adopt refreshing as a strategy for preserving digital information resources, Abdullahi Fodio library in addition to refreshing include emulation and migration as part of their preservation strategies. In addition to refreshing Kashim Ibrahim Library incorporate strategies like restoration and encapsulation while the University Library Dutsinma adopt back up as a strategy for preserving their digital information resources. It was noted that none of the university libraries studied adopted normalization, replication and reliance on standard as a preservation strategy. It was discovered that University library Kano and University library Dutsinma adopted only one preservation strategy and this implies that continuous access to information resources for teaching and research in these libraries will become difficult due to inadequate strategies for preservation.

**Table 3: Storage Media for preserving Digital Information Resources**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage Media  | Kashim Ibrahim Library Ahmadu Bello University Zaria | Bayero University Library Kano | Abdullahi Fodio Library Usman Dan Fodio University Sokoto |  Federal University Library Dutsinma |
| CDROM | X | ✓ | X | X |
| External Hard Drive  | X | ✓ | ✓ | ✓ |
| Computer Hard Disk | X | ✓ | X | X |
| DVD | X | X | X | X |
| Server  | X | X | ✓ | X |
| network drive of two terabyte | ✓ | X | X | X |

Key: X = Not Available ✓= Available

The findings from table 3 revealed that is the common storage used to preserve digital information resources by all the libraries studied is the external hard drive.. Bayero University Library Kano, Abdullahi Fodio Library UDUS and federal University Library Dutsinma incorporate the use of external hard drive while the Bayero University Library Kano include the CD-ROM as part of their storage device and finally Abdullahi Fodio Library incorporate the use of server. It was discovered during the interview that all the university libraries studied have established an institutional repository. This implies that that the university libraries studied are meeting expectations.

**Table 5: Challenges Facing Digital Preservation of Information**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Challenges | Kashim Ibrahim Library Ahmadu Bello University | Bayero University Library Kano | Abdullahi Fodio Library Usman Dan Fodio University Sokoto | Federal University Library Dutsinma |
| Lack of support from various departments | X | X | X | ✓ |
| Lack of dedicated personnel  | ✓ | X | X | X |
| Inadequate Skilled personnel | ✓ | X | ✓ | X |
| Poor internet connectivity | ✓ | X | X | X |
| Copyright issues | ✓ | X | X | X |
| Lack of support from the top management level | X | ✓ | ✓ | X |
| Technological Obsolescence | X | X | X | X |
| Inadequate Funding | ✓ | X | X | X |
| Erratic Power Supply  | ✓ | X | X | ✓ |
| Poor maintenance culture | X | X | ✓ | X |
| Technophobia | X | X | X | X |
| Absence Digitization of Policy | X | X | X | X |
| High Cost of Purchasing Equipment | ✓ | X | X | X |
| Bureaucracy | X | X | X | ✓ |
| Lack of In-house Training | X | ✓ | X | X |
| Poor funding | X | X | ✓ | X |
| Poor Digitization policy | X | X | ✓ | X |
| Inadequate Technological Equipment | X | ✓ | X | X |

Key: X = Not Available ✓= Available

The findings from the study reveal that erratic power supply; inadequate skills by personnel and lack of support for digital preservation from the top management level are the most common challenges facing digital preservation in the libraries studied. University library Dutsinma is faced with the issue of lack of support from various departments in the university in submitting their information resources for preservation in the library, while Kashim Ibrahim Library is faced with the challenge of lack of dedicated personnel to their work and also inadequate skilled personnel. Kashim Ibrahim Library and University Library Dutsinma are faced with inadequate skills on digital preservation by the personnel; in addition Kashim Ibrahim Library is face with poor internet connectivity, copy right issues, inadequate funding and high cost of purchasing equipment. Abdullahi Fodio library is faced with poor maintenance culture and poor funding and poor digitization policy while University library Dutsinma is faced with the issue of bureaucracy and finally university library Kano is faced with the issue of inadequate technological equipment for digital preservation. The findings are in line with Mesanye & Ngulube (2019) who stated that academic libraries in South Africa are affected by changes in the digital environment, lack of institutional commitment and participation, lack of established digital preservation standards, policies and processes, inadequate resources, lack of skills and training, inadequate collaboration efforts and partnership, lack of funding and technological obsolescence are some of challenges faced in an effort to preserve their digital content.

 Conclusion

Based on the findings, the study concluded that digital preservation of information resources is carried out in the digitization unit of the libraries studied but it is not effective and efficient despite the high benefits it has. There is need for varieties of resources to be preserve, more preservation strategies like normalization, adherence to preservation standards should be used, competent staff with skills on digital preservation should be employed, funds should be made available in order to train staff, acquire necessary facilities, provide alternative power supply such as the generation and solar systems . There is need for further studies that will cover more university libraries and other education institutions such as colleges of education and polytechnics in other regions of the country

Recommendation:

1. The university libraries should embark on sensitization of academic staff in their various universities on the importance of uploading their publications to the Institutional Repositories.
2. University libraries should adopt normalization as a strategy for preservation and also adhere to the standard for digital preservation strategy.
3. University libraries should adopt refreshing and more preservation strategies for their digital information resources.
4. Regular backup of information resources should be carried out and cloud storage should be adopted in libraries.
5. The top management should support digital preservation activities and also collaborate with the university librarians.
6. Early and proper planning should be done, a strategic plan should be developed, and policy on digitization should be developed and updated regularly.
7. In-house training such as workshops ,and seminars, conferences on digital preservation should be organised by the library; the staff involved in digital preservation should attend conferences , workshops , webinars, and trainings outside the university community to acquire more knowledge and digital skills on uploading ,browsing, Metadata ,scanning and to retrain others on their return.
8. Adequate and high capacity scanners, computers and digital camera should be provided.
9. Adequate, dedicated and competent professionals that are ICT literate should be employed, motivated and trained on digital preservation.
10. Generators, inverters and solar system should be provided and used in case of power failure.
11. Adequate funding should be provided for the purchase of technological equipment and infrastructure , management of the preservation activities, maintenance of the infrastructural facilities, training and for staff welfare.
12. Constant upgrade in technology
13. University libraries should form consortium with other university libraries to preserve digital information resources.

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