Design and Development of a National Digital Repository System (NDRS) for Bangladesh

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Design and Development of a National Digital Repository System (NDRS) for Bangladesh

A thesis submitted to the University of Dhaka, Bangladesh in partial fulfilment of the requirements for the award of Doctor of Philosophy

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Supervisor's Certificate

This is to certify that the thesis entitled "Design and Development of a National Digital Repository System (NDRS) for Bangladesh" submitted by Md. Mukhlesur Rahman for the degree of Doctor of Philosophy (PhD) in Information Science and Library Management, University of Dhaka is an original study carried out by him under my supervision and guidance.

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Supervisor

EXECUTIVE SUMMERY

Information and knowledge are considered as key resources for Research and Development (R&D). Access to right information in right time is strongly required for decision making and policy implementation. Researchers are conducting research in different fields from different perspectives and creating knowledge. But very often users cannot access easily to the finding of the research due to scatter sources and other access barriers. As a result, research finding cannot contribute to the development activities as expected. Accordingly, managing and providing timely access to those pertinent explicit knowledge has become a vital issue for the knowledge management professionals. Appropriate knowledge management tools are required to ensure the accessibility and visibility of recorded knowledge. Information professionals are initiating and adapting different knowledge management systems to cope with the changing pattern of information management tools and services. Digital Repositories (DR) have received wide attention in recent years by allowing access to digital information. DR have become widely accepted and preferred information sources in the areas of education, science and technology. Institutional Repository (IR) is common part of Digital Repository. Collective IR efforts lead many countries to hoist national Digital Repository network.

ICT facilities and services are increasing rapidly in Bangladesh. With the availability of technological apparatus and demand from both user and administrators Institutional Repository (IR) has been gaining importance in Bangladesh. Some well-infrastructural institutions implemented IR in Bangladesh while a lot of other organizations are on pipeline. But there are differences among the existing IR practices. Accordingly, the study aimed to identify the scenario of repository management in Bangladesh. Additionally, the study also investigated the constraints as well as assessed the needs of national based DR platform. One of the major aims was to design a DR platform considering the present scenario of DR in Bangladesh. With this view related literatures were reviewed, primary data were collected from around 300 researchers and 36 library heads.

The study observed that both libraries and individual researchers have different types of intellectual resources. It is found that around 50% users possess journal articles, more than 85% libraries have thesis and dissertation while 82.86% libraries have conference papers and 80% libraries have annual report and other collections. But there were differences in terms of management and dissemination of scholarly output. It is identified that a large number of researchers (40%) preserve their research output in personal computers and around 34% researchers disseminate their research output by e-mail to the fellow colleagues and other concern. But those resources are difficult to access and use by other information seekers. However, the study identified that 48.31% researchers think having IR in their respective organizations is very important. Accordingly, more than 83% researchers like to preserve their research output in their respective IR. Most of the users (59.91%) strongly agree that with the help of IR archiving of their scholarly resources will be very easy. Librarians are considered as the main custodian of administering and managing intellectual resources of the concerned organization. Library professionals are trying to meet the demand of web-based repository management activities maintaining the gear and tear. But very often they feel difficulty for managing so. The study identified that 44% library head identified lack of IT support stuff is the most challenging factor for establishing IR in Bangladesh. In addition, 45.71% library heads think 'inadequate financial support' and 'inappropriate infrastructure facilities' hinders IR development in Bangladesh. Besides, 45.71% librarian think 'inappropriate infrastructure facilities' is obstacle for establishing IR. The study revealed that most of the librarian/library in-charges (68%) think that National Digital Repository System (NDRS) is very important for Bangladesh. Besides, more than 77% librarians/library in-charges assume that NDRS will be very useful for their organizations. Most of the librarians/library in-charges (69%) are strongly in-favor of joining NDRS framework. Accordingly, after a thorough consultation of different repository software and the requirements of the country the study proposed a National Digital Repository System (NDRS) model for Bangladesh.

The proposed NDRS may be a gateway for individual researchers and research organizations to contribute to a national repository. The shared platform will ensure the standard, access opportunity and preservation protocol for all repositories of Bangladesh. Besides, an open access repository platform may help policy makers and analysts, academicians, training institutions, researchers and government and non-government organizations to know which research is already done in a particular topic, where to get the output or whom to contact. Users will be also able to search, browse and download full text report free of cost in a single platform. Moreover, by collaboration with leading online search engines viz. Google and Google Scholar, National Digital Repository System will increase the international visibility of research originating from Bangladesh. Open access to scientific literature will increase h-index of a scientist or scholar. It will also reflect the aggregated research output of all fields of the country. Above all, the NDRS will serve as a focal point for Research and Development (RD) as well as scholarly activities in Bangladesh.

The study also described different issues relating to policy and implementation including smooth operation of NDRS. Finally, the installation process, guidelines and functional overview discussed in this study will be helpful for building national repository in other countries.

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LIST OF ABBREVIATIONS AND ACRONYMS

AAU	—	Association of African Universities
ARL	—	Association of Research Libraries
ARROW	—	Australian Research Repositories Online to the World
BAUL	—	Bangladesh Agricultural University Library
BCPS	—	Bangladesh College of Physicians and Surgeons
BdREN	—	Bangladesh Research and Education Network
BIPC	—	Bangladesh INASP-PERI Consortium
BOAI	—	Budapest Open Access Initiative
BSMMUL	—	Bangabandhu Sheikh Mujib Medical University Library
BUET	—	Bangladesh University of Engineering and Technology
BUETL	—	Bangladesh University of Engineering & Technology Library
CIRDA	—	Centre on Integrated Rural Development for Asia and the Pacific
CMS	—	Content Management System
CRIS	—	Current Research Information System
DAATJ	—	Digital Archives of Agriculture Thesis and Journal
DANS	—	Data Archiving and Networked Services
DARE	—	Digital Academic REpositories
DOAR	—	Directory of Open Access Repository
DRM	—	Digital Rights Management
DUL	—	Dhaka University Library
ETD	—	Electronic Thesis and Dissertation
EWU	—	East West University
FOSS4LIB	—	Free and Open source Software for Library
HTML	—	HyperText markup Language
HTTP	—	HyperText Transfer Protocol
ICDDR,B	—	International Centre on Diarrhoeal Disease, Bangladesh
ICL	—	International Copyright Law
ICT	—	Information Communication Technology
IFLA	—	International Federation of Library Associations
INASP-PERI	—	International Network for the Availability of Scientific Publications - Program for Enhancement of Research Information
IP	—	Internet Protocol
IPR	—	Intellectual Property Right
IR	—	Institutional Repository
IT	—	Information Technology
IUBL	—	Independent University, Bangladesh Library
IUT	—	Islamic University of Technology

JAIRO	—	JApan Institutional Repository Online
JANET	—	Joint Academic Network
JU	—	Jahangirnagar University
LCSH	—	Library of Congress Subject Headings
LOR	—	Learning Object Repository
MARC	—	MAchine Readable Catalogue
MIT	—	Massachusetts Institute of Technology
MODS	—	Metadata Object Description Schema
NARICS	—	National Academic Research and Collaborations Information System
NGO	—	Non-government Organization
NIH	—	National Institutes of Health
OA	—	Open Access
OAI	—	Open Archives Initiative
OAI-PMH	—	Open Access Initiatives – Protocol for Metadata Harvesting
OARE	—	Online Access to Research in the Environment
OPAC	—	Online Public Access Catalogue
OpenDOAR	—	Directory of Open Access Archives
PDF	—	Portable Document Format
Ph.D	—	Doctor of Philosophy
PLoS	—	Public Library of Science
POP	—	Post Office Protocol
R & D	—	Research & Development
RM	—	Repository Management
ROAR	—	Registry of Open Access Repository
SARC	—	SAART Agriculture Resource Centre
SCOAP	—	Sponsoring Consortium for Open Access Publishing
SHERPA	—	Securing a Hybrid Environment for Research Preservation and
SPARC	—	Ŝcholarly Publishing and Academic Resources Coalition
SPSS	—	Statistical Package for the Social Sciences
SSRN	—	Social Science Research Network
SUST	—	Shahjalal University of Science and Technology
UDL	—	UGC Digital Library
UGC	—	University Grants Commission of Bangladesh
UNESCO	—	United Nations Educational, Scientific and Cultural Organization
USTC	—	University of Science and Technology Chittagong
VoIP	—	Voice over Internet Protocol
WiFi	—	Wireless Local Area Network
WWW	—	World Wide Web

Chapter - 1: Introduction

1.1 Introduction
1.2 Background of the Study
1.3 National Digital Repository System for Bangladesh
1.4 Rationale of the Study
1.5 Scope of the Work
1.6 Significance of the Study
1.7 Conclusion

1.1 Introduction

Information and knowledge are considered as key resources for Research and Development (R&D) of any country. Smooth R&D requires the availability of uptodate, relevant and specific information resources from the concerned field. Intellectual communities throughout the world are continuously creating new knowledge relevant to R&D activities. Accordingly, managing pertinent explicit knowledge have become vital issues for the knowledge management professionals. Knowledge management tools are required to ensure the accessibility and visibility of recorded knowledge. Information professionals are initiating and adapting appropriate knowledge management systems to cope with the changing pattern of information management tools and users' demand. Technological advancement in the field of digital information network helps professionals. With the development of the web environment, knowledge sharing in libraries is becoming increasingly important (Liu, Chang, & Hu, 2010). Internet technology has created great opportunity for acquiring knowledge and doing research in all disciplines. This technology ensures transparency, connects users, provides host services and enables sophisticated tools to access information. The internet has removed many of the restrictions traditionally

associated with access to knowledge including geographical barriers, time restrictions, delays in dissemination, and availability barriers that limited the range of sources that could be accessed by a single person. Improved access benefited researchers to study their context more broadly, reducing the amount of duplicative research, and helping researchers to produce better informed and quality output (Houghton, Sheehan, & Steele, 2006). Institutional Repository (IR) is common part of Digital Repository (DR). Collective IR efforts lead many countries to hoist national DR network. Some leading institutions in Bangladesh have been implemented IR individually. On the basis of available literatures, the study identified that there is no major research has been conducted to design and development of National Digital Repository System (NDRS) in Bangladesh.

1.2 Background of the Study

Access to right information in right time is a major pre-requisite for any research, development and other everyday activities. But due to information explosion, it is very difficult to keep contrast off all knowledge for information seekers as well as information professionals. Libraries are considered as store house of information and learning resources. But no libraries can ensure access to all types of information for its user community. Moreover, budget shortage is also important factor for collecting information resources. Though the budget shortage is acute in developed and under developed country libraries, developed country libraries are not exception of that. Many rich country libraries are bound to reorganise budget allocation for acquisitioning learning resources for survival. As a result, library users are supposed to get smaller sources of information than ever before.

To overcome those budget shortages of libraries and to find out suitable solution for providing maximum access to information resources, information professionals initiated many new techniques. Many institutions have revised their information policies, services and technologies adaptable long-term economic strategy. Rich libraries innovated new mechanism to manage, host, preserve and distributing scholarly output. Open access, self-archiving, resource sharing are some phenomenon which accelerate user to access more resources.

Long-term preservation of documentary collections is also another important issue for information professionals. Libraries have experienced a strong shift in focus over the past decade towards digital formats of information resources. A large number of libraries are now meeting users' demands through digital media and electronic dissemination as much as through paper-based media. Universities are investing to provide digitized teaching and learning resources (Tanner, 2006). Self-archiving of resources is getting popular among the authors and creators. Self-archiving is the act of (the author's) depositing a free copy of an electronic document online in order to provide open access to it (Harnad, 2001). The term usually refers to the self-archiving of peer-reviewed research journal and conference articles, as well as theses and book chapters, deposited in the author's own IR or open archive for the purpose of maximizing its accessibility, usage and citation impact. The term green open access has become common for distinguishing this approach from gold open access, where the journal itself makes the articles publicly available without charge to the reader (Harnad et. al., 2004).

IR has been emerged as a mechanism for storing digital contents created by research organizations, universities etc, aiming to reform the process of scholarly communication, and also becoming a key component within library and open access communities. Hernad, a key advocate of open access movement, consider IR also as the open access archives as cost effective and immediate route to providing maximum access to the results of public funded results.

The present study concentrates on demonstrating a National Digital Repository framework for scholarly communication by harvesting metadata from existing IR and other archives using the Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH). Besides, the study aims to explore solutions for preservation and management of research output from various level including the contribution of non-institution based researchers' research output. The study tried to demonstrate various workflow of developing a national based repository framework including policy formulation and implementation.

1.3 National Digital Repository System for Bangladesh

Internet and other digital technologies enable users to access libraries and library resources easily and timely. These technologies also enable information professionals to manage and disseminate their digital resources in user-friendly ways. One of the most advantageous mechanisms of collection and preservation of digitized resources is digital repository. Digital Repositories (DR) have received wide attention in recent years by allowing access to digital information from anywhere across the world (Mishra, 2010). DR has become widely accepted and preferred information sources in the areas of education, science and technology. In many countries, collective DR lead to form National Digital Repository System (NDRS). ***NDRS is a multi-institutional repository platform that is supposed to collect, preserve, promote and disseminate a nation's cultural heritage, intellectual output and creative commons.***

The proposed NDRS would be provided following features:

a) An operational open access digital repository in research and higher educational institutions that forms an integral part of the teaching, learning, research and administrative fabric of its host institution.
b) A supporting infrastructure based upon open standards and common implementations, facilitating interoperability and a coordinated approach to resource discovery, harvesting and curation of intellectual assets in Bangladesh.
c) Centrally provided technical and organisational support to assist institutions to construct, populate and embedded IR.
d) A national resource discovery and search service to provide integrated access to aggregated data of Bangladesh which also makes provision for long-term preservation and archiving.
e) Users can get high quality content from participating institutions.
f) By using validated metadata supplied by its partners to build its search indexes high quality of search result is possible in NDRS.
g) NDRS provides a shared information space for organizations for preservation and management of intellectual resources.
h) The repository community can use the NDRS infrastructure to provide national or regional repository search services.
i) IR can enjoy the increased visibility through joining NDRS.

The NDRS will be benefited in the following ways:

a) An Online repository with International visibility of research originating from Bangladesh and open access to scientific literature will increase h-index of a scientist or scholar.
b) Permanent digital record of research output.
c) Provides the users to view the aggregated research output to whole field, country or of individual scientists/researchers.
d) Allows researchers to search, browse and download full text Free of Cost.
e) Multi-disciplinary research collection that could have substantial impact on the nature of scholarly publishing.
f) Indexed by leading online search engines viz. Google and Google Scholar.

1.4 Rationale of the Study

Bangladesh is a developing country. Anyone can easily observe the technological development in all spares of life. Connection with sub-marine cable enabled Bangladesh to access information super highway globally. Internet access has become easy and reached to individual's doorsteps. In 2009, WiMax technology was introduced in the country which is enabling fast, secure and dedicated internet connection for all and is also breaking the barrier of not reaching the un-reached (Wahed, 2009). Besides, in October 2002, the Government of Bangladesh declared the first national policy on ICT known as the National ICT Policy 2002 with a vision for "a knowledge based society' (M. A. Islam & Alam, 2010). The act makes provisions for ensuring free flow of information and people's right to information. The freedom of thought, conscience and speech is recognized in the Constitution as a fundamental right and the Right to Information is an alienable part of it (Ministry of Law, Justice and Parliamentary Affairs, 2009). Hence, access to digital information became an essential monopoly for information users.

With the availability of information technology related products and services, many organizations are showing interest to deliver their research output to available for all. Some of the organizations in Bangladesh are providing open access to their concerned repositories while others are trying to implement them. In this regards, all the research organization come under a unique platform and provide research output in a centralize database, all sorts of people can access and use them. Open access NDRS may help end-users to find their required information which may facilitate them to conduct research on various areas. Besides, though some organizations in Bangladesh are providing IR services, there is no similarity and network system among them. A unique platform may overcome those standardization problem and work as a national portal for intellectual community.

1.5 Scope of the Work

At present there are 92 private universities, 37 public universities, 3 international universities in Bangladesh (UGC, 2016) which have their own repository content. Besides, some research organizations have enormous publications, which are helpful in decision-making process with regards to development activities of the country. There are some potential research organizations in Bangladesh, such as Bangladesh Institute of Development Studies (BIDS), Bangladesh Agricultural Research Council (BARC), and Bangladesh Medical Research Council (BMRC). These organizations are well-established in their respective fields (Chowdhury, Uddin, Afroz, & Sameni, 2011). Most of the institutions and their affiliated body are doing research and producing many scholarly outputs. Among them some institutions have established and hosted IR in Bangladesh. Patrons of the concerned institutions are getting benefits from those repositories. Some other institutions have also taken initiatives to introduce IR system. This study may be guide or manual for developing a National Digital Repository System (NDRS) for Bangladesh. The study provided adequate information for developing a central repository platform. The proposal may also be suitable for any other developing countries for establishing such platform.

1.6 Significance of the study

The present study contributes on the following issues related to NDRS:

- Review of related literature on IR, DR, OA, Scholarly communication etc.,
- Infrastructural facilities of IR providing organizations in Bangladesh,
- Present status if IR providers in Bangladesh,
- Survey of selected higher education and research libraries in Dhaka City,
- A framework for NDRS for Bangladesh on the basis of available infrastructure facilities and resources, software and other issues, and
- Strategies for implementing NDRS including policy, legal and other issues.

1.7 Operational Definition of the Study

1.7.1 Design

Defining the term 'design' in a single point of view is a difficult task. The meaning and concept of design differs from one subject area to another. But in general, design means an outline, sketch, or plan or structure of a work, an edifice, or a machine to be executed or constructed. In the field of architecture design means a complete sculpture of building or any other construction or products. But in computer engineering especially software engineering design means a plan or convention for the construction of an object, system or measurable human interaction. Design may be considered as an activity that leads an idea into action. In case of software design, design illustrates a process by which an agent creates a specification of a software artifact, intended to accomplish goals, using a set of primitive components and subject to constraints. In this case design is both a process and a model. The design process describes the sequence of steps and the design model demonstrates the workflow. The study consider design as ***a sequential process of activities involved with different phases of conception, initiation, analysis, construction, testing, production/ implementation and maintenance***.

In design phase, the study concentrated on designing following elements of NDRS:

- Customization of different interface
- Logo design
- Layout design
- Banner design
- Footer and side menu design

1.7.2 Development

Development is an act or process of developing something to meet the desired goal. Development is also considered as the act of improving by expanding, enlarging, or refining of different phases or activities involved with any project or development activities. These phases are also known as project development life cycle, development process and so on. It is often considered as a subset of system development life cycle. The development process includes the pre-definition of specific objects and artifacts that are created and completed by a project team to develop or maintain an application. ***The term development in this study demonstrates step by step activities involved with implementing a sustainable national digital repository system in Bangladesh.*** The activity involved with developing NDRS includes:

- Community and collection development
- Administrator and E-People management
- Content policy development
- Submission policies development
- Preservation policy development
- Marketing issues development, and so on.

1.7.3 Framework

A framework is a conceptual structure intended to serve as a support or guide for any goal oriented process. In computer systems, a framework is a layered structure indicating what kind of programs can or should be built and how they would interrelate. In other words, a framework may be a set of functions within a system and how they interrelate for smooth functioning. The purpose of a framework is to improve the efficiency of any system. For the purpose of this study, ***a framework is considered as a logical structure and relationship among the core functional activities of different module of repository life cycle namely store, retrieve, organize, protect, upload, download, or communicate to the process equipment. Development of NDRS framework implied with different building blocks of repository system including e-people management, data management, relationship entity management, material handling, etc.***

1.7.4 Repository Management System (RMS)

RMS is an architecture/protocol for archiving, managing, indexing, grouping, discovering, delivering and backing up, digital repositories. Being repository is a digital content, the study considered DRMS (Digital Repository Management System) as conceptual ingredient of RMS. ***DRMS is a mechanism that ensure systematic preservation, organization and dissemination services for digital collections including digital images, video and audio recording.*** It helps organizations connect people with information and expertise globally through internet. DRMS provide a central location to collect, contribute and share digital resources for use in instructional design and content development for both traditional and non-traditional learning environments.

1.7.5 Repository

A repository is a collection of institutional records, intellectual output and other resources created by members of any institution to support research, learning, and administrative processes.

1.7.6 Digital Archives

Digital archives are digitized collection of records, documents, or other materials in order to ensure long-term storage and access to information. In digital archiving system files in compressed for more efficient storage and transfer and preserve in CD/DVD, magnetic tape, and other electronic storage media.

1.7.7 Digital Preservation

Digital preservation involves with preservation activities including policies, strategies and action formulations relevant to preservation methods and techniques to ensure access to reformatted and born digital content regardless of the challenges of media failure and technological change.

1.7.8 Copyright Law

Copyright is a legal right created by the law of a country that ensure ownership as well as certain privilege to the creator of any creative original work. With the help of copyright privilege, the creator enjoys exclusive rights for use and distribution of such works. The concept and framework of copyright law differs from country to country. But all of them are supposed to ensure ownership of creative works.

1.7.9 Visibility

Visibility is a state in which a user can easily find any document without any trouble. Visibility relates to the dissemination, availability, and accessibility of any intellectual output. Rich visibility can ensure maximum use and frequent citation by other scholars.

1.7.10 Scholarly Communication

Scholarly communication is a very common term to the intellectual community to communicate with peers. Scholarly communication is considered as the process of creation, dissemination, evaluation, sharing and getting feedback of any scholarly activities for enhancing research and scholarship.

1.7.11 Discovery

Discovery is the activity of obtaining required resources relevant to an information need from a collection of information resources. Information discovery concerned with gathering relevant information from authentic sources.

1.7.12 Dissemination

Dissemination is the process of sharing message with other peers without getting any feedback. In other words, dissemination means the disclosure of knowledge by any appropriate means for interested audiences.

1.7.13 Citation

Citation is the recognition of using someone's thought or an idea in one's own writing. A citation is generally embedded in the body of an intellectual work and denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears.

1.7.14 H-Index

The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The h-index is calculated based on the total number of citation of an author divided by number of published articles.

1.7.15 Automated Library

Automated library is a library where all types of user services and activities of librarians and other staff members in the areas of acquisitions, cataloging and circulation etc. are done with the help of computer and other related technologies.

1.7.16 Partially Automated Library

In partially automated library certain parts of library activities are done with the help of computer and relevant technologies.

1.7.17 Hybrid Library

In hybrid library, certain activities of library services are done with the help of computer though other sectional activities are performed manually.

1.7.18 Digital Repository

A digital repository is a mechanism for collecting, preserving and disseminating digital content of intellectual output of an institution, particularly a research institution, organisation or department which enables users and institutions to manage and preserve it for deriving maximum value from it.

1.7.19 Institutional Repository (IR)

IR is a set of services for collecting, preserving, and disseminating digital copies of the intellectual output in the form of journal articles or research data, e-thesis, e-learning objects, and teaching materials, or any other scholarly work such as theses and dissertations created by the faculty, research staff, and students of a particular institution.

1.7.20 Open resources

The availability of scholarly literature and other types of information, without restrictions of price or permissions, on the global public digital networks.

1.7.21 Open Access (OA)

OA refers to works that are created with no expectation of direct monetary return and made available at no cost to the reader on the public Internet for purpose of education and research (Lynch & Lippincott, 2005).

1.7.22 Open Access Initiative (OAI)

OAI is a state that grant privilege the user to make legal and non-commercial use of scholarly material subject to proper acknowledgment of the rights of the original owner. Hence, OAI enables researchers to make their research output freely available to the public by means of any open access instruments such as open access journals or open access repositories.

1.7.23 Open Access Journal

Open access journals are scholarly journals that are available online and accessible without financial, legal, or technical barriers through internet or other access media.

1.7.24 Green Route

Green route is a model of scholarly publishing whereby researchers and academics can self-archive the pre-print or post print copies of their research work or publications to open access repositories.

1.7.25 Gold Route

Gold rout is a model of scholarly publication where author or author institution pay a fee to the publisher during publication time. As a result, the publisher makes the material available free for publicly use.

3.8 Organizational Structure of the Study

- ***Chapter - 1: Introduction.***

  The chapter introduces the research and describe background, the importance and emergence of NDRS, rationale, scope and significance of the study.

- ***Chapter - 2: Review of the Related Literatures***

  This chapter deals with reviewed available literatures published in national and international journals, websites and other sources relevant to NDRS.

- ***Chapter - 3: Methodology of the Study***

  The chapter highlights the methodology of the study. The topic mainly discussed here is objectives, research questions, research site, population and sample, data collection tools and methods etc.

- ***Chapter - 4: Finding of the Study.***

  The chapter describes present scenario of repository management practice especially use and demand including problems and prospects of IR in Bangladesh.

- ***Chapter - 5: Design and Development of NDRS.***

  The chapter highlights various requirements of developing NDRS including software requirements, software platform, installation and customization, access management and resource security, functional overview of NDRS including software overview, functional overview, setting up criteria, content types, and communities and collection selection, policy and legal issues etc.

- ***Chapter - 6: Discussion and Conclusions***.

  The chapter presents the summary of the outcome of the study, recommendation and conclusion of the entire research programme.

1.9 Conclusion

ICT facilities and services in Bangladesh are increasing rapidly to cope with the changing demands, maintaining global standards and overwhelming competitions among different organizations. Different initiatives for reducing the digital divide have already been taken and a number of institutions have established their network to work on it (A. Islam & Tsuji, 2011). Hence, access to digital information became much popular. Open access repository may help end-users to find their required information which may accelerate them to conduct more research on various national interests. Besides, an open access repository platform may help policy makers and analysts, academicians, training institutions, researchers and government and non-government organizations to know which research is already done in his/her research topic, where to get the output or whom to contact for related information. For this initiatives should be taken to utilize of all scholarly output as well as making a nationalized repository platform.

Chapter - 2: Review of the Related Literatures

2.1 Introduction

2.2 Background of Digital Repository

2.3 Types of Digital Repositories

2.4 Digital Repository VS Digital Library

2.5 Digital Repository Worldwide

2.6 Web-based Repository Management Practice in Bangladesh

2.7 Conclusion

2.1 Introduction

The adaption of digital communication media especially web technologies boosted intellectual community to access and share knowledge efficiently and conveniently. These technologies help information seekers to access and use scholarly resources scattered on various sources throughout the world. WWW technologies also enabled researchers to widen the audience and increase the research impact. In the field of scholarly communication both in information science and also in computer science discipline 'open access', 'free access', 'open access literature', 'scholarly communication', 'institutional repository', 'digital repository', 'self-archiving' have become common terms in digital information management system. All of the terms are used to ensure access and disseminate research output. For the purpose of the study, the available literatures relevant to various issues of digital repositories have been catagorised, reviewed and presented as below:

2.2 Background of Digital Repository

The origin and use of the term digital repository is almost as old as the Internet itself. Initially digital repository was emerged as subject-based repository allowing researchers from different institutions to preserve pre-prints of articles in advance of publication. Besides, the costs associated with storing and hosting large amounts of data declined

quickly influenced organizations throughout the world to implement web based DR management system. Harnad (2003) stated 'the open-access archive as the most cost-effective and immediate route to providing maximum access to the results of publicly funded research, thereby maximizing the potential research impact of these publications'. The momentum of the open access movement increased in early 1999 when National Institutes of Health in USA launched the e-biomed proposal, the digital archive of post-prints and pre-prints in biomedical sciences. The goal was to publish articles while making them available immediately without subscription fees or other restrictions, and where the costs of publishing were assumed by the author or their institution (Sánchez-Torrago, 2007).

Considering the importance of open access in scientific communication, many national and international organizations are working and providing support to promote web-based access to information. The United Nations Educational, Scientific and Cultural Organization (UNESCO) is one of the most influential organizations that is working to promote free access to information and knowledge and to make information available to research communities. "Open Access (OA) is an innovative form of scholarly communication within the digital environment aimed at achievement of universal access to information and knowledge" (Uddin, Koehlmoos, & Hossain, 2014). Pellizari (2005) examined the strengths and weaknesses of the OA strategy in general and more specifically of the OAI, by discussing experiences, criticisms and barriers related to OA. The OA removes restrictions on accessing research output by sharing knowledge and promoting research contributions and to help accelerate dissemination of research findings, which then results in better quality and improved efficiency in research and development as well as faster communication between academia and industry (Warr, 2001). The OAI opens access by removing the barriers created by the conventional

publication system (Pinfield, 2004) through increased visibility – papers become freely available for others to consult and cite (Harnad, 1990) – and increased impact (Ale Ebrahim et al., 2014). Antelman (2004b) mentioned, "Open access offers advantages to individual authors, researchers, institutions and to humanity itself for the progress of research generally by allowing improved management of intellectual outputs and freeing up the process of dissemination."

The impact of any research is being measured with the number of citations made on that specific research output. Very often, academic administration and management evaluate candidates on the basis of the contribution or research activities that were measured with citations produced. A citation is also considered as recognition of the research activities of any researcher. Fooladi (2013) stated, "Citations are applied to measure the importance of information contained in an article". Open access not only increases the visibility of research output but also improves the readership and citation impact. In 2005, Lynch and Lippincott (2005) surveyed academic institutions to examine the current state of IRs in the United States and found that out of 97 universities categorized as Carnegie "doctoral universities", 40% universities operated IRs. Among non-implementers, 88% were found to be in the planning stage of IR implementation.

A good number of studies have been conducted on authors' attitudes towards open access publication and have been concluded with very positive remarks towards OA. Rowlands surveyed the views and attitudes of 3,787 senior researchers from 97 countries concerning authors' attitudes towards the open access movement and found generally positive remarks (Rowlands, Nicholas, & Huntington, 2004). The Joint Information Systems Committee (JISC) and the Open Society Institute (OSI) surveyed journal authors. The survey investigated the authors' awareness of new open access possibilities, the ease of identification and submission to open access outlets, the experiences of

publishing work in OA, concerns about implications of open access publishing and the reasons why they did or did not chose to publish through an OA outlet (JISC/OSI, 2004). The study reported that almost two-thirds of respondents were familiar with the OA concept. The primary reason for choosing an OA outlet is a belief in the principle of free access to research information. Those authors also perceived OA journals as being faster disseminators than traditional journals. Because OA had a larger readership and thus resulted in higher numbers of citations of their work. Swan and Brown (2005) surveyed 1296 academics worldwide to determine the current situation with respect to authors' self-archiving behaviour. The survey also explored author experiences and opinions on publishing in open access journals. Davis et.al (2008) conducted a survey on 1619 research articles and reviews to measure the effect of free access to the scientific literature on article downloads and citations. The survey found that articles assigned to OA were associated with 89% more full text downloads, 42% more PDF downloads and 23% more unique visitors than subscription access articles in the first six months after publication. The study concluded that OA publishing might reach more readers than subscription access publishing.

2.3 Types of Digital Repositories

Digital repository is not new concept. Rather the term is being used in different name with different perspectives. Following discussion reflects the different view of digital repository considering the coverage and functionality.

Armbruster & Romary (2009) mentioned four types of digital repository namely:

i. Subject-based repositories
ii. Research repositories
iii. Institutional repositories
iv. National repository

Shoeb (2009) described four types of digital repository. These are-

i. Institutional Repository
ii. Discipline based repository
iii. Consortia Repository
iv. Learning Objects

It is observed that 'Institutional Repository' is common in the both list. Besides, discipline based repository mentioned by Shoeb and subject based repository are same in the study of Armbruster & Romary. However, the basic feature of each repository types is described below:

a) *Institutional Repository (IR)*

Institutional Repository (IR) is the most common form of DR. IR is digital assets generated by academics or other patrons in the form of datasets, administrative documents, course notes, learning objects, or conference proceedings. Lynch (2003) defined IR as "...a set of services that a university offers to members of its community for the management and dissemination of digital materials created by the institution and its community members." For a university, this includes materials such as monographs, eprints of academic journal articles—both preprints and postprints, electronic theses and dissertations (ETDs) etc. IRs provide scholars with a common platform so that everyone in the institution can contribute scholarly material to promote cross-campus interdisciplinary research. The objectives for having IRs are to provide open access to institutional research output by self-archiving it, to create global visibility for an institution's scholarly research, and to store and preserve institutional digital assets, including unpublished literature such as theses, working papers or technical reports for convenient use and preservation.

IR Features and Benefits

In the briefing paper on open access repositories Swan (2012) lists following benefits of IR for institutions:

- Opening up outputs of the institution to worldwide audience;
- Maximizing the visibility and impact of these outputs;
- Showcasing the institution to interested constituencies – prospective staff, prospective students and other stakeholders;
- Collecting and curating digital output;
- Managing and measuring research and teaching activities;
- Enabling and encouraging interdisciplinary approaches to research;
- Facilitating and sharing of digital teaching materials;
- Supporting student endeavours, providing access to e-resources.

b) Discipline/Subject-based Repository

Subject repositories collect and provide access to the literature of a single subject or a set of related subjects. This type of repository usually been set up by community members and are adopted by the wider community. Contributors usually consider this type of repository platform as an opportunity to communicate ideas and results early in the form of working papers and preprints before final publication. This type of repositories may produce variety of benefits like being able to claim priority, testing the value of an idea or result, improving a publication prior to submission, gaining recognition, achieving international attention and so on. As such, subject-based repositories are thematically well defined, and alert services and usage statistics are meaningful for community users (Armbruster & Romary, 2009).

There are many subject based repositories functioning all over the world. Adamick & Reznik-Zellen, (2010) identified ten most popular subject repositories as below:

i. PubMed Central (http://www.ncbi.nlm.nih.gov/pmc/)
ii. CiteSeer, (http://citeseerx.ist.psu.edu/index)
iii. Research Papers in Economics (RePEc) (http://repec.org/)
iv. arXiv (https://arxiv.org/)
v. Social Science Research Network (SSRN) (http://www.ssrn.com/en/)
vi. AgEcon Search (http://ageconsearch.umn.edu/)
vii. Policy Archive (http://www.policyarchive.org/)
viii. Archive of European Integration (AEI) (http://aei.pitt.edu/)
ix. E-prints in Library and Information Science (http://eprints.rclis.org/13617/)
x. Organic EPrints (http://orgprints.org/)

c) Learning Objects (LO)

A learning object is a collection of content, practice, and assessment relevant to a single discipline. Laverde (Laverde, Cifuentes, & Rodriguez, 2007) defined LO as "A digital self-contained and reusable entity, with a clear educational purpose, with at least three internal and editable components: content, learning activities and elements of context. The learning objects must have an external structure of information to facilitate their identification, storage and retrieval: the metadata." The National Ministry of Education of Colombia defines learning objects as ‘‘any digital resource that can be reused to support learning. LO has to be organized meaningfully, related to a learning aim, and has to be related to digital entities and deliverable over the Internet. A learning object repository refers to a repository of electronic learning materials used for supporting teaching and learning. Learning objects emerged as a response to the need to be provide high quality reusable instructional material for teaching which is well organized and easy to search. The LOR (Learning Objects Repository) is a project undertaken by VCILT-University of Mauritius and RMIT where objects can be used in online learning through the Blackboard and the DLS is a good example of Learning Objects Repository.

d) National Repository

National repository system is designed to capture scholarly output for preserving a record of scholarship, support teaching and learning in higher education etc. Such systems are likely to display scholarly outputs in the national language, highlight the publications of prominent scholars and develop a system for scholarly output of a nation. This repository may be considered as a part of a national research library that serves scholarly communication in the national language and supports public policy like generating open educational resources for higher education and enhancing public access to knowledge (Armbruster & Romary, 2009).

e) Research Repositories (RR)

Research Repository is a digital collection of open access scholarly research publications. Generally, RR collects, preserves and provide free access to its collection including peer-reviewed articles, working papers and conference papers created by particular researcher or researchers of any institution. University of the West of England (Research Repository, 2016) and Research Repository of University College London (Research Repository UCD, 2016) are examples of repository platform of research repository. Research repositories are usually sponsored by research funding or performing organisations to capture and preserve research results. This capturing typically requires a deposit mandate. The sponsor of the repository is likely to tie reporting functions to the deposit mandate, for example, the reporting of grantees to the funder or the presentation of research results in an annual report. Research repositories are likely to contain high-quality output. This is because its content is peer multiple times and the production of the results is well funded. Users who are collaborators, competitors or instigating a new research project are most likely to find the collections of relevance (Armbruster & Romary, 2009).

f) Consortia Repository

A consortia repository is an association of two or more organizations with the objective of participating in a common activity for sharing and managing their intellectual resources for achieving a common goal in a cost effective way. Brown (2009) defined consortia repository as "a collaborative venture in which participating institutions share the development and implementation of repository services."

Multi-institutional Repository Model

There are different types networked based repository model has been using in different countries. Brown (2009) described following three types of repository consortium:

- ***Shared***: a single repository serving multpiple institutions;
- ***Platform***: customised repository software made available to participating institutions;
- ***Aggregator***: a search service based on central harvesting of data from participating repositories.

Shared Model

In the consortium model of repository a group of organizations come under a single platform to form a common repository management system for all participating organizations. In the USA, Aladin Research Commons (ARC, 2016) of the Washington Research Library Consortium (WRLC) provides a shared digital institutional repository for its member institutions ("WRLC Digital Repository," 2016). Brown (2009) also mentioned following strength and weakness of shared model repository.

The key strengths of the shared model are:

- Creates ongoing sustainable service;
- Economies of scale;
- Pooling of expertise in central team;
- One team to handle detailed queries from all institutions;
- Central management policies for handling metadata and preservation issues;
- Opens up possibilities to institutions who not have own repository;
- Increased volume of content can lead to greater visibility for the whole.

The key drawbacks of the shared model are:

- Complexity among multiple systems across multiple institutions;
- Complexity between inter- and intra-institutional cultural and political issues;
- Requires sensitive handling of cross-institutional policies;
- Can lead to low commitment and a diluted sense of ownership;

Platform Model

In Platform model a group of institutions collaboratively develop a customized software platform which is used as the basis for repositories of the participatory institution. The platform is hosted under the custody odf any selected organization from the participants or any neutral location. Many countries of the world initiated this type of repository model. For example, in UK SHERPA-LEAP (SHERPA-LEAP, 2016), in Australian ARROW (ARROW, 2012), in Norway PEPIA and in India SHODHGANGA (Shodhganga, 2015) has been using platform model.

Key strengths of the platform model are:

- Institutional commitment is clearly defined.
- Reduced software development and customization costs.
- Defined community of practice and expertise among the networked institutes.
- Goal driven attitude to avoid different challenges and complexity.
- Easy to expand with minimal additional cost.
- Keeps repository local with staff presence at each institution.
- Easy for customization.
- Platform can be tailored to local conditions and needs.

Key weaknesses of platform model are:

- Requires duplication of effort compared to other models.
- Requires technical expertise within member institutions.
- Co-ordination of multiple repositories/partners can be problematic.

Aggregation Model or Participatory Institution Model (PIM)

In this model, multiple institutions come together to create a search aggregator to harvest content from their repositories. Single search interface of aggregation model ensure maximization of the impact of the harvesting system. However, it is mandatory for the member institutions to have their repositories to be part of a harvesting system. Dutch Digital Academic Repositories (DARE, 2016) and the Japanese Institutional Repositories Online (JAIRO, 2016) are the example of participatory institution model.

Key strengths of the aggregator model are:

- Creates ongoing sustainable service;
- Offers vastly increased visibility for researchers;
- Boosts site traffic;
- Creates a 'go-to' site for researchers seeking content;
- Offers single solution for other services looking to harvest metadata etc.;
- Minimal involvement for individual repositories beyond data level.

Some of its key weaknesses are:

- Relies on a community's goodwill;
- Multiplies opportunities for standard clash/mismatch;
- Remote from institutions and researchers;
- Requires relatively open ended funding.

With the above three model there is another model of consortium repository namely Proprietary Repository Model (PRM). "The PRM model depends on one institution (host), where it takes full responsibility of establishment of facility and some of the heads of the participating institution will be part of the governance and operate independently by the host organization" (Surinder, 2013).

2.4 Digital Repository vs Digital Library

Both digital repository and digital library emerged as tools for preserving and providing access to digital content of intellectual output to meet information needs of user. But there are differences between these two. A digital repository is a mechanism for managing and storing digital content. Lynch (2003) defined digital repository as "a set of services offered to a community for the management and dissemination of digital materials created by members of that community". A repository can support research, learning, and administrative processes. Repositories use open standards to ensure the content accessible, searchable and retrievable for later use. The international standards allows users to import, export, identify, store and retrieve the digital content within the repository (Das & Chatterjee, 2015). Digital repositories may include a wide range of content for a variety of purposes and users. Typically, content can include research outputs such as journal articles, research data, e-theses, e-learning objects, teaching materials, administrative data etc. Some repositories only take in particular items (such as theses or journal papers), whilst others seek to gather any credible scholarly work produced by the institution.

On the other hand, a Digital Library (DL) is a special type of library with a focused collection of digital objects. The objects can be text, audio material, video material, stored as electronic media formats. Digital libraries can vary immensely in size and scope, and can be maintained by individuals, organizations, or affiliated with established physical library buildings or institutions, or with academic institutions. The electronic content may be stored locally, or accessed remotely via computer networks ("Digital library - Wikipedia, the free encyclopedia," 2016).

A repository makes intellectual output of an organisation freely and openly accessible. On the other hand, digital library is a gateway to electronic resources including but not limited to OPAC, e-books, e-journals, bibliographic databases and citation management tools. Adhering to principles of open access a repository aims to publish material that originates from a single organisation, typically a university. Moreover, a repository has the task to store the fulltexts, whereas in a digital library the metadata to those publications is presented, but the fulltext are not stored there. Digital libraries are organized gateways to digital resources. Conceptual organizations include standards but also thesauri, ontologies and other sorts of organized terminologies. Repositories are the digital resources that contain the "intellectual output" of people or organizations which could be organized from different viewpoints.

2.5 Digital Repository Worldwide

The development of institutional repositories emerged as a new strategy for promoting scholarly communication. Accordingly, DRs have been widely developed and maintained in different areas around the world. The Directory of Open Access Repositories (OpenDOAR) provides information about the worldwide growth and development of IRs. According to the OpenDOAR database, as on July 2016 there are about 3,151 institutions that are providing access to their repositories worldwide. By continent, Europe is the top ranked having 1417 institutions and Asia is second with 634 institutions. Among others North America has 582, South America 272, Africa 140, Australia 68 IR providing organizations (“OpenDOAR,” 2016).

Multi-Institutional or Network-based Repositories

In addition to individual IRs in many countries ministries of education and also some professional organisations have established joint repositories network for smooth operation and better service quality. There are repository networks established in Norway, Netherlands, Belgium, Ireland, India, Pakistan, Japan, Australia and also some other countries of the world. Each network has developed different lines according to their mission, vision and attributes but provides a broad-scope central database of open access content that can be added to, searched, mined, re-used, exploited for specific interest groups and built upon over time. Some of the popular multi-institutional or networked-based repositories are described below:

Europe

In Europe, Digital Repository Infrastructure Vision for European Research (DRIVER) has been developed to establish a cohesive, pan-European infrastructure of digital repositories, offering sophisticated functionality and services to both researchers and the general public ("DRIVER," 2012). DRIVER is a European Union funded project which provides unified approach and supporting and enhancing repository development in Europe. It provides access to the network of freely accessible digital repositories with content across academic disciplines with over 3,500,000 scientific publications in the form of journal articles, dissertations, books, lectures, reports, etc., harvested regularly from more than 295 repositories, from 38 countries.

Netherland

In the Netherlands, the SURF organisation set up DAREnet3 to link the institutional repositories of all Dutch universities. In 2004, the development of NARCIS (National Academic Research and Collaborations Information System) started as part of the development of services within the DARE programme of SURFfoundation. "NARCIS provides access to scientific information, including open access publications from the repositories of all the Dutch universities and a number of research institutes, datasets from some data archives as well as descriptions of research projects, researchers and research institutes." ("NARCIS," 2004). This project is funded by government through National Action Plan electronic highway to give a boost to provide academic information through a single window in the Netherlands.

United Kingdom

In United Kingdom multiple repository platforms available which are as below:

SHERPA-LEAP

In UK, SHERPA-LEAP (London E-prints Access Project, a partner of SHERPA - Securing a Hybrid Environment for Research Preservation and Access) was established in February 2004 as a consortium of seven higher education institutions (SHERPA-LEAP, 2016). The aims of the project was to create e-prints repositories, hosted centrally by UCL (University College London), for each of the partner institutions, and to populate those repositories through collaborative advocacy (Moyle, Stockley, & Tonkin, 2007). Besides, the Welsh Repository Network (WRN) Enhancement Project built on the technical infrastructure established during the WRN Start-Up project by investigating the potential of a collaborative, centrally managed model for accelerating the development and uptake of repository services in Higher Education Institutions in Wales and across the UK as a whole ("Welsh Repository Network," 2009).

E-Print UK

E-Print UK project was developed under the Focus on Access to Institutional Resources (FAIR) programme. The aim of this project was to develop a national service provider repository by harvesting metadata from institutional and subject based e-prints archive using the Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH). E-Print UK has also developed web services to provide metadata to the external agencies for enhancement or validation of the metadata.

Australia

In Australia, the top research universities have repositories that are linked to form ARROW (Australian Research Repositories Online to the World)("ARROW," 2012). The ARROW Discovery Service, developed and operated by the National Library of Australia, provides the search interface participating institutions.

New Zealand

Open Access Repositories in New Zealand (OARINZ) project is aim to connect institutional digital research repositories of New Zealand. OARINZ project has implemented PKP harvester by harvesting data from its partner institutional repositories.

USA

National Science Digital Library (NSDL) based on metadata aggregation using Dublin Core and OAI-PMH. It has deployed Lucene Search engine that indexes metadata and also full text content available in the database. It was launched in 2002 and one of the earlier experiment in building aggregation model.

Canada

Canada Association of Research Libraries (CARL) is supporting for implementing institutional repositories in Canada and also monitoring the development of individual repository and facilitates exchange of best practices and lessons learned. CARL has also launched its harvester by harvesting data from 20 different institutional repositories.

Norway

In Norway, there are also multiple repository platforms. Those are:

NORA

Norwegian Open Research Repository (NORA) network consists of only four research universities at the moment but may extend to the remaining research universities and be linked to the FE sector's own network over time. Each university has a repository exposing content to OAI harvesters. NORA provides a search interface for users ("NORA," 2008).

PEPIA

In 2005, a number of Norwegian university libraries, university college libraries and other libraries met to discuss a joint effort to create institutional repositories for the libraries and their institutions. On the basis of recommendation, the Project for Electronic Publications and Institutional Archives (PEPIA) was formed in Norway. PEPIA was developed on the basis of a customisable, scalable repository platform 'Brage'. Brage was built on existing open source software and was developed with the specifics of the Norwegian research environment in mind (Brown, 2009).

Ireland

DRI

The Digital Repository of Ireland (DRI) is an interactive, trusted digital repository for social and cultural content held by Irish institutions. The DRI was built by a research consortium of six academic partners working together to deliver the repository, formulate policies, guidelines and training. By providing a central internet access point and interactive multimedia tools, the DRI facilitates engagement with contemporary and historical data, allowing the public, students, and scholars to research Ireland's cultural heritage and social life. As a national digital infrastructure, the DRI is working with a wide range of institutional stakeholders to link together and preserve Ireland's rich and varied humanities and social science data (DRI, 2016).

NDLR

The National Digital Learning Resources (NDLR) is a collaborative community of higher education institutions of Ireland who are interested in developing and sharing digital teaching resources and promoting a new teaching and learning culture. The NDLR mission is to promote and support higher education sector staff in the collaborative development and sharing of learning resources and associated teaching practices ("NDLR," 2012). A key impact of the NDLR service is to support greater collaboration in developing and sharing of digital teaching resources. NDLR also involve with associating teaching experience across all subject disciplines and communities of academics and to promote good practice use and re-use of existing resources. Staff from different disciplines can share effort and expertise to support their students learning, embed research in their teaching and potentially embracing partnerships with research and industry, both in Ireland and internationally.

India

Shodhganga

In India, the Shodhganga@INFLIBNET Centre provides a platform for research students to deposit their Ph.D. theses and make it available to the entire scholarly community. The repository has the ability to capture, index, store, disseminate and preserve Electronic Theses and Dissertations (ETDs) submitted by the researchers (Shodhganga, 2015). As of April 2016, Shodhganga included more than 72000 full text PhD theses from 245 contributing universities. The platform ensures not only easy access and archiving of Indian doctoral theses but also help to maintain the standard and quality of research.

OSDD

The project Open Source Drug Discovery (OSDD) repository has been started by Council of Scientific Industrial Research (CSIR) with close cooperation with other collaborators from academics as well as from Industry. It is a collaborative effort in developing Mycobacterium Tuberculosis (MBT) database to develop drug discovery in the field of Tuberculosis (OSDD, 2016).

NML

National Medical Library (NML)) consortia called Electronic Resources in Medicine (ERMED) started in 2008 to strengthen the relationship between the librarians of medical institutions and health science universities. 72 government medical colleges/institutes across the country are providing over 1600 medical journals from 9 leading medical journal publishers to the consortium in 28 labs of India (NML, 2016).

Japan

In Japan, JAIRO (Japanese Institutional Repositories Online) provides free of charge access to academic information (journal articles, theses or dissertations, departmental bulletin papers, research papers, etc.) of cross-sectional Japanese institutional repositories. The National Institute of Informatics (NII) collects metadata of institutional repositories according to an application from the person in charge of the management of the institutional repository of each institution. As of March 2016, JAIRO contains about 2,217,541 contents from 540 organizations to be searched for (JAIRO, 2016).

2.6 Web-based repository management in Bangladesh

The concept of networking and resource sharing among the libraries and information centers emerged in Bangladesh in 1980s when S. M. Mannan conducted PhD research on "Networking and Resource Sharing among the libraries in Bangladesh: present condition and future prospects." He proposed a national network plan for resource sharing among the university libraries and special libraries in Bangladesh. The study also provided useful guidelines in planning and designing an effective network plan for resource sharing among the university libraries and special libraries of the country with the name of Bangladesh Academic and Special Library Network (BASLIBNET) (Mannan, 1987). After that, there was no remarkable progress had been observed in Bangladesh regarding resource sharing and networking activities. However, after the 2000s, with the emergence of various open sources repository management software web based repository management system gained popularity in Bangladesh like other parts of the world.

Web-based repository management practices have become one of the major research areas to the library and information management professionals in Bangladesh. Researchers are doing research on various fields of implementing sustainable digital institutional

repository system in Bangladesh. Shoeb (2010) described different stages of developing digital institutional repository system for a private university library in Bangladesh. Islam & Alam (2010) pointed out various issues of designing and developing IR in a public university in Bangladesh. Chowdhury, Uddin, Afroz, & Sameni (2011) made comparative analysis of two practicing IR system in Bangladesh. Mezbah-ul-Islam & Chandel (2011) summarized the core functional activities for making sustainable digital institutional repository. Rahman & Mezbah-ul-Islam (2014) described different issues and challenges of IR system in Bangladesh. IR services have been gaining popularity in Bangladesh since 2006. The first IR services was initiated in Bangladesh in 2006 by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B). BRAC University Library is the second successive organization who is providing IR services to its clients. BRAC IR is the first academic institution who implemented IR in Bangladesh with the open source software DSpace. East West University (EWU) Library initiated digital library with GreenStone software in 2011. Later on EWU implemented DSpace software to provide IR services. Independent University, Bangladesh (IUB) Library and East West University Library implemented IR in 2012 with DSpace software. Besides, University of Dhaka (DU) and Chittagong Veterinary University of Science and Technology also are managing their repository with DSpace. Some well-known universities, such as Khulna University of Engineering and Technology (KUET), Khulna University, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahjalal University of Science and Technology (SUST), Chittagong Veterinary and Animal Sciences University (CVASU), Sher-E-Bangla Agriculture University (SAU), South East University (SEU), Bangladesh Agriculture University (BAU) and Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) initiated open access repository platform but have not listed with OpenDOAR yet.

Considering the worldwide importance and access to research output, in 2007, a new OA platform has been emerged in Bangladesh namely Bangladesh Journal Online (BanglaJOL). With the support of International Network for the Availability of Scientific Publication **(**INASP), BanglaJOL included journals of all academic disciplines originated from Bangladesh, to ensure greater visibility to the participating journals, and to the research they convey. The platform tries to make Bangladeshi journals publicly available through OA. It aims to promote the awareness and use of published journals in all disciplines originated from Bangladesh by providing access to tables of contents (TOCs), abstracts and full text on the Internet. There are now 136 journals on BanglaJOL with 1265 Tables of Contents listing 16,513 articles. Among them 15,579 of the articles are available in full text (PDF) (BanglaJOL, 2007).

There is also a network based repository management system in Bangladesh. Digital Archive on Agricultural Theses and Journals of Bangladesh (DAATJ) was established with financial help from Window 3 (University-wide Innovation) of Academic Innovation Fund (AIF) of Higher Education Quality Enhancement Project (HEQEP) under University Grants Commission of Bangladesh (UGCB). MS/M.Sc. and PhD Theses/Dissertations and Journals of Bangladesh Agricultural University (BAU), Mymensingh; Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and Sher-e-Bangla Agricultural University (SAU), Dhaka are included in this digital archive (DAATJ, 2015).

Thus, the OA movement has been gaining popularity in Bangladesh. At the same time, contributors of those IR-providing institutions are becoming concern about the benefits of OA. However, the movement has to go a long journey before researchers and the public obtain the maximum benefit from OA.

2.7 Conclusion

On the basis of above literature reviews, it may be concluded that, IR has been gaining importance in Bangladesh. Many new organizations are coming forward to implement IR. Researchers are also trying to find out the best possible solution to get maximum benefit from IR. But till date all the existing research and services are confined to institutional based repositories. No initiative has been taken to identify the feasibility of designing and developing a National Digital Repository System (NDRS) for Bangladesh. Therefore, this study aims to focus on making a National Digital Repository System. The proposed framework may be a gateway for individual researchers and research organizations to contribute to a national repository. The shared platform will ensure the standard, access opportunity and preservation protocol for all repositories of Bangladesh. More specifically, the proposed framework will:

- Support students, faculty members and other concerned of all higher education institutions in the collaboration and sharing of digital learning and teaching resources across all subject disciplines in all higher education institutions,
- Provide a repository platform for storage, search and retrieval facilities for intellectual resources,
- Provide a focal point for scholars and intellectual community to support communication and collaboration across different intellectual areas,
- Promote usage and sharing of digital resources through national programme of training and events, and
- Support open access digital rights management of scholarly resources.

Chapter - 3: Methodology of the Study

3.0 Introduction

3.1 Objectives of the Study

3.2 Research Questions

3.3. Research Site

3.4 Population and Sample

3.5 Data Collection Tools

3.6 Data Collection Methods

3.7 Data Analysis and Presentation

3.8 Software Selection

3.0 Introduction

To keep pace with the changing attitude of information management, organizations in Bangladesh began to implement digital resources management system. The system provides the basis for disseminating scholarly output while at the same time allowing for preservation and management of intellectual resources of the institution. For adapting suitable repository management system information professionals of Bangladesh followed methods and procedures practice by libraries and library professionals of developed countries. Accordingly, on the basis of the finding and recommendation of different study, this study was conducted with the following methodology.

3.1 Objectives of the Study

The main objective of the study is to design and development of a National Digital Repository System (NDRS) for Bangladesh. The sub-objectives are as follows to-

1. explore the present scenario of repository management system in Bangladesh;
2. find out the problems and prospects of repository management systems;
3. determine the use and demand of repository systems in Bangladesh;
4. identify the needs of NDRS in Bangladesh;
5. design and development of a National Digital Repository System (NDRS) for Bangladesh.

3.2 Research Questions (RQ)

To achieve the above objectives, the study has formulated the following research questions which guided the entire research:

RQ1: What is the present scenario of repository management practice in Bangladesh?

RQ2: Which types of repository contents are available in different organizations in Bangladesh?

RQ3: What are the constraints associated with preservation and management of repositories?

RQ4: How NDRS may help to manage research output in a single platform?

RQ5: What types of policies and guidelines should be incorporated to smooth operation of NDRS.

3.3 Research Sites

There are many research organizations in Bangladesh which have been conducting research in different fields from different perspectives. On the basis of nature of main business, these research organizations are categorized into five broad disciplines namely Educational, Science and Technology, Agricultural, Medical and Medicine, and Social Science research. The universities in Bangladesh are categorized into public and private universities. The public universities are autonomous and funded by Government of Bangladesh whereas private universities are funded by non-governmental organizations. However, private universities are approved by University Grants Commission (UGC) of Bangladesh. There are 117 universities (Public 35, private 80 and international 02) and in Bangladesh (UGC, 2016). Out of the 117 universities, almost 45% i.e. 50 universities (public 07, private 42 and 01 international) are situated in Dhaka.

In addition to the higher education research organization, there are Agriculture, Medicine and Medical, Science and Technology and Social Science research institutions in Bangladesh which are conducting research. Agriculture research organization conducts research and development activities on various agricultural crops. Some well-known agricultural research organization in Bangladesh are Bangladesh Agriculture Research Institute (BARI), Bangladesh Agriculture Research Council (BARC), Bangladesh Rice Research Institute (BRRI), Soil Resource Development Institute (SRDI), Bangladesh Jute Research Institute (BJRI), Bangladesh Fisheries Research Institute (FRI), Bangladesh Forest Research Institute (BFRI), Bangladesh Sugar Research Institute (BSRI), Bangladesh Tea Research Institute (BTRI), Cotton Development Board (CDB), Bangladesh Agricultural Research Institute (BARI), Bangladesh Agricultural Development Corporation (BADC). Bangladesh Council of Scientific and Industrial Research (BCSIR) is a scientific research organization and regulatory body of Bangladesh. Its main objective is to pursue scientific research for the betterment of the Bangladeshi people.

Bangladesh Medical Research Council (BMRC) was established in 1972 to create effective and quality health care facilities for the whole population of the Country by promoting health research through strengthening of research facilities, training and dissemination of research results. BMRC is the focal point for Health Research. Besides, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), Bangladesh College of Physicians and Surgeons (BCPS) are also conducting medical research in Bangladesh.

On the basis of available literature, research contribution and infrastructural facilities for developing National Digital Repository System for Bangladesh following universities have been chosen for this study:

Table 3. 1: List of Universities brought under the survey

SL	Name of universities	Year of Establishment	Status
1.	University of Dhaka	1921	Public
2.	Bangladesh University of Engineering & Technology	1962	Public
3.	Jahangirnagar University	1970	Public
4.	Islamic University of Technology	1981	Int'l
5.	International University of Business Agriculture and Technology	1991	Private
6.	North South University	1992	Private
7.	Darul Ihsan University	1992	Private
8.	Central Women's University	1993	Private
9.	Independent University, Bangladesh	1993	Private
10.	American International University-Bangladesh	1994	Private
11.	Ahsanullah University of Science and Technology	1995	Private
12.	Dhaka International University	1995	Private
13.	East West University	1996	Private
14.	Asian University of Bangladesh	1996	Private
15.	Queens University	1996	Private
16.	Gono Bishwabidyalay	1996	Private
17.	People's University of Bangladesh	1996	Private
18.	University of Asia Pacific (Bangladesh)	1996	Private
19.	Bangabandhu Sheikh Mujib Medical University	1998	Public
20.	Sher-e-Bangla Agricultural University	2001	Public
21.	Bangladesh University	2001	Private
22.	Manarat International University	2001	Private
23.	City University, Bangladesh	2002	Private
24.	Green University of Bangladesh	2002	Private
25.	Northern University, Bangladesh	2002	Private
26.	Prime University	2002	Private
27.	Southeast University	2002	Private
28.	Stamford University Bangladesh	2002	Private
29.	State University of Bangladesh	2002	Private
30.	University of Development Alternative	2002	Private
31.	Bangladesh University of Business and Technology	2003	Private
32.	Millennium University	2003	Private
33.	Presidency University	2003	Private
34.	Primeasia University	2003	Private
35.	Royal University of Dhaka	2003	Private
36.	Shanto-Mariam University of Creative Technology	2003	Private
37.	United International University	2003	Private
38.	University of Information Technology and Sciences	2003	Private
39.	University of South Asia, Bangladesh	2003	Private
40.	Uttara University	2003	Private
41.	Victoria University of Bangladesh	2003	Private
42.	World University of Bangladesh	2003	Private
43.	Atish Dipankar University of Science and Technology	2004	Private
44.	University of Liberal Arts Bangladesh	2004	Private
45.	Jagannath University	2005	Public
46.	Asa University Bangladesh	2006	Private
47.	Bangladesh Islami University	2006	Private
48.	Bangladesh University of Professionals	2008	Public
49.	Bangladesh University of Textiles	2010	Public
50.	European University of Bangladesh	2012	Private

Source: http://www.ugc.gov.bd/en Accessed July 25, 2013

However, except above listed 50 higher education institutions/universities two organizations from each category have been purposively selected for the study which are as below:

Table 3. 2 List of sample organization (non-educational)

Nature of Organization	Name of Sample Organization
Agricultural	1. Bangladesh Agricultural Research Centre (BARC), 2. Bangladesh Agricultural Research Institute (BARI).
Medicine & Medical	1. International Centre on Diarrhoeal Diseases Research- Bangladesh (ICDDR,B) ; 2. Bangladesh College of Physician and Surgeons (BCPS),
Science & Technology	1. Bangladesh Atomic Energy Commission (BAEC), 2. Bangladesh Council of Scientific and Industrial Research (BCSIR),
Social Science	1. Bangladesh Institute of Development Studies (BIDS), 2. Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP),

3.4 Population and Sample

The population for this study comprise the scholars as well as research organization. The research organization includes all types of Higher Educational, Science and Technology, Agricultural, Medical and Medicine, Social Science research organization in Bangladesh. However, librarian/library in-charge of 50 universities situated in Dhaka and 02 organizations each from other four categories included in the sample. Besides, a random sample of 50 users each from five higher education organization (02 Public universities, 02 Private universities, 01 International university) and 20 users from other four types of organizations is drawn for user sample.

3.5 Data Collection Methods

Data collection methods followed in the study were discussed below.

3.5.1 Questionnaire

Questionnaire Booklet-1 was distributed to scholar (Faculty member, researcher, professional, student and other) of the selected organizations during 1 July 2016 to 31 July 2016 in order to collect user specific data. The questionnaire consisted of 11 structural questions and 01 open-end question. The questionnaire had both online and printed versions. The online version was made on Google form and distributed through email account of purposively selected library users of selected organizations. The printed questionnaires were also distributed to other selected organizations through personal visit. A total of 330 questionnaires had been distributed. Finally, 221 (66.97%) responses were collected for analysis. Following table reflects the distribution of data received through Questionnaire Booklet-1.

Table 3. 3 Response from user

SL	Organization	Category	Questionnaire Distributed to Users	F	%
1.	University of Dhaka	Higher Education (Public University)	50	34	68
2.	Jahangirnagar University	Higher Education (Public University)	50	26	52
3.	Independent University, Bangladesh	Higher Education (Private University)	50	43	86
4.	BRAC University	Higher Education (Private University)	50	38	76
5.	International Islamic University of Technology	Higher Education (Int'l University)	50	36	72
6.	Bangladesh Agricultural Research Centre (BARC),	Agriculture Research	20	8	40
7.	International Centre on Diarrhoea Diseases Research-Bangladesh (ICDDR,B) ;	Medicine & Medical Research	20	13	65
8.	Bangladesh Atomic Energy Commission (BAEC),	Science and Technology	20	14	70
9.	Bangladesh Institute of Development Studies (BIDS),	Social Science research	20	9	45
		Total	**330**	**221**	**66.97**

Questionnaire Booklet-2 was distributed to the librarian/library in-charge of the selected organizations during 10 July 2016 to 31 July 2016 in order to collect organization specific data. The questionnaire consisted of 29 structural questions. The questionnaire had both online and printed versions. The online version was made on Google form and distributed through email account of Librarian/Library In-charge of each organization including a cover letter inviting to participate. The printed questionnaire was also distributed to other selected organizations through personal visit. A total of 58 questionnaires had been distributed. Finally, 36 (62.06%) responses were received for analysis. Following table reflects the distribution of data received through Questionnaire Booklet-2.

Table 3. 4 : Response from Librarian/Library In-Charge

Type of Organization	Questionnaire distributed	Questionnaire received	Row percentage	Cumulative percentage
Higher Education	50	29	58 %	80.56
Science and Technology	2	1	50 %	2.78
Medicine and Medical	2	2	100 %	5.56
Agriculture research	2	2	100 %	5.56
Social Science research	2	2	100 %	5.56
Total	**58**	**36**	62.06 %	**100%**

3.5.2 Literature Review

Initially, a substantial number of literatures have been collected and reviewed to come up with an idea of formulating the thesis. With the view to formulate clear conceptual framework for the study, a comprehensive literature searches have been made through Google, Google Scholar, Emerald and other open access platform. General phrase and Boolean search techniques have been applied to retrieve data on the following topic.

a. History of Digital Repository
b. Types of Digital Repositories
c. Digital repository AND digital library
d. Digital Institutional Repository worldwide
e. National Digital Repository
f. Institutional Repository in Bangladesh

Then in-depth review was made with the retrieved literature relevant to the study. Moreover, different grey literatures including journal articles, project proposal, research reports, conference proceedings, theses, etc. were consulted. Final list of literatures used in the study is mentioned at the end of the thesis.

3.6 Data Collection Tools

Primary data were collected using questionnaire methods. In most cases, questions were adapted from previous empirical studies and modified to reflect the local situation on the basis of the findings and discussion of the studies. Initially, a pilot questionnaire was distributed by electronic mail to some purposively selected library professionals in order to formulate appropriate questions. The questionnaire had been revised several times with academic advisors and also pre-tested before final delivery. Finally, two sets of open and close-end questionnaire set have been designed for collection of purposive data.

Questionnaire Booklet-1

"Questionnaire Booklet-1" is prepared based on "A survey of attitudes about digital repositories among faculty at Louisiana State University at Baton Rouge" (Lercher, 2008) and "Scholarly communication in the digital environment: The 2005 survey of journal author behaviour and attitudes" (Rowlands & Nicholas, 2005). Both the questionnaire were modified and adopted to **Assessing needs of Institutional Repository (IR) for managing digital resources**. A total 71 items were divided into two sections. A summary is given in the below table.

Questionnaire Booklet- 1: Survey Questionnaire for User

Table 3. 5 Background Information

No of Question	Indicator	No of Variables	Type of Variables	Measurement
1.	Organization name	1	Free text	Open
2.	Type of user	5	Radio button	Single option
3.	Materials available	15	Check box	Multiple option allowed
4.	Preservation of publications	6	Check box	Multiple option allowed
5.	Dissemination of research output	8	Check box	Multiple option allowed
	Total	**35**		

Table 3. 6 Perception regarding IR

No of Question	Indicator	No of Variables	Type of Variables	Measurement
6.	Knowledge about IR	5	Radio button	***5 Point Scale*** 1=Very Strongly, 2= Strongly, 3=Moderate, 4=Poor, 5=Very Poor
7.	Importance of IR	5	Radio button	***5 Point Scale*** 1=Extremely Important, 2= Very Important, 3=Important, 4=Less Important, 5=No Important
8.	Opinion regarding depositing to IR	2	Radio button	Yes/No
9.	Concern about Copyright Law	5	Check box	***5 Point Scale*** 1=Very Concern, 2= Moderately Concern, 3=Do not Know, 4=Poor Concern, 5=No Concern
10.	Perceived benefits of IR	12	Radio button	***5 Point Scale*** SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree
11.	Suggestion for promoting IR	7	Radio button	***5 Point Scale*** SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree
12.	Suggestion/ Comments	---	Free text	***Open text***
	Total	**36**		

Questionnaire Booklet- 2

Questionnaire booklet-2 was made based on modified version of "The European Repository Landscape 2008: Inventory of Digital Repositories for Research Output" (Van der Graaf, 2009). It was used for assessing attitude of librarian/library in-charge on "**Towards Developing a Framework for National Digital Repository System (NDRS) in Bangladesh**". A total 146 items were grouped into 05 broad categories as below:

Questionnaire Booklet- 2: Survey Questionnaire Librarian/Library In-Charge

Table 3. 7 Organizational Background

No of Question	Indicator	No of Variables	Type of Variables	Measurement
1.	Name of organization	1	Free Text	Open text
2.	Year of Establishment	2	Free Text	Open text
3.	Nature of Organization	5	Check Box	Single option
4.	Availability of dedicated server	2	Yes/No	Single option
5.	Automation status	5	Check Box	
6.	Availability of digital archives	2	Yes/No	Single option
7.	Number of LIS Professional	5	Check Box	Single option
8.	Number of LIS Professional	4	Check Box	Single option
	Total	**26**		

Table 3. 8 Scenario of Repository Management

No of Question	Indicator	No of Variables	Type of Variables	Measurement
9.	Availability of repository resources	15	Check Box	Multiple option allowed
10.	Subject coverage	9	Check Box	Multiple option allowed
11.	Place of managing repository	5	Check Box	Multiple option allowed
12.	Management of repository	5	Radio button	***5 Point Scale*** 1=Fully Automated, 2= Partially Automated, 3=Hybrid, 4=Manual, 5=Other
13.	Level of Satisfaction	5	Radio button	***5 Point Scale*** 1=Very Satisfied, 2= Satisfied, 3=Neutral, 4=Dissatisfied, 5=Very Dissatisfied
	Total	**39**		

Table 3. 9 Existing IR System

No of Question	Indicator	No of Variables	Type of Variables	Measurement
14.	Availability of IR	2	Radio button	Yes, No
15.	Year of Commencement	1	Free text	Text
16.	URL	1	Free text	Text/link
17.	Status of IR	3	Radio button	Single selection
18.	Software used	5	Radio button	Single selection
19.	Constraints of existing IR	9	Check box	Multiple selection
20.	Plan for setting up IR	2	Radio button	Yes/No
21.	Constraints of setting up IR	10	Check box	Multiple selection
	Total	**33**		

Table 3. 10 Needs of NDRS

No of Question	Indicator	No of Variables	Type of Variables	Measurement
22.	Importance of NDRS	5	Radio button	5 Point Scale
23.	Usefulness of NDRS	5	Radio button	5 Point Scale
24.	Remarks of NDRS	5	Radio button	5 Point Scale
25.	Benefits of NDRS	11	Radio button	***5 Point Scale*** SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree
	Total	**26**		

Table 3. 11 Policies and Issues

No of Question	Indicator	No of Variables	Type of Variables	Measurement
26.	Required policies	8	Radio button	***5 Point Scale*** SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree
27.	Deposit policy	5	Radio button	***5 Point Scale*** 1= Mandatory depositing, 2= Partly Mandatory depositing, 3= Voluntary with encouragement, 4= Voluntary depositing, 5= Other
28.	Suggestion	9	Radio button	***5 Point Scale*** SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree
	Total	**22**		

3.7 Data Analysis and Presentation

The collected data were analyzed by frequency count and percentage methods. For analyzing data, following formula has been applied:

Count = Number of respondents in a particular query.

Column N% = $\frac{C*100}{CN}$

Row N% = $\frac{\text{sum(1st Row:Last Row)}}{100}$

Layer Column N% = $\frac{C*100}{\text{Total N}}$

Here, C = Count

CN = Count Number

Total N = Total Number of Respondents

However, the following functional steps have been pursued for data processing, analysis and presentation:

i) Prepared code manual and coding all the answers in the questionnaire.
ii) Designed database using SPSS (version 17.0), impose variable labels and value labels, necessary constraints and validation check as per instruction of the code manual.
iii) Input relevant data in the database.
iv) Data cleaning and removing/correcting inconsistencies.
v) Executed Pearson's correlation among factors.
vi) Produced 24 tables and used them in text.
vii) A total of 42 graphical presentations were made and presented.

3.8 Software selection

There are a number of repository management software packages available for making digital repository system. FOSS4LIB (2015) mentioned such 30 free and open source software package. After reviewing the literature and observing the comparison of the different functionalities, architectural and feasibility analysis, Agri-Ocean DSpace software package was adopted.

Chapter - 4: Finding of the Study

4.1.Introduction

4.2.Background Information

4.2.1. Organizational Background

4.2.2. Types of Respondents

4.3.Present Scenario

4.3.1. Available Repository Content

4.3.2. Coverage of Repository Content

4.3.3. Management of Repository Content

4.3.4. Preservation of Repository Content

4.3.5. Dissemination of Repository Content

4.3.6. Awareness Regarding IR

4.4. Use and Demand of IR

4.4.1 List of Available IR providing Organization

4.4.2 Plan for Establishing IR

4.4.3 Suggestion for Promoting IR

4.4.3.1.1 Users' Suggestions

4.4.3.1.2 Library Heads' Suggestions

4.5. Problems and Prospects of IR

4.5.1. Problems if Establishing IR

4.5.2. Constraints with Existing IR Development

4.5.3. Prospects of IR

4.6. Needs of NDRS

4.6.1. Importance to have NDRS in Bangladesh

4.6.2. Willingness to join NDRS

4.6.3. Usefulness of NDRS

4.6.4. *Benefits of NDRS*

4.7 Issues of NDRS

4.7.1. Issues of Copyright Concern

4.7.2. Policies and Legal Issues for NDRS Framework

4.8 NDRS Software

4.8.1. Digital Repository Software

4.8.2. Comparison of Repository Software

4.8.3. Selection of NDRS Software

4.9 Summary of Finding

4.1 Introduction

This chapter illustrates the result of the data analyses. Collected data were catagorised into some aspects namely background information of the participating library; present scenario of repository management in Bangladesh; use and demand of IR; problems and prospects of IR; issues and needs of NDRS etc. Different table, graphs and charts were used to represent data and websites were also consulted to identify various features of widely used repository software. Analysis of different features and functionality of different IR software were also made. Finally, considering different issues, a suitable software has been selected for NDRS.

4.1. Background Information

4.1.1 Organizational Background

A total of 58 organizations were selected from different perspectives and questionnaire were distributed and 36 responses were received from selected organizations. Following table (Table 4.1) demonstrates the organizational background of the surveyed organization.

Table 4. 1 Organizational Background

		Count	Column N%	Layer Column N%	Total N
Nature of your Organization	Public	6	16.67	16.67	
	Private	25	**69.44**	69.44	
	Autonomous	2	5.56	5.56	
	NGO	0	0.00	0.00	
	Other	3	8.33	8.33	
	Total	**36**	**100.00**	**100.00**	**36**
Nature of Library	Fully automated	5	15.15	13.89	
	Partially automated	7	21.21	19.44	
	Hybrid	17	**51.52**	47.22	
	Manual	4	12.12	11.11	
	Other		0.00	0.00	
	Total	**33**	**100**	**91.67**	**36**
Number of Library professional	1-5	21	**60.00**	58.33	
	6-10	9	25.71	25.00	
	11-15	2	5.71	5.56	
	16-20	2	5.71	5.56	
	21 or more	1	2.86	2.78	
	Total	**35**	**100**	**97.22**	**36**
Number of IT professional in library	None	17	**47.22**	47.22	
	1-2	13	36.11	36.11	
	3-5	5	13.89	13.89	
	6 or more	1	2.78	2.78	
	Total	**36**	**100**	**100**	
Availability of digital archives	Yes	26	**72.22**	72.22	
	No	10	27.78	27.78	
	Total	**36**	**100.00**	**100.00**	**36**
Have dedicated server	Yes	17	47.22	47.22	
	No	19	**52.78**	52.78	
	Total	**36**	**100**	**100**	**36**

(Here C (Count) = Number of respondents in a particular query; Column N% = $\frac{C*100}{CN}$; Layer Column N% = $\frac{C*100}{\text{Total N}}$; CN = Count Number and Total N = Total Number of Respondents)

The study revealed that out of 36 organizations 69.44% are private whereas only 16.67% are government organizations. On the other hand, 5.56% are autonomous and 8.33% are 'Other' category. It indicates that most organizations are private. Adoption of Information and Communication Technology (ICT) in libraries has become an indispensable part of modern library to provide uptodate services for maximizing users' satisfaction. The more use of ICTs in library ensures more sophisticated and user-friendly services. In terms of library services there are differences between poor libraries and rich libraries. There are also other types of libraries called 'partial automated library' where some services of libraries are done with the help of technology. On the other hand, in Hybrid library-a portion of services is done manually and the rest are done with the help of computer. But in manual library, all types of activities and services are done manually. The study revealed that most of the libraries (51.52%) are Hybrid library whereas 21.21% are partially automated libraries. There are 15.15% fully automated and 12.12% libraries are manual as well.

Adequate and competent library personnel are considered as the main driving force to organize and operate libraries smoothly. In other words, the number of library professionals and their educational qualifications indicates the organization's enthusiasm for supporting their patrons for study and research. The study found that in most of the libraries (60%) possesses 1-5 library professionals while 25.71% libraries have 6-10 library professionals. It is also found that very few libraries (5.71%) have 11-15 and 16-20 library professionals. On the other hand, out of 36 libraries, only Dhaka University library has more 21 than library professionals. At the same time the study identified that among the participating libraries majority of the libraries (47.22%) do not have IT professionals. The second largest portion (36.11%) have only 1-2 IT professionals who have at least diploma, master or any other IT

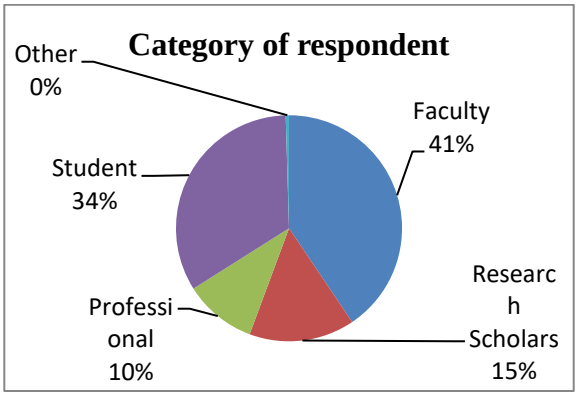
degrees. However, only 1 library (2.78%) has 6 or more IT professionals. The survey found that 72.22% libraries have digital resources though remaining 27.78% have no digital collections. Besides, most of the libraries (52.78%) libraries do not have their own server to provide IT based services.

The organizational background suggests that most of the libraries (69.44%) are private organization library and hybrid in nature. About 60% libraries possesses less than 5 library professionals but do not have IT professional at all. Most of the library (72.78%) do not have any dedicated server for preservation of digital resources.

4.1.2 Types of Respondents

Demographic profile of respondents is always an important part of any research especially in social research. For collecting user data, the study used five variables namely 'Faculty', 'Research Scholar'; 'Professional', 'Student' and 'Other'. Faculty includes all type of teaching professional who are involved with teaching in higher education institutions. Similarly, research scholars involve with research activities; professionals are involved with any specific profession rather that teaching and students are considered as graduate level students only. A total of 212 responses have been count and analyzed for this study. Following graph illustrate the distribution of users who responded in the study.

Figure 4. 1 Category of Respondent



From the Figure 4.1 it is seen that maximum number (41%) of the respondents of the study are faculty members whereas the second highest respondents (34%) are students. Other group of respondents includes research scholars (15%) and professionals (10%).

4.3 Present Scenario

4.3.1 Available IR Content

Availability of enriched contents is considered as the pre-requisite of successful IR. In the study, library heads and users were required mention available IR contents under their custody. A total of fourteen questions were given to choose for selecting IR content. Table 4. 2 demonstrate the availability of IR contents with library heads and users.

Table 4. 2 IR Content

	Library Head (N=36)		**Library Users (N=212)**	
	Count	Column N%	Count	Column N%
Annual reports	28	**80.00**	15	7.08
Book chapters	23	**65.71**	60	28.30
Conference papers	29	**82.86**	74	34.91
Course catalogues	21	**60.00**	18	8.49
Images	10	28.57	17	8.02
Journal Articles	28	**80.00**	104	**49.06**
Maps	13	37.14	12	5.66
Music	0	0.00	11	5.19
News clippings	22	**62.86**	31	14.62
Primary datasets	5	14.29	25	11.79
Teaching materials	19	**54.29**	18	8.49
Theses/Dissertations	30	**85.71**	71	33.49
Videos	8	22.86	17	8.02
Working papers	16	45.71	51	24.06
Others	3	8.57	7	3.30

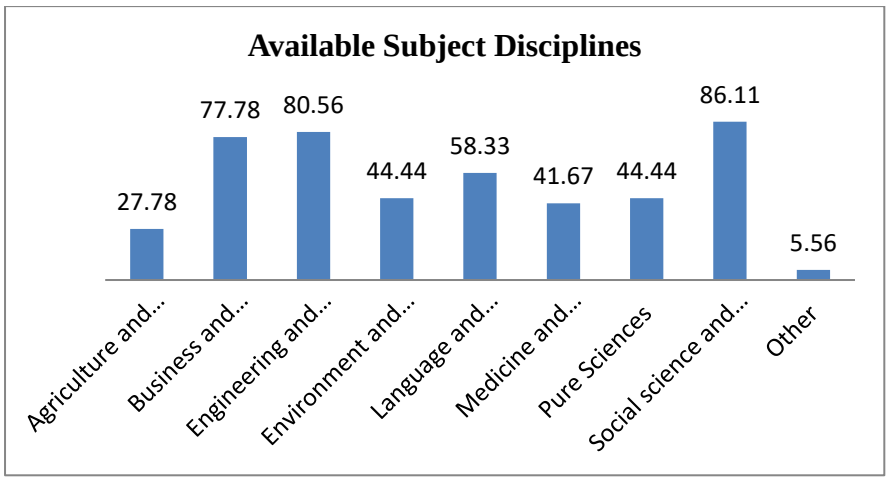
(Here N = number of respondents)

From the table, it is seen that majority of the users (49.06%) possesses journal articles where as 34.91% holds conference paper and 33.49% hold thesis/dissertation. Besides, 28.30% user possesses book chapter, 24.06% possesses working paper and 11.79% users have primary datasets respectively. On the other hand, the availability of IR contents is very high in regards to library heads/librarians. The table shows that out of fifteen types of IR contents, four items are available to about 80% libraries. Specifically, thesis/dissertation is the most available IR content which are holding 85.71% libraries. Other available resources include conference paper (82.86%), and journal article and annual report in 80.00% libraries. Besides, 62.86% libraries hold news clipping, 60.00% library holds course catalogue and 54.29% library hold teaching materials. The availability of other contents remains below fifty percent. But it is worth to mention here that out of the fifteen resources, no library possesses music where as 5.19% users have the resources. However, it can be said that most of the libraries have good number of IR contents for establishing IR.

4.3.2 Coverage of Repository Content

Being a multi-institutional repository management system, NDRS aims to include all types of digital resources available in various organizations. Accordingly, the survey identified following subject coverage of the digital resources available in different organizations.

Figure 4. 2 Subject Coverage of Repository Resources



The study found that most of the libraries (86.11%) have resources on social science and humanities while 80.56% organizations have digital resources on engineering and technology disciplines. Also business and economic discipline resources are available to more than 77% libraries. The availability of resources on environmental and earth science and pure science are same (44.44%) while the ratio is 41.67% for medicine and medical science resources. This means contents on social science and humanities, business and economics and engineering and technology are most common repository content among the libraries of Bangladesh.

4.3.3 Scenario of Repository Management in Bangladesh

Management of repository is very important both for information provider and information seekers. In fact, librarians are not only preserving the learning resources but also they are continuously updating their own systems for the users' convenient. However, in Bangladesh the expertise of librarians are not properly evaluated. Librarians are not considered as right person for repository management system. As a result, the smooth growth of IR system in Bangladesh is greatly hampered. Table 4. 3 illustrate the real scenario of repository management in Bangladesh.

Table 4. 3 Status of Existing Repository Management System

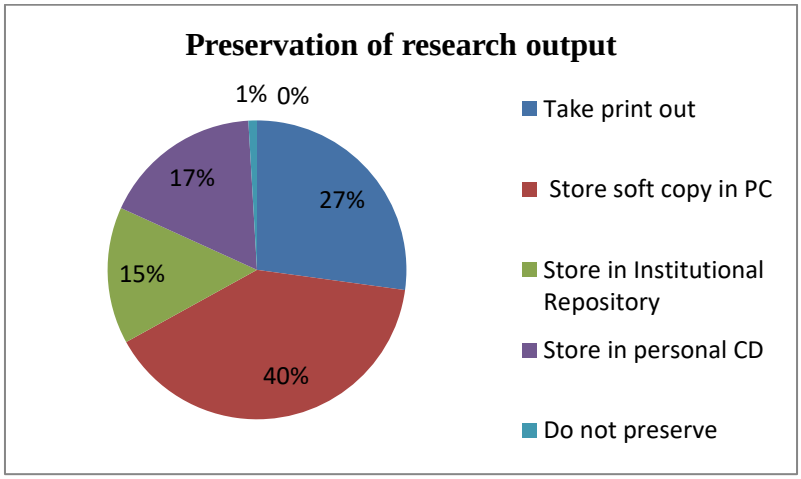
		Count	Column N%
Repository is managed by-	Library	17	37.78
	IT Centre	19	**42.22**
	Concerned Faculty	5	11.11
	Concerned Department	3	6.67
	Other	1	2.22
	Total	**45**	**100**
Repository Management system is-	Fully automated	6	16.43
	Partially automated	13	**48.31**
	Hybrid	15	33.33
	Manual	1	1.93
	Other	0	0
	Total	**35**	**100**
Level of satisfaction in present Repository Management system	Very Satisfied	4	11.11
	Satisfied	13	36.11
	Neither satisfied nor dissatisfied	14	**38.89**
	Dissatisfied	4	11.11
	Very Dissatisfied	1	2.78
	Total	**36**	**100**

The study revealed that majority of the organizations (42.22%) manage their repositories through IT Centres followed by library (37.78%). The study also found that majority (48.31%) of the repository management system is done with partially automated while second largest number (33.33%) followed the hybrid system. There was also fully automated (16.43) and manual (1.93%) repository management system among the surveyed organizations. But it is a matter of great concern that majority of librarians (38.89%) are neither satisfied nor dissatisfied with the existing repository management system. On the other hand, 36.11% librarians are satisfied and 11.11% are fully satisfied with the existing repository management system. In contrast, 11.11% librarians are dissatisfied and 2.78% are very dissatisfied. In brief, majority of institutions of Bangladesh manage their repositories through IT centre but librarians are not satisfied with the service quality.

4.3.4 Preservation of Research Output

Preservation and providing access to research output is very important for the researchers' community. A research output may be needed even hundreds of years later. Hence, preservation of research contribution should be given importance. The users were asked to mention their means of preserving their output. Following chart shows the response of user regarding preservation of scholarly materials.

Figure 4. 3 Preservation of Scholarly Output



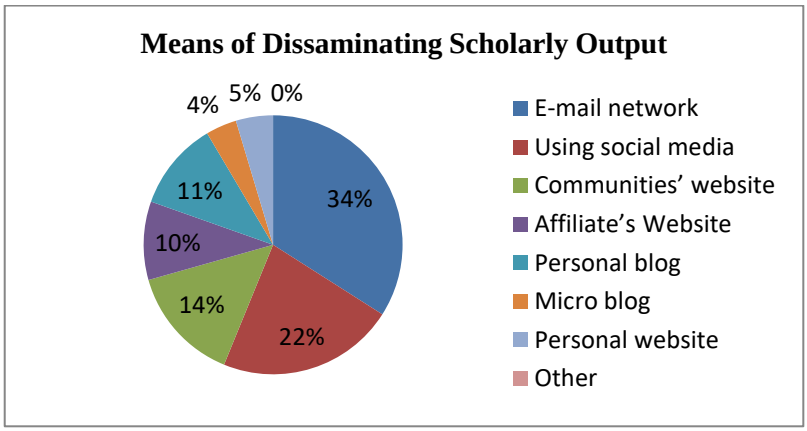
From the chart it is seen that majority of the researchers (40%) preserve their research output in personal computers while 27% researchers take print out of the document for preservation. Besides, 17% users preserve their research output in Compact Disks (CDs). However, only 15% researchers deposit their research output to their respective IR for publicly access. So, users are usually preserve their research output in their personal computer which are not accessible to others.

4.3.5 Dissemination of Repository Content

To maximize the reach visibility, research output must be disseminated through appropriate media. With the help of internet and other electronic media access to digital information became much easier than ever before. Depending on the access opportunity, users can easily access to any electronic documents using any internet connected computers. But in case of printed article it is very difficult to access and use them unless have the printed copy in hand. These types of access barriers create

problem both to information seekers and researchers as well. Due to access barriers users cannot use the research output for citation and references which creates low impact for research. This study investigated the medium of dissemination channel for delivering research knowledge for maximizing research impact. Following chart illustrates the trends of using dissemination channel for research output.

Figure 4. 4 Dissemination of Research Knowledge



It is found that majority of the researchers (34%) disseminate their research output by e-mail to the fellow colleagues. A good number of researchers (22%) use various social media channel for disseminating the same. The third largest number of researchers (14%) disseminates their research information through commuter's website. There are also other disseminating tools have been used for dissemination research output namely personal blog, affiliate's website, personal website which are 11%, 10% and 5% respectively. However, e-mailing and using social media for disseminating research knowledge are most familiar to the researchers of Bangladesh.

4.3.6 Users' Awareness Regarding IR

Library users were assessed about their awareness and state regarding IR. Table 4. 4 shows the summery of the users' responses regarding awareness of IR.

Table 4. 4 Awareness Regarding IR

		Count	Column N%	Layer Column N%	Total N
What is your idea about IR?	Very Strong	63	30.00	29.72	
	Strong	82	39.05	**38.68**	
	Moderate	60	28.57	28.30	
	Poor	4	1.90	1.89	
	Very Poor	1	0.48	0.47	
	Total	**210**			**212**
Importance to have IR in your organization	Extremely Important	34	16.43	16.43	
	Very Important	100	48.31	**48.31**	
	Important	69	33.33	33.33	
	Less Important	4	1.93	1.93	
	No Important		0.00	0.00	
	Total	**207**			**212**
Would you like to preserve your research output at IR?	Yes	169	83.3	**83.25**	
	No	34	16.7	16.75	
	Total	**203**			**212**

(Here C (Count) = Number of respondents in a particular query; Column N% = $\frac{C*100}{CN}$; Layer Column N% = $\frac{C*100}{Total\ N}$; CN = Count Number and Total N = Total Number of Respondents)

From Table 4. 4 it is observed that among the 210 respondents 38.68% and 29.72% have strong and very strong ideas respectively about the scope and opportunities of IR while 28.30% have moderate ideas. A large number of users 48.31% think that having IR in their respective organizations is very important while 33.33% respondents fell important. At the same time, 16.34% respondents think that it is extremely important to have IR in their respective organization. It is optimistic that 83.25% likes to preserve their research output in their respective IR. In short, majority of the respondents have strong ideas about IR. They think IR is very important for their institution. Most of them are agree to preserve their research output in the IR.

4.4 Use and Demand of IR

4.4.1 Existing IR Providing Organizations

The study consulted Directory of Open Access Repository (OpenDOAR) ("OpenDOAR - Table - Bangladesh," 2016) and Registry of Open Access Repository (ROAR) ("ROAR," 2015) databases for getting ideas about the IR practice in Bangladesh. The finding shows that though both directories provide IR information in Bangladesh but there are differences among these two directory. Following table mentioned the available registered IR providing organization in Bangladesh.

Table 4. 5 Institutional Repositories of Bangladesh in OpenDOAR and ROAR

Open DOAR		ROAR	
1.	BRAC University Institutional Repository http://dspace.bracu.ac.bd/	1.	Bangabondhu Shekh Mujib Medical University, Bangladesh
2.	Daffodil International University Institutional Digital Repository http://dspace.daffodilvarsity.edu.bd:8080/	2.	Daffodil International University Institutional Digital Repository
3.	EWU Institutional Repository http://dspace.ewubd.edu/	3.	BRAC University Repository
4.	Eastern University Digital Library http://gsdl.easternuni.edu.bd/greenstone/cgi-bin/library.cgi	4.	EWU Institutional Repository
5.	IUB Library Digital Repository http://dir.iub.edu.bd:8081/	5.	International Centre for Diarrhoeal Disease Research
6.	International Centre for Diarrhoeal Disease Research Digital Repository, Bangladesh (ICDDR,B) http://dspace.icddrb.org/dspace/	6.	IUB Library Digital Repository
7.	Islamic University of Technology Digital Library http://lib.iutoic-dhaka.edu/	7.	IUT Digital Library
8.	Dhaka University Institutional Repository http://repository.library.du.ac.bd/	8.	National Library Digital Repository
		9.	Eastern University Digital Library
		10.	Dhaka University Repository

In order to get real scenario of current IR services, the study collected data on IR status, year of initiative, software used and the URL. Table 4. 7 illustrate brief overview of IR status of Bangladesh.

Table 4. 6 List of IR providers in Bangladesh

SL	Name of Institution	Year	URL	Software
1.	ICDDR,B Digital Repository	2006	http://dspace.icddrb.org:8080/jspui/	DSpace
2.	BRAC University Institutional Repository	2008	http://dspace.bracu.ac.bd/	DSpace
3.	IUT Digital Library	2011	http://lib.iutoic-dhaka.edu/greenstone/cgi-bin/library.cgi	GreenStone
4.	Daffodil International University Institutional Digital Repository	2012	http://dspace.daffodilvarsity.edu.bd:8080/	DSpace
5.	Eastern University Digital Library	2012	dspace.easternuni.edu.bd:8080/xmlui/	DSpace
6.	EWU Institutional Repository	2012	http://dspace.ewubd.edu/	DSpace
7.	IUB Library Digital	2012	http://dir.iub.edu.bd:8081/	DSpace
8.	CIRDAP DSpace	2013	http://dspace.cirdap.org:8080/	DSpace
9.	Dhaka University Institutional Repository	2013	http://repository.library.du.ac.bd/xmlui/	DSpace
10.	North South University Library	2002	http://library.northsouth.edu	Customised
11.	NUB Digital Institutional Repository	2013	http://202.74.245.22:8080/xmlui/	DSpace
12.	Asian University of Bangladesh	2013	Confined to AUB administration	DSpace
13.	Bangladesh University of Engineering and Technology	2013	http://lib.buet.ac.bd:8080/xmlui/	DSpace
14.	Presidency University	2014	http://172.19.79.175:8080/xmlui/ (it's an Intranet URL)	DSpace

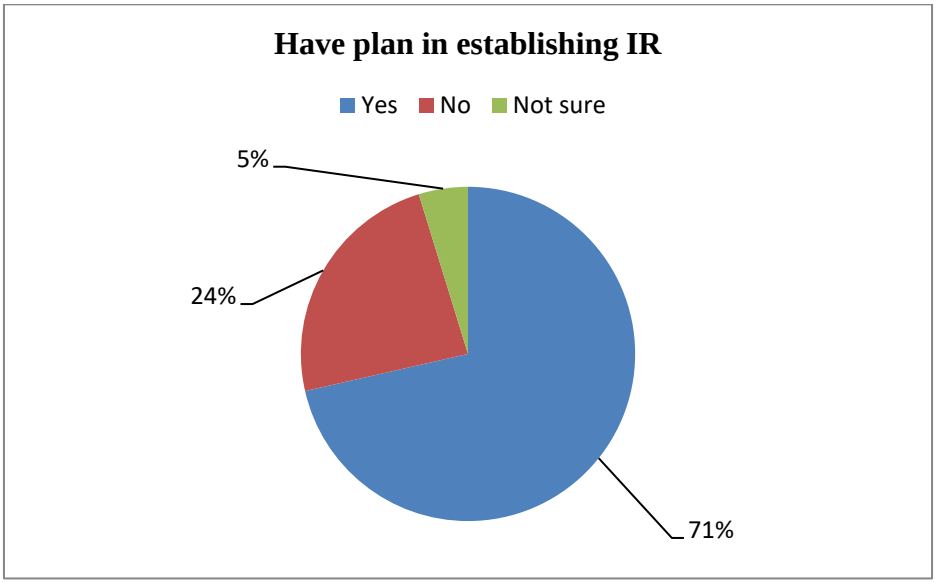
From the survey it is found that out of the 36 organizations, 14 organizations are providing IR services. But some of the organizations did not register their domain with the OpenDOAR or ROAR directory. The study also identified that some organizations i.e. Presidency University and CIRDAP provides intranet based IR services. Besides, though Asian University of Bangladesh (AUB) maintains IR, their services are confined to certain executives with specified user name and password.

North South University library manages their repository with their customized software compatible with their library management system. These organizations did not register their information in any repository databases. However, it is very clear that web-based repository management has been gaining importance in Bangladesh.

4.4.2 Plan for Establishing IR

The study tried to identify the wiliness of library heads who do not have IR but have digital resources. A total of 22 responses were counted. Figure 4.5 provided information about the future plan of the respondents.

Figure 4. 5 Plan to establishing IR in future



It is found that most of the library heads (71%) are very much interested to establish IR in their respective organization in future. At the same time, around one forth (24%) libraries do not have any plan while 5% libraries are not sure to establish IR in their respective organization in near future.

4.4.3 Suggestion for Promoting IR

4.4.3.1 User Suggestion for Promoting IR

User involvement is strongly required for smooth implementation and development of IR. Accordingly, the study looked for user suggestion for IR success. users were offered to mark their remarks regarding some suggestive option. Users' were supposed to mark their level of concern from Strongly Agree (SA) to Strongly Disagree (SD). Total number of participated users of each option is mentioned in the right hand column of the Table 4.8. The summery of the finding is as below:

Table 4. 7 User Suggestion for Promoting IR

	SA	Ag	Ne	DA	SD	Total N
	Row N%	Row N%	Row N%	Row N%	Row N%	
Awareness-raising campaign(s) among academicians	34.43	**40.57**	20.28	2.36	2.36	212
Advocating University/organization in establishing IR	25.59	**49.29**	21.33	3.32	0.47	211
Promotional activities should be increased	26.19	**43.81**	25.71	3.81	0.48	210
Publicizing the benefit of IR	18.93	**53.40**	22.82	4.37	0.49	206
Coordination IR and departments should be increased	26.44	**41.83**	26.92	4.81	0.00	208
IR staff should act as liaison between depositor and IR	21.63	**44.71**	25.96	6.73	0.96	208
Training on using and managing repository	28.30	**39.62**	27.36	3.30	1.42	212

(Here SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree)

From the table it is noticed that most of the users (53.40%) agreed on publicizing the benefits of IR to other concerned scholars, beneficiary and other stockholders whereas 49.29% users agreed for advocating university/organization in initiating IR in their respective organizations. The other suggestion includes, 44.71% users agreed on 'IR staff should act as liaison between depositor and IR'; 'Promotional activities should be increased' (43.81%); 'Awareness-raising campaign(s) among academicians' (40.57%) and 'Training on using and managing repository' (39.62%).

4.4.3.1 Librarians' Suggestion for Promoting NDRS

Library heads were also asked to weight the nine suggestion statements related to promotion of NDRS. The statements were in a five points Likert scale, 'Strongly Agree', 'Agree', 'Neutral', 'Disagree' and 'Strongly Disagree'. Respondents were allowed to select one option for each statement. All the respondents (36 librarians) were answered the questions. Following table (Table 4. 9) illustrates the response from the librarians/library in-charges.

Table 4. 8 Librarian/Library In-Charge Suggestion for Promoting NDRS

	SA	Ag	Ne	DA	SD	Total N
	Row N%	Row N%	Row N%	Row N%	Row N%	
Awareness-raising campaign(s) among academicians	**83.33**	5.56	5.56	5.56	0.00	36
Advocating University administration to join and contribute to NDRS	41.67	**47.22**	8.33	2.78	0.00	36
Publicizing benefits of joining NDRS	25.00	**58.33**	11.11	5.56	0.00	36
Organization's infrastructure should be given priority	13.89	16.67	**38.89**	25.00	5.56	36
IR should be integrated/linked with NDRS	30.30	30.56	30.56	2.78	0.00	33
Mandatory joining for all universities/higher education institutions	25.00	**58.33**	11.11	5.56	0.00	36
NDRS should be run under the umbrella of UGC/Govt. apex body	13.89	**61.11**	13.89	5.56	5.56	36
Unique metadata standard should be formed	20.00	25.00	**41.67**	8.33	2.78	35
Training on using and managing repository	**61.11**	33.33	5.56	0.00	0.00	36

(Here SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree)

From the table it is seen that most of the librarians are strongly agree for 'Awareness-raising campaign(s) among academicians' and 'Training on using and managing repository' which is 83.33% and 61.11% respectively. Besides, 61.11% librarians think that NDRS should be run under the umbrella of UGC/Govt. apex body, while

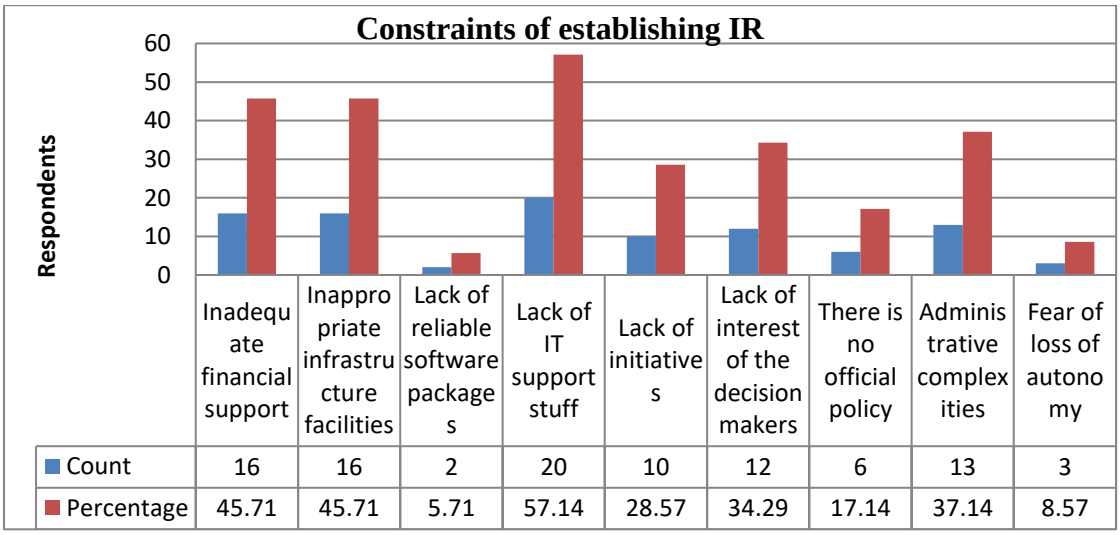
58.33% librarians emphasize on 'Publicizing benefits of joining NDRS' and 58.33% librarians suggest for 'Mandatory joining for all universities/higher education institutions' under NDRS framework. However, a large number of librarians are neutral in their opinion in regards to 'Unique metadata standard should be formed' and 'Organization's infrastructure should be given priority' which are 41.67% and 38.89% respectively.

4.5 Problems and Prospects of IR

4.5.1 Constraints with Establishing IR

Despite the world wide accelerating growth of IR, Bangladesh is still lagging behind to keep pace of establishing IR. There are several challenges that affect the effective development of IR to improve scholarly communication in Bangladesh. Librarians/Library In-Charges were asked to mark the issues that affect the establishment of IR. There were nine statements relating to various types of obstacles. Respondents were free to choose as much options as they liked. The findings are briefly highlighted below.

Figure 4. 6 Constraints for Establishing IR

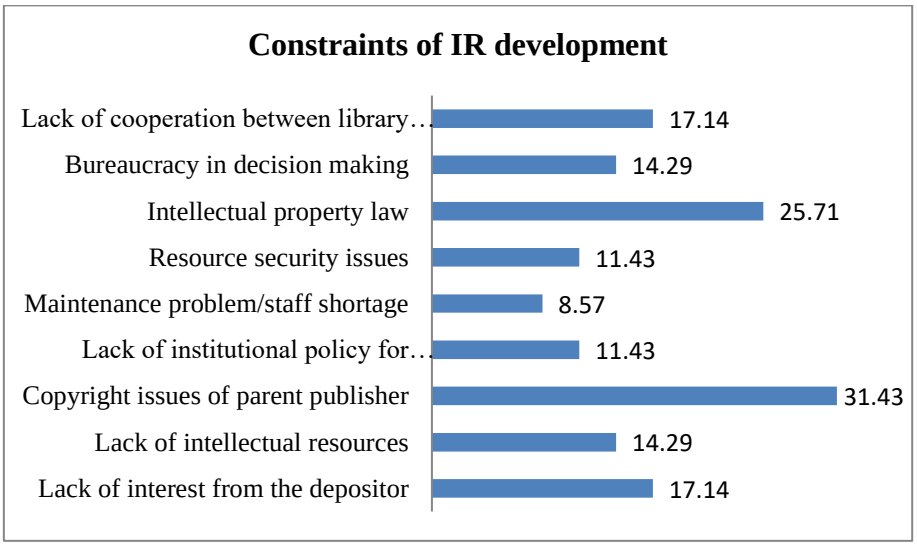


In the Figure 4. 6 several factors were identified as challenges for establishing IR in Bangladesh. Most respondents (44%) identified that lack of IT support stuff is the most challenging factor for establishing IR in Bangladesh. The other reasons includes 'inadequate financial support' and 'inappropriate infrastructure facilities' (45.71%). 'administrative complexities' and 'lack of interest of the decision maker' which is 37.14% and 34.29% respectively. Moreover, 'lack of initiatives' (28.57%), 'no official policy' (17.14%) and 'fear of loss of autonomy' (8.57%) are also significant constraints for IR establishment in Bangladesh. However, lack of IT support stuff including inappropriate infrastructural facilities are major obstacles for establishing IR in Bangladesh.

4.5.2 Constraints with Existing IR

The study also tried to identify constraints with existing IR development in Bangladesh. The Librarians/Library In-Charges who have implemented IR in their respective organizations were asked to mark different issues that hinder the development of IR. Out of the surveyed 36 librarians/library in-charge, 14 librarians having IR marked their existing issues. There were nine statements relevant to various issues of IR development in the questions. Respondents had the opportunity to select multiple options as liked. Figure 4.7 demonstrate the result.

Figure 4. 7 Constraints with Existing IR

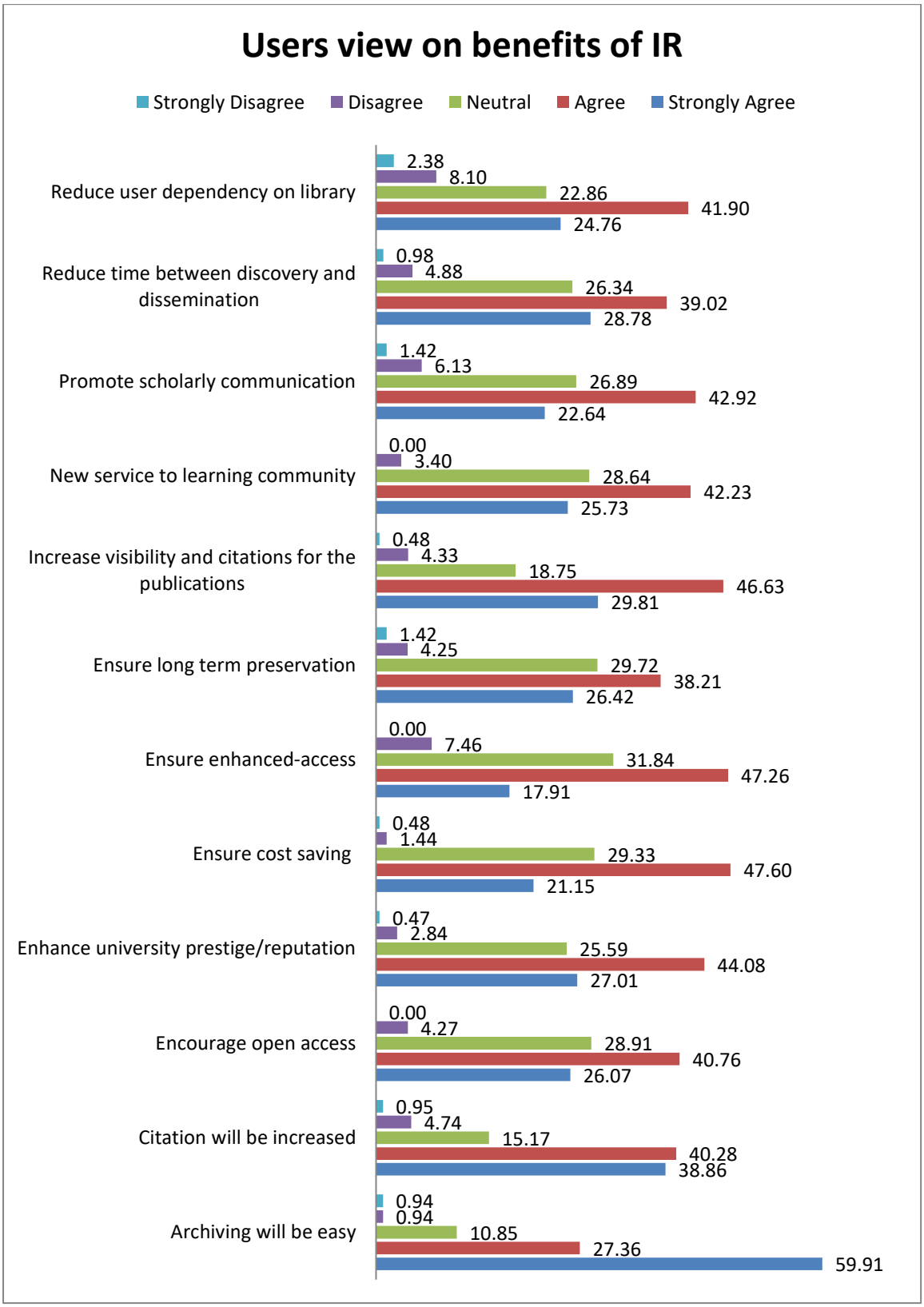


The study revealed that among the existing IR providing organizations 31.43% organizations faced copyright restriction of parent publisher as the obstacle of content submission from the depositor. Other subsequent factors that are responsible for slow growth of IR are 'Intellectual property law' (25.71%), 'lack of interest from depositor' and 'lack of cooperation between library and departments' (17.14%) etc.

4.5.3 Prospects of IR

IR has become one of the major tools for promoting scholarly communication nowadays. IR benefits researchers, institutions, society and nations as a whole by increasing visibility, usage and impact for research output. The study tried to identify the users' view regarding the benefits of IR. Users were proposed to weight twelve benefit statements and asked to mark their views (strongly agree to strongly disagree) to each options. A total of 212 users expressed their views on perceive benefit of IR. Following chart illustrates the response from the users.

Figure 4. 8 Users view on perceived benefits of depositing research output to IR



From the chart it is seen that majority of the users are aware about the benefits of IR. Most of the users (59.91%) strongly agree that with the help of IR archiving of their scholarly resources will be very easy for them. At the same time, it is very optimistic that majority of the respondents (40% to 50%) are agreed with the provided benefits of IR. Moreover, 59.91% users strongly agree that 'archiving will be easy'. Besides, 40.28% users agree that 'citation will be increased', encourage open access (40.76%), 'enhance university prestige/reputation' (44.08%), 'ensure cost saving' (47.60%), 'ensure enhanced-access' (47.26%), 'ensure long term preservation' (38.21%), 'increase visibility and citations for the publications' (46.63%), 'new service to learning community' (42.23%), promote scholarly communication (42.92%), 'reduce time between discovery and dissemination' (39.02%) and 'reduce user dependency on library' (41.90%). However, a good number of users do not also have clear ideas about the benefits of IR. The study identified that around 30% users are neither agree nor disagree with the mentioned benefits of IR.

4.6 Needs of NDRS

4.6.1 Importance of NDRS in Bangladesh

Open access national repository system supposed to help information seekers to find their required information to conduct further research and development on various areas. A central platform may overcome the standardization problem and work as a national portal for intellectual community. Librarians are considered as the main patronage for managing information and providing right information to right person at right time. For providing optimum information delivery services librarians always think about the technological application with traditional methodologies. But due to certain limitation like budgetary shortage, stuffing and other constraints, librarians sometimes feel difficulty in proper management and delivery of information services. A joint venture of information management may help them to overcome traditional

barriers as well as promote service quality. Accordingly, librarians/library in-charges were asked to mark their concern about the importance of NRDS in Bangladesh. There was a single selection option in the question and the respondents had to select their opinion from the option 'Very Important' to 'Not at all important'. All the librarians/library in-charges responded the question. The following graph illustrates the response about the importance of NDRS in Bangladesh.

Figure 4. 9 Importance to have NDRS in Bangladesh

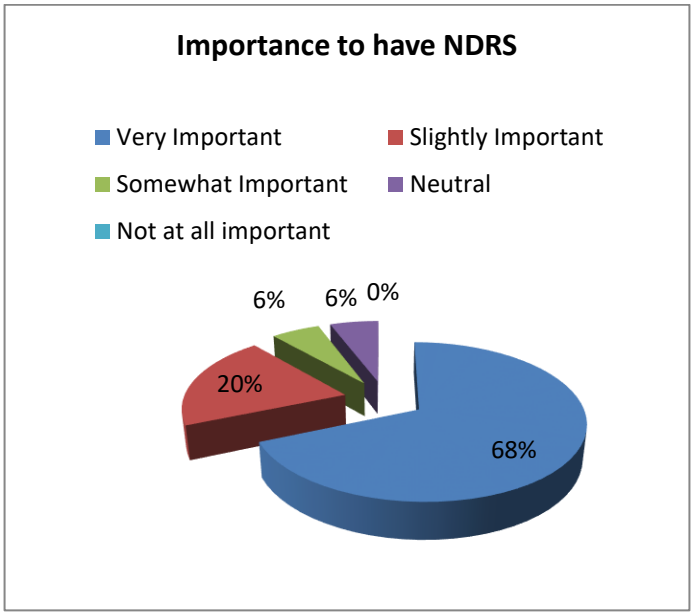


Figure 4. 9 illustrates that most of the librarian/library in-charges (68%) think that NDRS is very important for Bangladesh. At the same time 20% librarians think NDRS is slightly important while 6% think somewhat important. On the other hand, though only 6% librarians opined neutral but no one thinks that NDRS is not important at all. Accordingly, the study assume that from the library heads point of view NDRS is very important for Bangladesh.

4.6.2 Willingness to Joining NDRS

Librarians/Library In-Charges were also asked to weigh their concern about joining NDRS. Accordingly, the study proposed single selection from 'Strongly in-favour' to 'Strongly against'. All the respondents recorded their opinion. Following figure illustrate the opinion regarding the willingness of joining NDRS framework.

Figure 4. 10 Librarians' view on joining NDRS framework

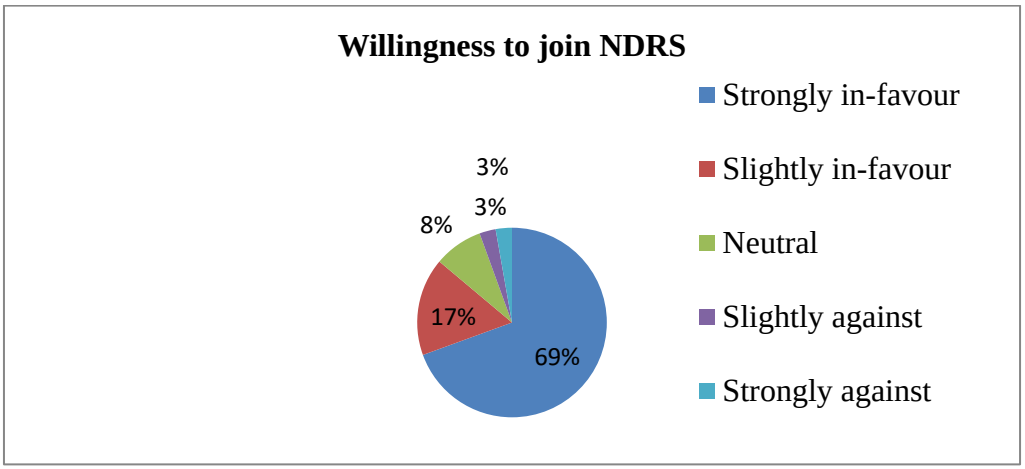


Figure 4. 1 illustrate that most of the librarians/library in-charges (69%) are strongly in-favour while 17% are slightly in-favour for joining NDRS framework. Besides, 8% librarians are neutral in their opinion regarding joining NDRS framework. So, the study accepted that most of the library heads are interested to join NDRS.

4.6.3 Usefulness of NDRS

Librarians/Library In-Charges were also asked whether NDRS may be useful or not for their respective organization. The response required single selection option from 'Very useful' to 'Not at all useful'. A total of 35 librarian/library in-charge recorded their opinion. Following figure illustrate the opinion regarding the usefulness of NDRS in their respective organizations.

Figure 4. 11 Usefulness of NDRS for organizations

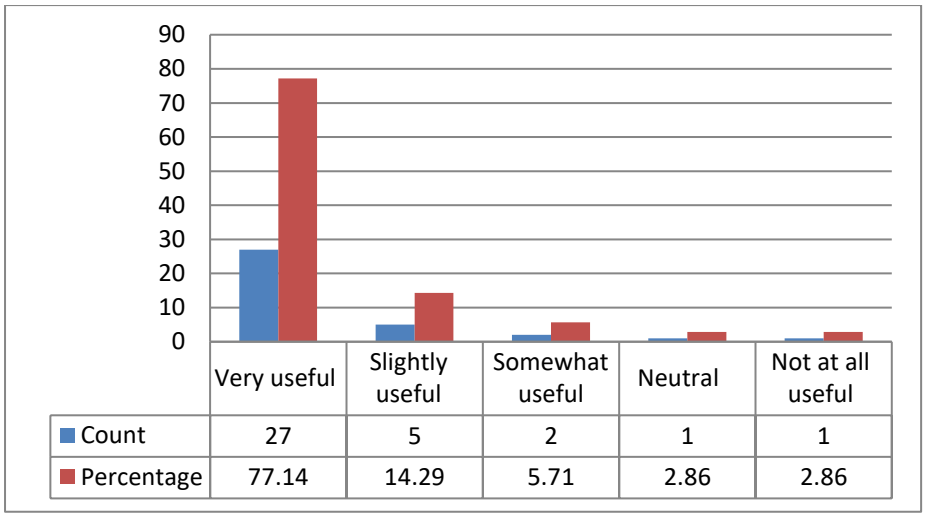
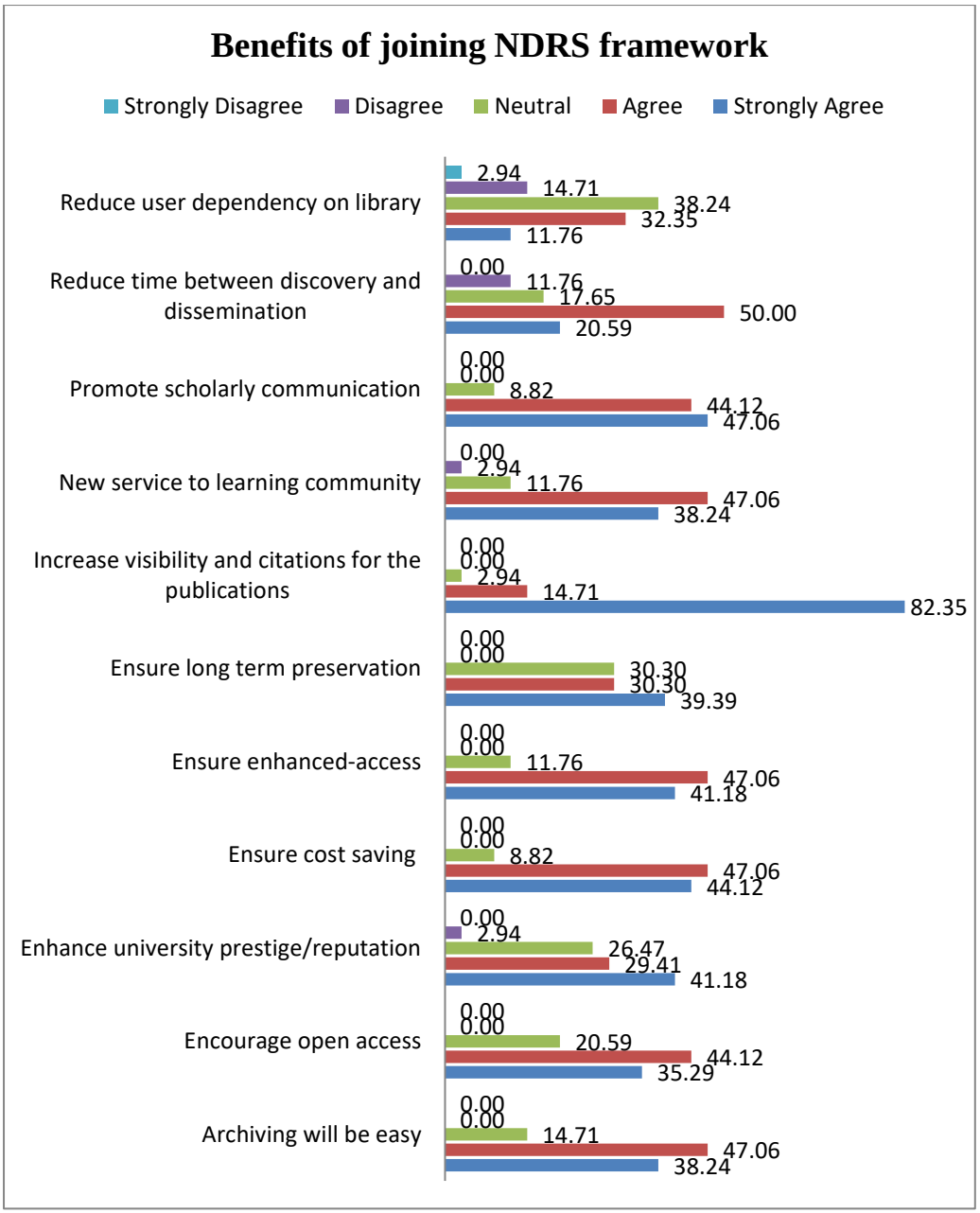


Figure 4.11 illustrate that most of the librarians/library in-charges (77.14%) assume that NDRS will be very useful for their organizations while 14.29% thinks slightly useful. Moreover, though only 5.71% librarians think NDRS as somewhat or little useful, very few (only 2.86%) are neutral in their opinion or not at all useful.

4.6.4 Benefits of having IR

Library heads were asked to weight twelve benefit statements related to IR in a five points Likert scale, Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree. Respondents were allowed to select one option for each statement. All the respondents (36 librarians) were answered the questions. Following graph illustrates the response on benefits of joining NDRS framework.

Figure 4. 12 Librarians' view on Benefits of joining NDRS framework



From the Figure 4.12 it is found that most of the librarians (82.35%) are strongly agree that with the help of NDRS visibility and citations for the publications will be increased. However, the data interpretation of individual statements response indicates that in case of 'Ensure cost saving' 44.12% librarians strongly agree and 47.06% agree. In other issues for example, in case of 'Archiving will be easy' 38.24% librarians strongly agree and 47.06% agree, 'Enhance university prestige/reputation'

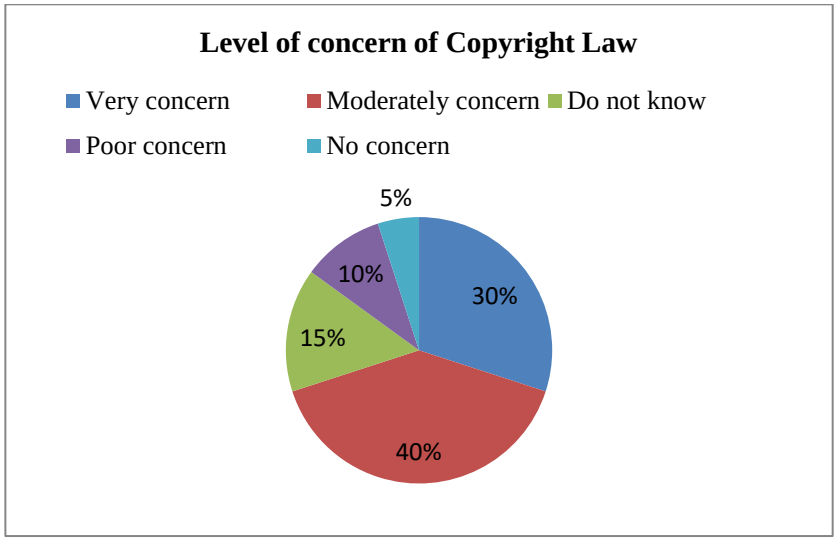
41.18% librarians strongly agree and 29.41% agree, 'Ensure enhanced-access' 41.12% librarians strongly agree and 47.06% agree, 'Promote scholarly communication' 47.06% librarians strongly agree and 44.12% agree, 'New service to learning community' 38.24% librarians strongly agree and 47.06% agree, 'Encourage open access' 35.29% librarians strongly agree and 44.12% agree, 'Ensure long term preservation' 39.39% librarians strongly agree and 30.30% agree, 'Reduce time between discovery and dissemination' 20.59% librarians strongly agree and 50.00% agree, 'Reduce user dependency on library' 11.76% librarians strongly agree and 32.35% agree. However, it is also noted that majority of librarians' remarks are neutral in case of the statement NDRS will 'reduce user dependency on library'.

4.7 Issues of NDRS

4.7.1 Issues of Copyright Concern

Copyright is a legal right that ensures the ownership and rights to use and distribution of any scholarly work. In general, researchers usually hold the copyright to their own books and articles. But when a researcher publishes scholarly works with a publisher, he or she usually grants legal right to the publisher to publish and manage the work. As a result, the researcher is not allowed to publish the same article anywhere else. Moreover, in some cases publisher do not allow researchers to redistribute the digital version of the article to any other open access media. Researchers are supposed to maintain the redistribution policy of the publisher. But sometimes it is seen that knowingly or unknowingly researchers deposit their published work to other open access platform including a personal homepage, an institutional server, a subject repository or other media to accelerate the access and use of the publication. In this case the study tried to identify the level of concern of authors about the copyright issues. Following figure shows the researcher's concern regarding the copyright issues of research output.

Figure 4. 13 Level of Concern about Copyright Law



The study identified that respondents are very scattered opinions in terms of copyright issues. It is found that majority of the respondents (40%) are moderately concern about the copyright implication at the time of depositing their research content to other digital storage and re-distribution media. At the same time, around 30% of respondents are very concern about copyright issues while 15% respondents do know about copyright law. However, 10% respondents possess very poor concern while 5% no concern at all about the copyright law.

4.7.2 Policies for NDRS Framework

Policies are considered as foundation for sustainability of any system or services. NDRS should also have such policy guideline for its proper governance and management. With this view, librarians were also provided eight policy statements. Each statement used five points Likert scale, ‘Strongly Agree’, ‘Agree’, ‘Neutral’, ‘Disagree’ and ‘Strongly Disagree’. Respondents were allowed to select one option for each statement. All the respondents were answered the questions. Following table (Table 4.9) illustrates the response from the librarians/library in-charges.

Table 4. 9 Library Heads' View on Required Policies for NDRS Framework

Policies	SA	Ag	Ne	DA	SD	Total N
	Row N%	Row N%	Row N%	Row N%	Row N%	
Coordination policy	**57.14**	28.57	11.43	0.00	2.86	
Policy to safeguard the long-	41.18	**50.00**	5.88	2.94	0.00	
Policy of depositing materials	31.43	**48.57**	17.14	0.00	2.86	
Content policy	38.24	**58.82**	2.94	0.00	0.00	
Copyright policy	**41.18**	**41.18**	14.71	0.00	2.94	
Submission policy	38.24	**47.06**	11.76	0.00	2.94	
Licensing policy	37.14	37.14	22.86	0.00	2.86	
Access management policy	**41.18**	32.35	20.59	2.94	2.94	36

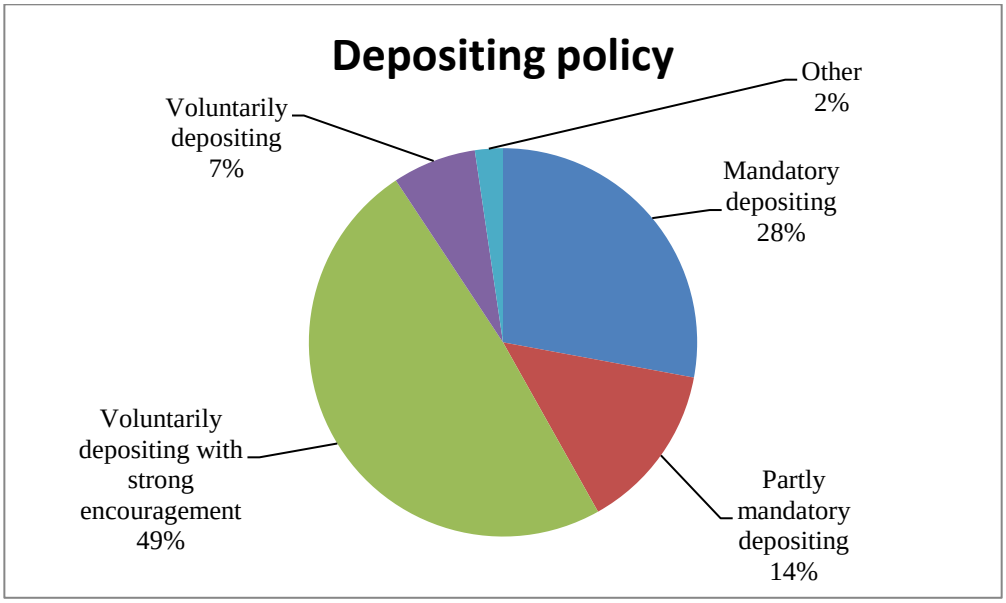
(Here SA=Strongly Agree, Ag= Agree, Ne=Neutral, DA=Disagree, SD=Strongly Disagree)

From the table it is found that most of the librarians (57.14%) are strongly agree that there should be a smooth coordination policy in the proposed NDRS. In addition, 41.18% respondents are strongly agreed to incorporate 'copyright policy' and 'access management policy' in NDRS. Besides, majority of the librarians agree with the policy statements of 'policy to safeguard the long-term preservation' (50%), 'policy of depositing materials' (48.57%), 'content policy' (41.18%), 'submission policy' (47.06%). But librarians' opinion regarding having 'licensing policy' is very bias.

Depositing Policy

More resources ensure more usability, user satisfaction and system sustainability. In this regard, developing contents is the highest challenge of NDRS success. Many literatures reported that due to voluntary submission provisions a lot of IRs did not enrich with much contents. The stakeholders need to be convinced to submit their scholarly contents. To find out an acceptable means of deposition, library heads were asked to select appropriate depositing policy. Following figure illustrates the response in regards to depositing policy.

Figure 4. 14 Depositing Policy of NDRS Framework



From the graph it is seen that majority of the respondents (49%) argue for voluntarily depositing with strong encouragement followed by mandatory depositing (28%). 'Partially mandatory depositing' for the collection of thesis/dissertation, faculty pre-prints etc. is twice (14%) than 'voluntary depositing' (7%). So, the NDRS framework should adopt voluntarily depositing with strong encouragement'.

4.8 NDRS Software

4.8.1 Digital Repository Software

There are many repository management software have been using throughout the world. Some of the software are proprietary and customize as per the needs and requirements of the parent organizations. Besides, there are also many free and open sources repository management software. FOSS4LIB (Free/Open Source Software) (FOSS4LIB, 2015) listed 30 repository management software. A brief description of some of the popular open source repository management software is described below:

Archimede

Archimede is a Canadian software solution for IRs. The Laval University Library launched the software. Some important features of Archimede are as below:

- Archimede has been developed in a multilingual perspective. Using the open source standard (i18n), content interface is independent and not embedded in the code. English, French and Spanish interfaces are already offered in Archimede. Multi-lingual feature allows users to switch easily from language to language anywhere and anytime during the search and retrieval process.
- Archimede is flexible for installation on Linux as well as on Windows.
- Archimede allows searching on metadata as well as on the full text.
- The search engine is based on open source Lucene, using LIUS (Lucene Index Update and Search).
- LIUS allows indexing of different documents formats: XML, HTML, PDF, RTF, MS Word, MS Excel, JavaBeans. It also allows mixed indexing, integrating metadata in XML and full text in PDF, HTML, etc. (Archimede, 2016).

Archivematica

Archivematica is an integrated suite of open-source software tools that allows users to process digital objects from ingest to access in compliance with the ISO-OAIS functional model. Archivematica uses METS, PREMIS, Dublin Core, the Library of Congress BagIt specification and other recognized standards to generate trustworthy, authentic, reliable and system-independent Archival Information Packages (AIPs) for storage in your preferred repository (Archivematica, 2016).

BitCurator

The BitCurator is built on free and open source digital forensics tools and associated software libraries. The BitCurator software is freely distributed under open source license. It can be installed as a Linux environment; run as a virtual machine on top of most contemporary operating systems; or run as individual software tools, packages, support scripts, and documentation. Features of BitCurator include:

- Pre-imaging data triage
- Forensic disk imaging
- File system analysis and reporting
- Identification of private and individually identifying information
- Export of technical and other metadata (BitCurator, 2016).

CollectionSpace

CollectionSpace is an open-source collections management application especially designed for museums, historical societies, and other collection-holding organizations. CollectionSpace is designed to be configurable to each organization's needs, serving as a gateway to digital and physical assets across an institution (CollectionSpace, 2016).

DSpace

DSpace is the software of choice for academic, non-profit, and commercial organizations building open digital repositories. It is free and easy to install and completely customizable to fit the needs of any organization. DSpace preserves and enables easy and open access to all types of digital content including text, images, moving images, mpegs and data sets. With an ever-growing community of developers, DSpace committed to continuously expanding and improving the software (DSpace, 2009).

DSpace CRIS

Dspace-CRIS is a new additional open source module for the DSpace platform. It extends the DSpace data model giving the ability to manage, collect and expose data about all the research aspects. DSpace-CRIS is developed by Cineca as a project funded by the Hong Kong University. The project aims to make publicly available the feature initially developed by CILEA for the IR of The University of Hong Kong, The HKU Scholars Hub (DSpace CRIS, 2016).

EPrints

EPrints is a free and open-source software package for building open access repositories that are compliant with the Open Archives Initiative Protocol for Metadata Harvesting. It shares many of the features of document management systems, but is primarily used for IRs and scientific journals. EPrints has been developed at the University of Southampton School of Electronics and Computer Science and released under a GPL license (EPrints, 2016).

eXtensible Text Framework

The eXtensible Text Framework (XTF) is a powerful open source platform for providing access to digital content. XTF developed and maintained by the California Digital Library (CDL), XTF functions as the primary access technology for the CDL's digital collections and other digital projects worldwide. XTF consists of Java and XSLT 2.0 code that indexes, queries, and displays digital objects. The software is actively maintained and supported by CDL developers and is in use at institutions across the world. The XTF source code is based on open source software (e.g., Lucene, Saxon) and is freely available for developers to download, install and configure. Developers from government agencies, university presses, and other cultural heritage institutions such as OCLC are currently experimenting with XTF (eXtensible Text Framework, 2016). The XTF system is divided into four components:

1. crossQuery: The front-end to the collection search system.
2. dynaXML: Interface to individual documents.
3. Text Engine: Used by crossQuery and dynaXML to perform text searches.
4. Indexer: Full-text indexer based on Lucene.

Fedora

Fedora (Flexible Extensible Digital Object Repository Architecture) was developed by researchers at Cornell University as an architecture for storing, managing, and accessing digital content in the form of digital objects. Fedora is a robust, modular, open source repository system for the management and dissemination of digital content. It is also used to provide specialized access to very large and complex digital collections of historic and cultural materials as well as scientific data. Fedora has a worldwide installed user base that includes academic and cultural heritage organizations, universities, research institutions, university libraries, national libraries, and government agencies. The Fedora project is led by the Fedora Leadership Group and is under the stewardship of the DuraSpace not-for-profit organization providing leadership and innovation for open source technology projects and solutions that focus on durable, persistent access to digital data (Fedora, 2016).

Goobi

Goobi is an open-source software application for digitisation projects. It allows users to model, manage and supervise freely definable production processes and is used to handle all the steps involved in creating a digital library. These include importing data from library catalogues, scanning and content-based indexing and the digital presentation and delivery of results in popular standardised formats (Goobi, 2016).

Hydra

Hydra is a repository solution that is being used by institutions to provide access to their digital content. Hydra provides a versatile and feature rich environment for end-users and repository administrators as well. Hydra allows institutions to build and deploy robust and durable digital repositories, fully-featured digital asset management applications and tailored workflows. Its principal platforms are the Fedora Commons repository software, Solr, Ruby on Rails and Blacklight (Hydra, 2016).

IR+ (irplus) Institutional Repository

IR+ is a fully featured digital repository management solution. Its goals are to meet the needs of any organization that needs to author, publish and preserve digital information. IR+ is a standalone system that has several major features not offered by any other repositories. These features make the repository relevant to the demand of the core consumers of the institutional repository including Faculty, Graduate Students and Staff (IR+, 2016).

Islandora

Islandora is an open source framework developed by the University of Prince Edward Island's Robertson Library. Islandora uniquely combines the Drupal and Fedora open software applications to create a robust digital asset management system that can be fitted to meet the short and long term collaborative requirements of digital data stewardship (Islandora, 2016).

Kora

KORA is an open-source, database-driven, online digital repository application for complex multimedia objects (text, images, audio, video) created by MATRIX. The application ingests, manages, and delivers digital objects with corresponding metadata that enhances the research and educational value of the objects. KORA's flexible architecture can accommodate any metadata scheme allowing for individualized digital collections with differing contents and metadata structures (Kora, 2016).

MyCoRe

MyCoRe is an open source project for the development of repositories, digital library and archive solutions. The technical base of the system is formed on Java class libraries, XML technology and different database back-ends (MyCoRe, 2016).

Omeka

Omeka is a free, flexible, and open source web-publishing platform for library, museum, archives, and scholarly collections and exhibitions. Its "five-minute setup" makes launching an online exhibition as easy as launching a blog. Omeka is designed considering expertise of non-IT specialists, allowing users to focus on content and interpretation rather than programming. It brings Web 2.0 technologies and approaches to academic and cultural websites to foster user interaction and participation. Its robust open-source developer and user communities underwrite Omeka's stability and sustainability (Omeka, 2016).

SobekCM

SobekCM is the software engine which powers both the University of Florida Digital Collections (UFDC) and the Digital Library of the Caribbean (dLOC) digital repositories (SobekCM, 2016). SobekCM allows users to discover online resources via semantic and full-text searches, as well as a variety of different browse mechanisms. For each digital resource in the repository there are a plethora of display options, which may be selected by an appropriately authenticated use. This repository includes online metadata editing and online submissions in support of IRs. This software was developed at the George A. Smathers Library at the University of Florida. However, additional user testing, input, and resources have been contributed from other libraries, universities, and archives around Florida, the Caribbean, etc.

Other repository management software

Besides the above software some other software are being used in different parts of the world. Following is a list of such repository management software.

Table 4. 10 List of other available IR Software

Name	Link
Archivematica	https://www.archivematica.org
ArchivesSpace	http://www.archivesspace.org
AtoM	https://www.accesstomemory.org
Avalon Media System	http://www.avalonmediasystem.org
Bepress	http://www.bepress.com
BRICKS	http://www.brickscommunity.org
Cendari	http://www.cendari.eu
CONTENTdm	http://www.contentdm.org
Content Pro	http://www.iii.com/products/contentpro
DAITSS	http://daitss.fcla.edu
DLibra	http://dlibra.psnc.pl
DPubS	http://dpubs.org
DSpaceDirect	http://dspacedirect.org
Dienst	http://www.cs.cornell.edu/cdlrg/dienst/software/DienstSoftware.
DigiTool	http://www.exlibrisgroup.com/category/DigiToolOverview
Digibis	http://www.digibis.com
Diva Portal	http://www.diva-portal.org
EQUELLA	http://www.equella.com
ETD-db	http://scholar.lib.vt.edu/ETD-db/index.shtml
Fez	https://github.com/uqlibrary/fez
Hubzero	https://hubzero.org
Imeji	http://imeji.org
Intrallect	http://www.intrallect.com/solutions/managing_content
Invenio	http://invenio-software.org
KnowledgeArc	http://www.knowledgearc.com
MEMAT	http://memat.blogs.africamediaonline.com
MOAI	http://moai.infrae.com
Muselog	http://museolog.unesco.kz
Netcommons	http://www.netcommons.org
OPUS	http://www.kobv.de/entwicklung/software/opus-4
Okina	http://okina.univ-angers.fr
OpenRepository	http://www.openrepository.com
OurDigitalWorld	http://ourdigitalworld.org
PeerLibrary	https://github.com/peerlibrary/peerlibrary
Polaris	https://polaris.mysciencework.com
Preservica	http://preservica.com
Scalar	http://scalar.usc.edu
Shared Shelf	http://www.artstor.org/sharedshelf
SimpleDL	http://www.simpledl.com
Tizra	http://www.tizra.com
Vireo	http://vireoetd.org
Vital	http://www.iii.com/products/vital
WEKO	http://weko.at.nii.ac.jp

Source: http://wiki.lib.sun.ac.za/index.php/List_of_Repository_Software Accessed on 11 August 2016

4.8.2 Comparison of repository software

Selecting a suitable software is one of the most important factors of building IRs in individual institution. But, it is difficult to determine which software is best suited for building IR. Free and Open Source Software for Libraries (FOSS4LIB) mentioned 'Choosing the right software for use in a library can be difficult when faced with the plethora of options and versions of library solutions available. Selecting the best software can seem impossible as variables often do not compare like for like and can be dependent on a multitude of tangential factors'(FOSS4LIB, 2015). The Agricultural Information Management System (AIMS) of Food and Agriculture Organization of UNESCO has published guidelines to compare IRe Software as part of its open access strategy. The comparison is divided into eleven categories to help repository managers identify the features that are most important to building a successful IR program at their institution (AIMS, 2014). These are; -

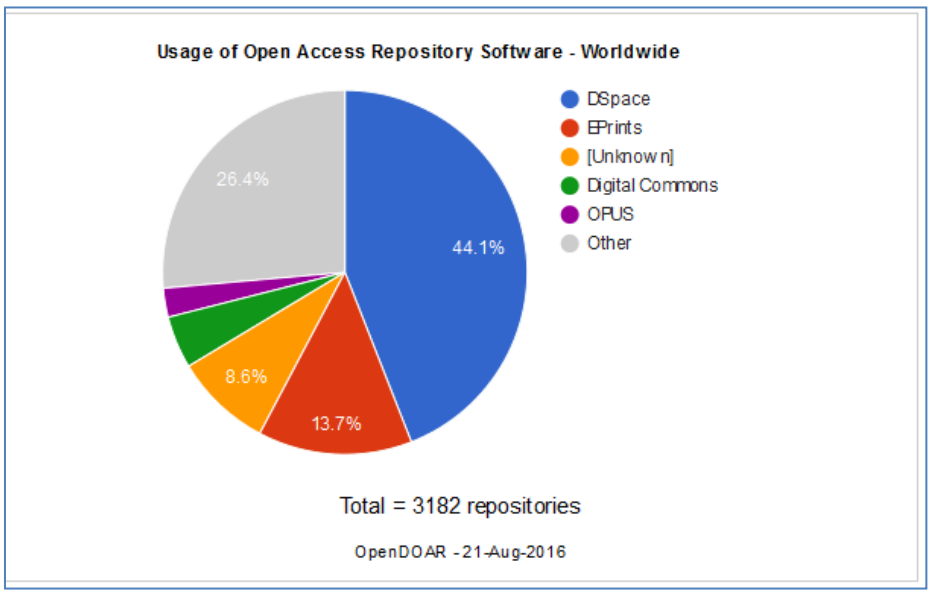
- Infrastructure
- Front-End design
- Content Organisation and Control
- Content Discovery
- Publication Tools
- Reporting
- Multimedia
- Social Features and Notifications
- Interoperability
- Authentication
- Accessibility
- Preservation

AIMS also made a comparative analysis among Digital Commons, DSpace, Eprints, Fedora and Islandora. Besides, Michel Castagné (Castagné, 2013) made a comparative analysis among five IR software namely DSpace, EPrints, Digital Commons, Islandora and Hydra. Castagné also made a summary saying-

> "In recent years, Fedora 3 has seen a declining number of developers and commits, but the ongoing development of Fedora 4 has attracted renewed interest from the community. The power of Fedora makes both Hydra and Islandora exciting new entries in the IR software landscape. Paired with Archivematica, either of these platforms could provide a single solution to the storage, display and preservation needs of a large spectrum of digital collections. The main drawback is that because both are still relative newcomers, they have not been as thoroughly tested by institutions, at least in comparison to DSpace."

However, from the worldwide usages statistics DSpace is considered as the mostly used IR software. Following figure illustrates the usages of different IR software worldwide.

Figure 4. 15 Worldwide usage of Repository Software



Source: http://www.opendoar.org/find.php?format=charts Accessed on August 21, 2016

4.8.3 Selection of NDRS Software

From the above two comparison and review from other literature it is observed that DSpae is the most user friendly IR software in terms of feature, usability, community involved and software architecture. DSpace has several version like DSpace CRIS, DSpace Direct, Agri-Ocean DSpace and so on. Considering the functionality and adoptability Agri-Ocean DSpace has been chosen for NDRS.

AgriOcean DSpace

AgriOcean DSpace (AOD) is a joint initiative of the United Nations agencies of FAO and UNESCO-IOC/IODE to provide a customized version of DSpace 1.7.1 an open source, digital repository software (AgriOcean DSpace, 2014). Its main objective is to make scientific literature in the field of oceanography, agriculture and related sciences available in digital form. AgriOcean DSpace is set-up for the digital repository communities of AGRIS (FAO) and Odin (UNESCO-IOC), but can be downloaded and used by any research institution interested.

4.9 Summary of the Finding

After discussing above, it may be summaries here that the trends of digital information management system in Bangladesh has been changing rapidly. Libraries and information centres are now providing technology based repository management services to ensure maximum benefit from the limited resources. Library personnel are initiating new technology-based content delivery services to the user community. Accordingly, library professionals implemented digital repository management software in their libraries. Though the first repository services in 2006 by ICDDR, B, after that a lot of other organizations come forward and implemented IR software and many are in pipeline to implement. As a result, awareness regarding digital repository increased dramatically both to researchers and information seekers. However, till now more than 83% library heads think that awareness rising camping should be conducted to get maximum benefits from repository platform. But repository management issues greatly hampered with some traditional barriers like inadequate financial support from the authority, inappropriate infrastructural facilities, administrative complexity and so on. In this regard, developing a common platform namely NDRS may be a good solution. It would be ensured standard, save money and other resources and above all maximize the impact by increasing the visibility.

Chapter - 5: Design and Development of NDRS

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5.4.1.8 Supervisors

5.4.1.9 Statistics

5.4.1.10 Import Metadata

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5.4.4 News Customization

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5.7 Summery

5.1 Introduction

Taking into account of all feature and advantages as well as adaptability of free and open source repository management software, Agri-Ocean DSpace (AOD) has been chosen for developing NDRS for Bangladesh. This chapter mainly describes different level planning, setting up of different criteria, customization of different features and finally describe functional overview of NDRS.

5.2 Software overview

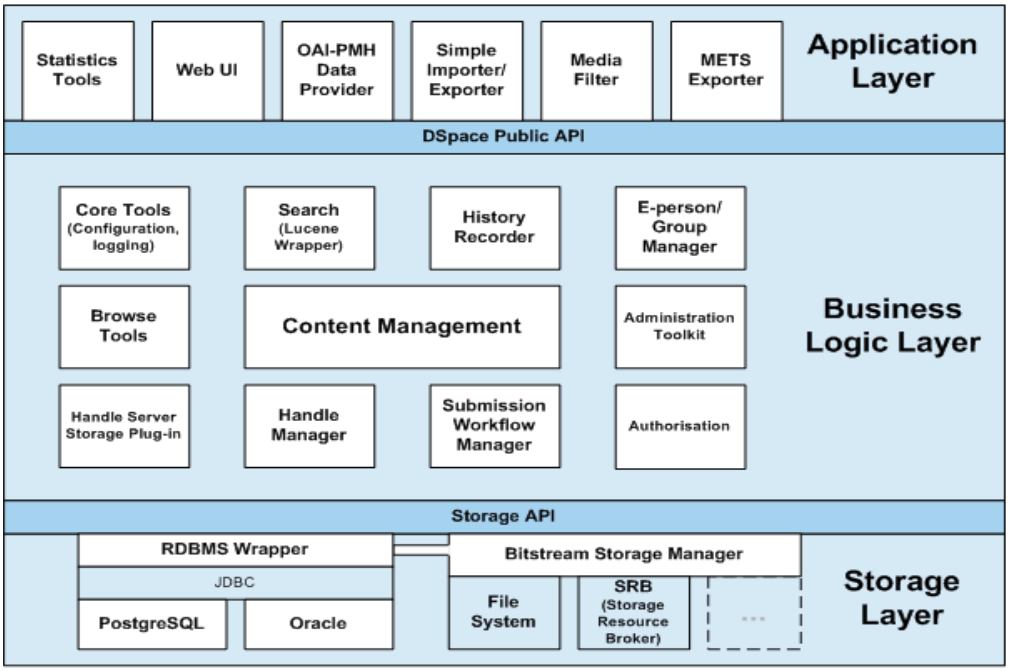
AOD system information model of is built on the idea of 'Communities'- natural sub-units of organization's distinctive management requirements. Communities are divided into sub-communities. Each communities and sub-communities can adapt the system to meet its particular needs and manage the submission process itself. AOD application has many features and tools for managing and preserving digital content. The web applications provide interfaces for administration, deposit, ingest, search, and access. AOD stores different types of content and offers built-in workflows for contents submission and review. The metadata, including access and configuration information, is stored in a relational database. Organizations can easily make their digital collections available on the Web using AOD's customizable end-user interfaces along with many community-developed features and utilities.

AOD is built in Java and server-side Java technologies including Java Servlets, JSP, Taglets, Filters, Java mail. AOD uses the PostgreSQL database as its default backend database to store user and system information and metadata.

5.2.1 System Architecture

AOD maintains straightforward three-layer architecture namely application layer, business logic layer and storage layer. Each layer has a documented API to allow for future customization and enhancement. Each layer is described in a separate section. Following figure illustrates various layer of AOD which are incorporated in NDRS.

Figure 5. 1 NDRS System Architect



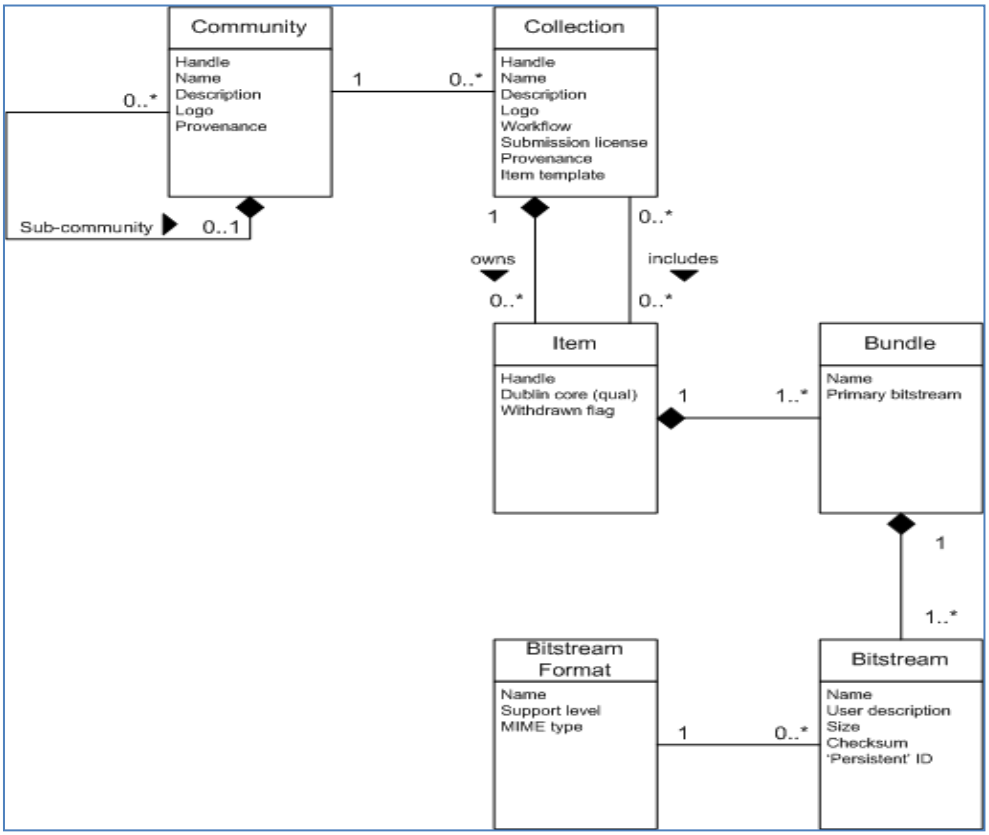
Source: https://wiki.duraspace.org/display/DSDOC3x/Architecture Accessed 04 May, 2016

The storage layer is mainly involved with physical storage of metadata and content. The business logic layer performs with managing the content of the archive, users of the archive (e-people), authorization, and also the workflow of the system. However, each layer only invokes the layer below it. Each component in the storage and business logic layers has a defined public API (Application Program Interface). The union of the APIs of those components are referred to as the Storage API and the DSpace Public API.

5.2.2 Data Model Diagram

Data model is a flowchart that illustrates the relationships between different entities. The main aim of data models is to support the development of information systems by providing the definition and format of data. Basically, AOD follows the DSpace data model diagram for describing relationship of different entities. Following figure illustrates DSpace data model diagram.

Figure 5. 2 Data Model Diagram



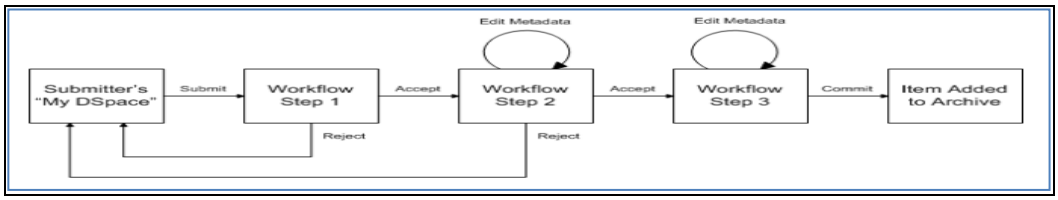
Source: http://dspace.org/sites/dspace.org/files/archive/1_6_2Documentation/ch02.html#docbook-functional.html Accessed on August 22, 2016

In DSpace data, organization follows structural hierarchy from upper level to lower level. Each DSpace site is divided into *communities*, which can be further divided into *sub-communities*. Communities contain *collections* of related content. However, a collection may appear in multiple communities. Each collection is composed of *items*, which are the basic archival elements of the archive. Each item is owned by one collection. Additionally, an item may appear in additional collections. Items are further subdivided into *bundles* of *bitstreams*. Bitstreams are usually ordinary computer files. Each bitstream is associated with one *Bitstream Format*. Each bitstream format additionally has a *support level*, indicating how well the hosting institution is likely to be able to preserve content in the format in the future. ("DSpace System Documentation: Functional Overview," 2009).

5.2.3 Workflow Steps

The workflow system in AOD is illustrated below:

Figure 5. 3 Submission Workflow in AOD



Source: http://dspace.org/sites/dspace.org/files/archive/1_6_2Documentation/image/workflow.gif Accessed on August 22, 2016

DSpace collection's workflow covers up to three steps: submit, accept/reject and commit. Each collection should have an associated e-person group for performing each step. But if the collection does not have e-person groups associated with any step, submissions to that collection are installed straight into the main archive. When a step is invoked, the task of performing that workflow step put in the 'task pool' of the associated group. When a member of that group takes a task from the pool, it is then removed from the task pool. If a submission is rejected, the collection is returned to the submitter's 'My DSpace' page mentioning the reason of rejected. Accordingly, the accepted submission is passed to the next step in the workflow and if no more workflow steps remain the submission is committed in the main archive.

5.2.4 Software requirements

AgriOcean DSpace requires some pre-requisite software for its smooth operation. Before going to final installation following pre-requisite software needs to be downloaded from the required sources:

- Java JRE (jre-8u73-windows-i586)
  Source: http://www.java.com
- Apache Tomcat 7.0 (apache-tomcat-7.0.68)
  Source: http://tomcat.apache.org/download-70.cgi
- PostGreSQL (postgresql-9.4.6-1-windows)
  Source: http://www.postgresql.org/download/windows
- AgriOcean DSpace (AgriOceanSetup-1-2)
  Source: http://code.google.com/p/agriocean/downloads/list

5.2.5 Software platform

AgriOcean DSpace has three installation platforms namely Windows, Linux and Vista. Each platform requires different level of technological competency and hardware configuration. However, anyone can choose any of the platforms depending on the criteria and available resources. For the demo installation of NDRS Windows platform has been selected and implemented.

5.2.6 Installation

Before final installation of the software following checklists have been made:

a. Created a folder named "AOD" in the PC drive E:
b. Downloaded all the required software;
c. Checked computer to ensure whether any of the pre-requisite software have already been installed or not. Pre-installation software needs to be removed to make fresh installation compatible with the AgriOcean DSpace.

Finally, step-by-steps installation have been followed for installing AgriOcean DSpace on Windows platform for creating digital repository platform. The details installation process is mentioned in Appendix IV.

5.3 Setting of NDRS

5.3.1 Building communities and collections

Communities and collections help to tie up similar content together for the convenience of information provider as well as information seekers. Selection of desired communities and collection of proposed NDRS was a difficult task. This is because in general IR involves with creating communities and collection related to any particular institution. But, NDRS is a vast concept and the stakeholder of NDRS includes all types of organization including academic, research, NGO, medical, agriculture and many more organizations within a national jurisdiction. Each institution has its own subject area different from other institutions. In that case the proposed platform followed the Dewey Decimal Classification (DDC) hierarchy to classify knowledge for making appropriate communities and collections. Moreover, some existing IR site also consulted to come into conclusion. Finally, the following 08 communities have been decided to incorporate in the proposed model. Furthermore, each community has been catagorised into several subject disciplines. There is also an additional community has been created to incorporate collection that does not suite for any specific communities. Finally, the following communities and collection have been incorporated in NDRS.

Table 5. 1 List of Communities and Collections of NDRS

Agriculture and Live stokes	
➢ Agriculture ➢ Animal Husbandry ➢ Botany ➢ Crop ➢ Fisheries	➢ Forestry ➢ Irrigation and Water management ➢ Soil ➢ Veterinary
Business and Economics	
➢ Accountancy ➢ Banking and Insurance ➢ Business	➢ Finance and Economics ➢ Foreign Trade ➢ Management Marketing
Engineering and Technology	
➢ Architecture ➢ Astronomy & Space Technology ➢ Chemical engineering ➢ Communication engineering ➢ Computer Science & Networking	➢ Bio-technology engineering ➢ Nuclear engineering ➢ Telecommunication engineering ➢ Urbanization
Environment and Earth Science	
➢ Atmosphere and climate ➢ Disaster Management ➢ Ecology ➢ Energy and sustainability	➢ Geography ➢ Natural Hazards ➢ Natural Resources ➢ Oceanography
Language and Literature	
➢ Biography ➢ Drama ➢ Essays ➢ Letters	➢ Miscellaneous writings ➢ Novel ➢ Poetry ➢ Speeches
Medicine and Medical Research	
➢ Acupuncture ➢ Dentistry ➢ Diseases ➢ Drug ➢ Microbiology ➢ Neuroscience	➢ Nursing ➢ Nutrition ➢ Pathology ➢ Pharmacology ➢ Radiology ➢ Surgery
Pure Sciences	
➢ Biology ➢ Chemistry ➢ Genetics ➢ Life Sciences	➢ Mathematics ➢ Physics ➢ Probability & Statistics
Social Science and Humanities	
➢ Anthropology ➢ Arts and Aesthetics ➢ Criminology ➢ Education ➢ General History ➢ Government & Politics ➢ International Relations ➢ Journalism	➢ Law ➢ Library and Information ➢ Media and Entertainment ➢ Philosophy ➢ Psychology ➢ Religion ➢ Sociology
Others (Not covered anywhere above)	

5.3.2 File format

Being a national repository, NRDS may include different types of file format.

However, commonly used file format of NDRS may include as below:

Table 5. 2 NDRS File Format

Text	PDF (.pdf), HTML, ASCII (.txt), XML, SGML
Images	PDF (.pdf), JPEG (.jpg), GIF (.gif), PNG (.png)
Video	MPEG (MPEG-1, MPEG-2) (.mpg), QuickTime Apple (.mov) Audio Video Interleaved Microsoft (.avi)
Audio	MPEG-2, MP3, AIFF (.aif), SND (.snd), WAV (.wav), MIDI (.midi)

5.3.3 Content types

The contents of NDRS may include as below:

Table 5. 3 NDRS Content Type

Content Type	Content Description
Article	Scholarly writing published in a peer reviewed journal.
Review	Discussion and evaluation on any specific publications like newly published book or any other scholarly work.
Editorial	Remarks of the chief editor(s) of a journal relating to any issue.
Book section	Relevant section or part of a published book.
Book	Non-periodical publication written by a specialist in the field.
Proceedings paper	A conference paper published in the proceedings of the conference.
Poster	Visual description of a project on large sheet of paper.
Presentation	Textual and graphical description of any important issues.
Research report	Scientific or technical findings having report number.
Working paper	Research paper seeking comments from peer but not for circulation.
Thesis	A scholarly report on any specialized topic, submitted to a college or university as a requirements for a Bachelor´s, Master's, Ph.D. degree.
Pre-print	A draft article seeking review from colleagues before final submission to peer reviewed journal.
Pre-publication	Submitted document for peer review and publication process.
Pending publication	A final draft of scholarly manuscript accepted for publication.
Published item	Published with any publisher having publisher's logo and layout.

5.4 Customization

5.4.1 Administrative tool

After login to NDRS with administrative credentials, administrator can perform different administrative activities relevant to administration and management of system. The administrative activities include:

- Creating and managing communities/collection
- Managing E-people
- Creating and managing different functional groups
- Register administrative metadata
- Bitstream Format Registry
- Managing workflow
- Edit news
- Customising license
- Creating and managing supervisors
- Maintain statistics
- Import metadata
- Withdraw item and so on

Details of administrative activities are described below.

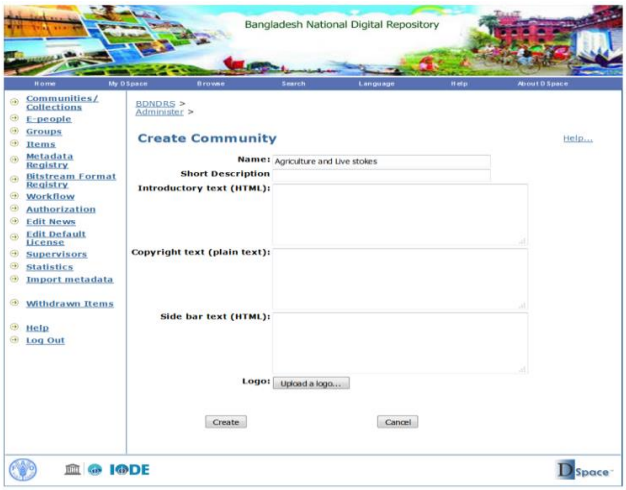
5.4.1.1 Controlling Communities and Collection

Communities and Collections are used within repository system to provide easy navigation among the institution's resources planning. Communities are considered as the highest level of the repository content hierarchy. Each community contains descriptive metadata about itself and the collections contained within it. There are some basic descriptive fields for each community for describing each community and its collections. The descriptive of fields are:

- Title
- Short Description
- Introductory text
- Copyright information
- Side bar text
- License information
- Provenance
- Logo

Following figure illustrates basic information field for creating community of NDRS.

Figure 5. 4 NDRS create community



The NDRS Collection

Depending on the specific subject area, each community of NDRS further divided into collections maintaining the below steps:

Creating NDRS Collections

Creation of a NDRS collection involves with:

- Selecting the parent community of the collection.
- Responding initial questions about the collection.
- Entering the descriptive metadata for the collection.
- Configuring the workflows for the collection.
- Configuring the collections authorisations.

Figure 5. 5 NDRS create Collection

5.4.1.2 Managing E-people

NDRS identifies application users for the purpose of granting privileges with E-People. This identity is bound to a session of a NDRS application. NDRS generally preserve the following information about each e-person:

- E-mail address;
- First and last names;
- Whether the user is able to log in to the system via the Web UI, and whether they must use an X509 certificate to do so;
- A password;
- Selection of collections assigned for the e-person.

Figure 5. 6 NDRS E-People creation

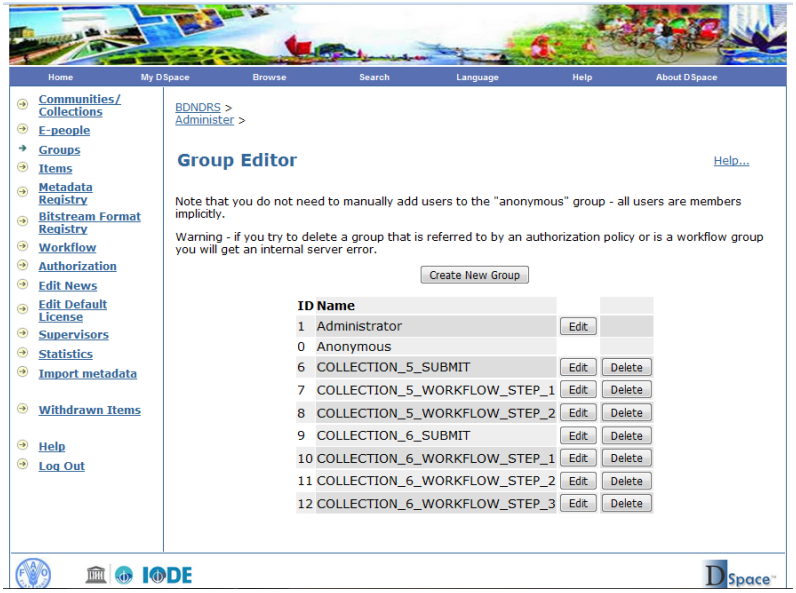
5.4.1.3 Administering Groups

A group is usually an explicit list of E-People. Groups members can be granted permissions in the authorization system.

Creating Groups of NDRS

- Login with administrative credential,
- Go to Group,
- Name a Group
- Select E-People for the Group
- Click Update Group

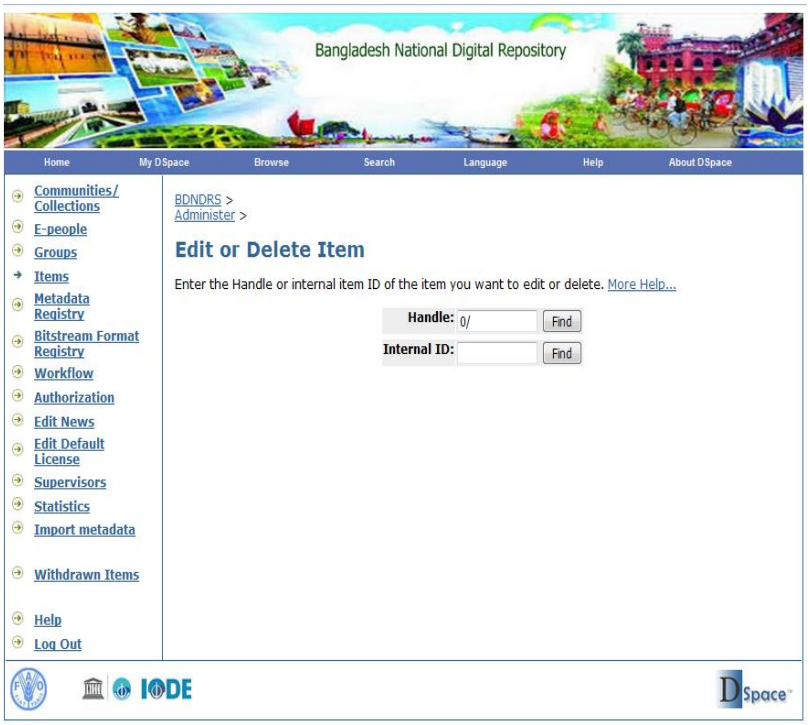
Figure 5. 7 NDRS create Group



5.4.1.4 Items

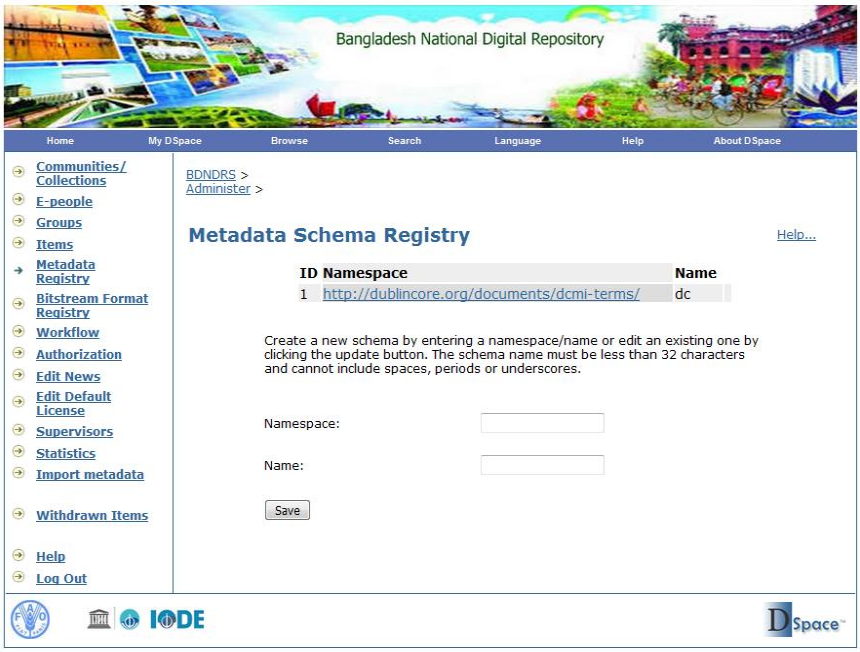
NDRS item menu helps to- ADD/REMOVE (adding or removing bundles), READ (to view item) and WRITE (to modify) item. Figure 5.8 illustrates the required fields for edit or delete items of NDRS.

Figure 5. 8 NDRS Items



5.4.1.5 Metadata Registry

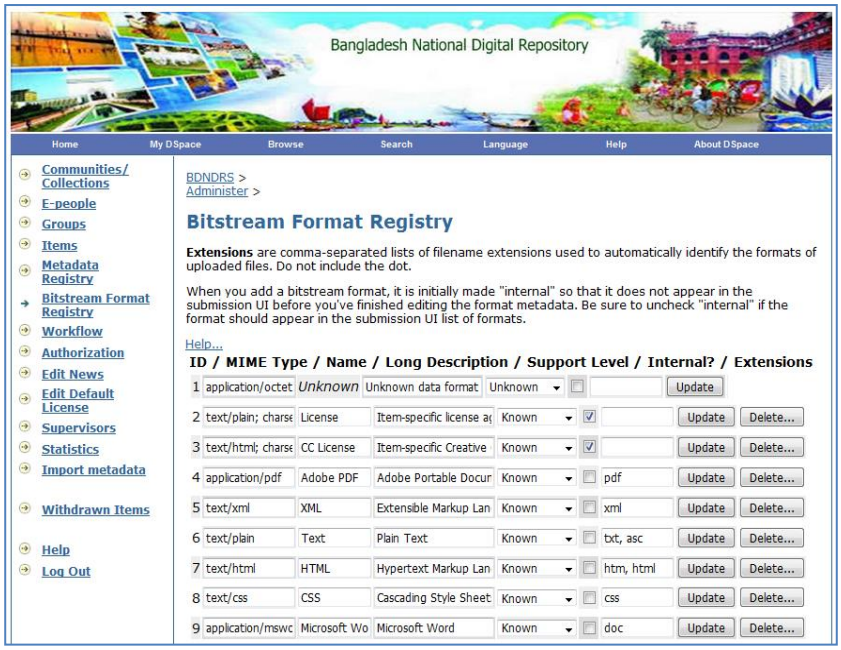
Figure 5. 9 NDRS Metadata Registry



5.4.1.6 Bitstream Format Registry

In NDRS, bitstream is associated with Bitstream Format. Specific bitstream format is essential to capture the specific files formats that users submit. In DSpace, a bitstream format is a unique and consistent way to refer to a particular file format. Each bitstream format additionally has a support level, indicating how well the hosting institution is likely to be able to preserve content in the format in the future. There are three possible support levels that bitstream formats may be assigned by the hosting institution. In NDRS, each item has one qualified Dublin Core (DC) metadata record. The DC metadata may be entered by end-users during content submission. Besides, metadata might be derived from other metadata as part of an ingest process.

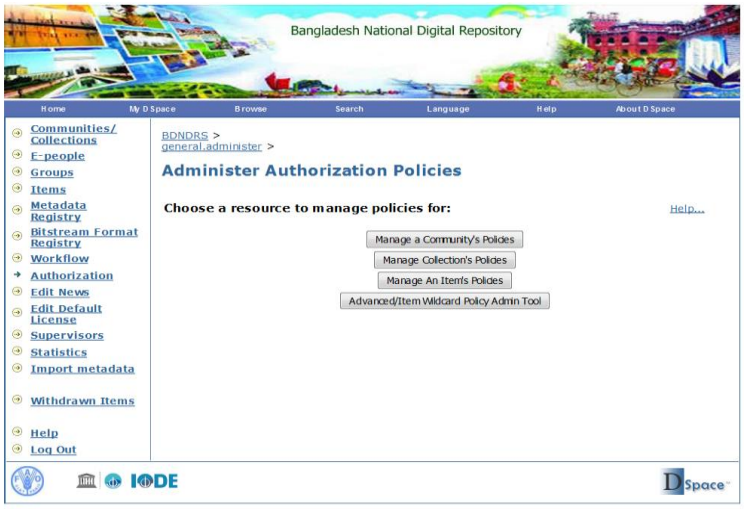
Figure 5. 10 NDRS Bitstream Format Registry



5.4.1.7 Authorization

An authority of a repository system is a source of fixed values for a given domain. Authorizing system assigns privilege for different groups including administrator in performing specific task. NDRS authorization system helps to associate actions with objects including the lists of E-People for performing any responsibility. The associations are called Resource Policies, and the lists of E-People are called Groups. Following figure illustrates the authorization policy of NDRS.

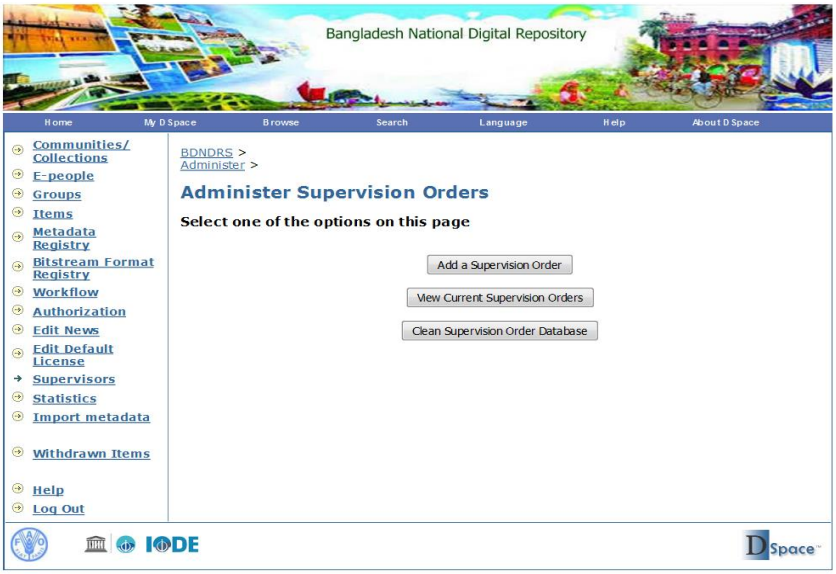
Figure 5. 11 Authorization Policy Administration of NDRS



5.4.1.8 Supervisors

Supervising is a top level activities of monitoring and managing specific tasks. NDRS offers scope of controlling activities of supervisor. In NDRS, a supervision order system serves to bind groups of users to an item in pre-submission workspace.

Figure 5. 12 NDRS Supervisor Administration



5.4.1.9 Statistics

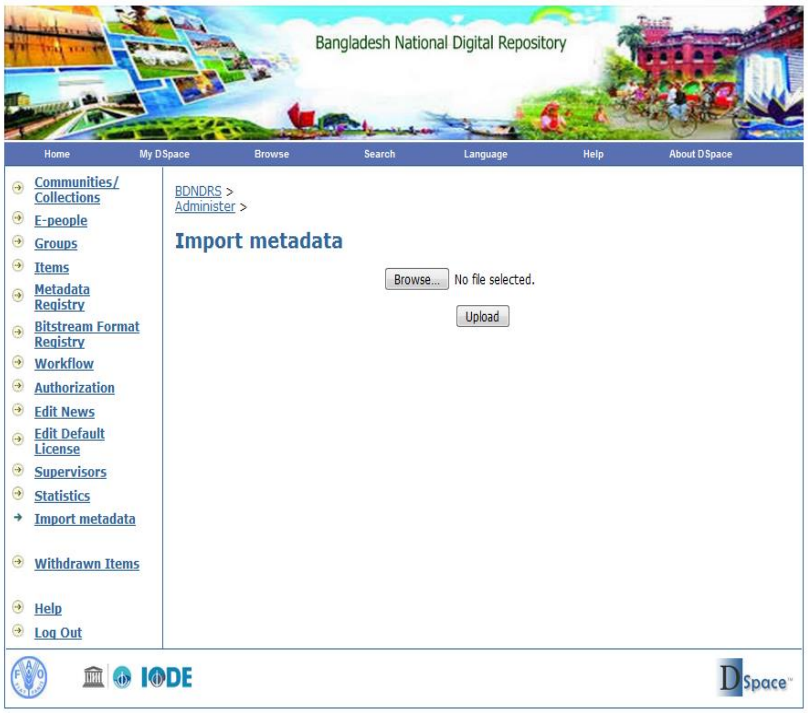
Statistics tool of NDRS provide information on-

- Number of items archived
- Number of bitstream views
- Number of item page views
- Number of collection page views
- Number of community page views
- Number of searches performed
- Number of license rejections
- Number of OAI Requests
- Customisable summary of archive contents
- A full break-down of all performed actions
- User logins information
- Most popular searches
- Processing information

5.4.1.10 Import Metadata

There is also option for importing metadata from other repository systems in NDRS. Following figure illustrates the process.

Figure 5. 13 NDRS Import Metadata



5.4.2 Banner Change

At first a banner was created with the dimension of 977 pixel (width) and 135 pixel (hight) as below and named as banner-large.jpg

Figure 5. 14 NDRS Banner

Than the banner was pasted in image folder at

Apache>Tomcat 7.0>webapps>dspace>image folder.

5.4.3 License Customization

In granting license, the NDRS adopted and customized the DSpace license rule available at Apache>Tomcat 7.0>webapps>dspace>license.jsp as below:

```
<%--
    The contents of this file are subject to the license and
copyright detailed in the LICENSE and NOTICE files at the root
of the source tree and available online at

    http://www.dspace.org/license/
--%>

<%@page contentType="text/html" pageEncoding="UTF-8"%>
<dspace:layout titlekey="jsp.license.page-title">
  <h1>AgriOcean Dspace copyright policy</h1>

  <p>In self-archiving this collection of files and associated
bibliographic metadata, the author (or the person who is
responsible for the submission) grants the National Digital
Repository the right to store them and make them permanently
available publicly for free on-line. This material has to be
author’s own intellectual property. The National Digital
Repository does not assume any responsibility if there is any
breach of copyright in distributing these files or metadata. All
authors are urged to prominently assert their copyright on the
title page of their work. </p>

  <h2>Author’s Copyright</h2>

  <p>Submitting a work to the National Digital Repository System
does not affect the copyright of the work. When author submit a
preprint to an e-prints server, author retain copyright. Texts
that an author has himself written are his own intellectual
property. Unless noted otherwise, the creators or authors retain
copyright and other proprietary rights. Submitting authors will
be responsible for ensuring the documents they archive do not
have any restrictions on their electronic distribution. The
author holds the copyright for the pre-refereed preprints, so
they can be self-archived without seeking anyone else's
permission. For the refereed post-print, the author has to verify
if the work can be submitted to an open archive or he can try
to modify the copyright transfer agreement to allow self-
archiving, or, failing that, can append or link a corrigenda
file to the already self-archived preprint.  It is suggested to
add a Creative Commons license to control the open access to
work, where the authors' intention is to hold the copyright.
</p>

  <p>See more information on:</p>
  <ul>
    <li><a href="http://www.arl.org/sparc/author/">SPARC's
Author Rights Initiative</a></li>
```

```
    <li><a href="http://www.sherpa.ac.uk/romeo">Project
Romeo</a> (Publisher copyright policies and self-archiving:
use this site to find a summary of permissions that are
normally given as part of each publisher's copyright transfer
agreement.</li>
    <li><a
href="http://useBDT.ecs.soton.ac.uk/lac/archpol.html">Draft
Research    Self-Archiving    Policy    of    University    of
Southampton</a></li>
    <li><a  href="http://www.openaccessweek.org/">Open  Access
Week</a></li>
    <li><a          href="http://creativecommons.org/">Creative
Commons</a></li>
  </ul>

  <p>The right to self-archive of the refereed post-print is a
legal matter because the copyright transfer agreement pertains
to that text. But the pre-refereed preprint is self-archived at
a time when no copyright transfer agreement exists and so the
author holds exclusive and full copyright. In general, when
author publish in a journal, author transfer copyright to the
publisher. Most journals permit self-archiving, but it depends
on the publisher's copyright policy. Authors can also deposit
the post-print inside the archive with restricted access.
Authors may request that the publisher give back certain rights,
e.g. the right to deposit the post-print in an open access
archive, or to put it on author’s own homepage. Some publishers
have stated that they grant these rights as a standard procedure.
Copyright law gives the creator of copyrighted work exclusive
rights, which may be both segmented and transferred to otheBDT.
Managing copyright wisely can significantly enhance the values
of the educational system.</p>

  <h2>Disclaimer</h2>

  <p>To the extent permissible under applicable laws, no
responsibility is assumed and is hereby disclaimed by NDRS and
for any injury and/or damage to persons or property as a result
of any actual or alleged libellous statements, infringement of
intellectual property or privacy rights, or products liability,
whether resulting from negligence or otherwise, including
without limitation from any use or operation of any ideas,
instructions, procedures, products or methods contained in the
material therein. Access to this site is provided on an "as is"
basis, and neither AgriOcean Dspace warrant that the information
or software contained herein is complete or accurate or free
from error. Information or software downloaded by the user should
be checked for defects or viruses before being used.</p>
</dspace:layout>
```

5.4.4 News Customization

AgriOcean DSpace provides two types of news available. One is top news and another is sidebar news. Both the default news has been customized for NDRS as below:

Top News edit

- Made necessary changes as below:

```
<table class="miscTable" width="100%" align="center"> <tr> <td class="latestLayoutTitle"> Bangladesh National Digital Repository
</td> </tr> <tr>
<td><p><b>Bangladesh National Digital Repository System (BDNDRS) is a gateway for individual researchers and research organizations to contribute to a national repository. The shared platform is supposed to ensure the standard, access opportunity and preservation protocol for all repositories of Bangladesh.</b> </p><P>BDNDRS aims to help end-users to find their required information which may facilitate them to conduct research on various areas. BDNDRS is developed based on AgriOcean Dspace repository software a customised version of DSpace 1.7 to offer Open Access to the literature. They will use the same high standards for metadata, thesauri and other ontologies ensuring advanced access to the scientific publications in the field and the possibility to create new services for their research in Bangladesh. </p></td></tr></table>
```

Sidebar News Edit

For making necessary linkage with other IR and also incorporating other information provider, NDRS sidebar news have been changed as below:

```
<tr> <td class="navigationBarSpacing" colspan="2"> </td> </tr><tr><td>Links:</td></tr><tr><td> </td></tr><tr><td><br/><a target="_blank" href="http://agris.fao.org/">Agris</a>, <a target="_blank" href="http://scholar.google.com/">Google Scholar</a>, <a target="_blank" href="http://www.research4life.org/">Research4Life</a>, <br/><br/> Institutional Repositories: <br/><a target="_blank" href=" http://dspace.bracu.ac.bd/"> BRACU </a>, <a target="_blank" href=" http://library.cvasu.ac.bd:8081/">CVASU</a>,<a target="_blank" href=" http://dspace.library.daffodilvarsity.edu.bd:8080/"> DaffodilUni </a>, <a target="_blank" href="http://repository.library.du.ac.bd/xmlui/">DU</a>, <a target="_blank" href=" http://gsdl.easternuni.edu.bd/greenstone/cgi-bin/library.cgi "> EasternUni </a>, <a target="_blank" href=" http://dspace.ewubd.edu/"> EWU </a>, <a target="_blank" href=" http://dspace.icddrb.org/"> ICDDR,B </a>,<a target="_blank" href=" http://dir.iub.edu.bd:8180/"> IUB </a>, <a target="_blank" href=" http://lib.iutoic-dhaka.edu/greenstone/cgi-bin/library.cgi/"> IUT </a>, <a target="_blank" href=" http://202.74.245.22:8080/xmlui/"> NUB </a>, <a target="_blank" href=" http://180.211.185.225:8080/"> RU </a><br/><br/>More information about AgriOcean Dspace <a target="_blank" href="http://aims.fao.org/agriocean-dspace">at AIMS</a></td></tr>
```

5.4.5 Customizing Submission Module

In NDRS, customization have been made on submission module for more user convenient. The customization are done with the below code:

```
<collection-type>
<collection handle="default">
<type name="Journal Contribution" />
<type name="Book"/>
<type name="Book Section" />
<type name="Proceedings Paper" />
<type name="Working Paper" />
<type name="Map" />
<type name="Data Set" />
<type name="Other" />
</collection>
        </collection-type>
```

Authority control on Journal title

- Using the AOD authority functionality
    - Based on local table: e.g. *sql.asfa = SELECT termcode as authority, en as value FROM asfa WHERE lower(en) LIKE '%' || lower(?) || '%' ORDER BY en LIMIT 500.*
    - Link between field and authority list is defined in input-forms-extended.xml (not in in dspace.cfg): ex. <authority closed="true" editable="false" presentation="suggest" limit="50">asfa</authority>

Authority control on journal titles

- Possibility to add besides the title an ISSN if not available in the authority list
- ISSN is copied to dc.identifier.issn
- title + volume + issue + start + end page > dc.identifier.citation

Import on interface level

- Import in the submission workflow as 'unfinished submission'
- Metadata of xml and ris-based formats:
    - xml: Agris AP, MODS
    - Ris: Endnote
- Translation to DIM format

5.4.6 Subject Headings control

Besides the author's control submission form, the Library of Congress Subject Heading (LCSH) is adapted in the NDRS to increase its application more convenient. The LCSH input form is added in the record submission form by modifying the file C:\aod\repos\config\input-forms-extended.xml.

5.5 Policy Development, Legal and Other Issues

Setting up an acceptable digital repository management policy and legal issues is a major concern for repository administrator, stack holder and policy maker of any digital repository. There are around 3047 institutions throughout the world have been providing digital repository services ("OpenDOAR," 2016). Among them, some institutions are fundamentally very strong in terms of policy and administration. At the same time, a large number of institutions do not have clear repository management policies. In a study Millington (Millington, 2006) discovered that about two thirds of open access repositories do not have publicly stated policies for the permitted re-use of deposited items or for such things as submission of items, long term preservation, etc. In principle, policy formulation of individual IR depends on policy and legal status of that particular organization. On the other hand, since the content and beneficiary of national repository is not confined to any specific organizations rather the participatory organizations as a whole, formulating appropriate policy is a difficult task. In order to ensure legal, regulatory and social obligations with regard to the use and management of repository, NDRS is supposed to adhere to the nationally and internationally recognised set of repository management rules. With this view a lot of different individual institution's repository policies have been observed to formulate policy relevant information, customised and adopted to NDRS. It is observed that most of the available repository policies of different organizations are almost same. However, some well-established universities like Nottingham University ePrint policy, ("Policies - Nottingham ePrints," 2016), York St John University repository policy, ("Institutional Repository Policy Statement | York St John," 2016), University of Calgary repository policies ("Digital Repository Policies," 2012) have been consulted to adopt suitable policies for NDRS. Moreover, the Directory of Open Access Repository (OpenDOAR) aims to ensure standard practice of digital repository for all repository organizations

worldwide. OpenDOAR has created simple tool to help repository administrators to formulate and/or present standard repository's policies. These policies serve as a guideline to make the best use of repository's content ("OpenDOAR - Policies Tool - Directory of Open Access Repositories," 2016). The OpenDOAR Policy Tool covers the following major policy issues:

- ***Metadata Policy***- for information describing items in the repository, which includes access to metadata; re-use of metadata etc.
- ***Data Policy*** - for full-text and other full data items.
- ***Content Policy*** - for types of document and dataset including repository type; type of material held; principal languages.
- ***Submission Policy*** – covering eligible depositors; deposition rules; moderation; content quality control; publishers' and funders' embargos; copyright policy.
- ***Preservation Policy*** - covers retention period; functional preservation; file preservation; withdrawal policy; withdrawn items; closure policy.

However, considering different relevant issues, strategies and practical experiences of different institutional as well as consortium based repositories, following policies have been taken into consideration for the smooth operation of the NDRS.

5.5.1 Content policies

The content policy is provided below with regard to the types of document and related data sets held.

5.5.1.1 File format

The following file formats can be accepted for the NDRS:

- Portable Document File (.pdf)
- Plain Text (.txt)
- Postscript (.ps)
- Rich Text (.rtf)
- Extensible Markup Language (.xml)
- Hypertext Markup Language (.html, .htm)
- Microsoft Word (.doc)
- Microsoft PowerPoint (.ppt)
- Microsoft Excel (.xls)
- Latex (.latex)
- Tex (.tex)

5.5.1.2 Deposited items may include:

- Working drafts.
- Submitted versions.
- Accepted versions.
- Published versions.
- Unpublished thesis/dissertation.

5.5.1.3 Use of content

- Anyone may access full items free of charge unless the item's accompanying rights declaration states otherwise.
- Access to some items may be restricted including temporary embargo.
- Copies of full items can be reproduced, displayed and stored in a database in any format or medium.
- Full items must not be sold commercially in any format without formal permission of the copyright holders.
- Copies of full items generally can be used for personal research, educational or not-for-profit purposes without prior permission or charge. In that case the user must ensure that they:
    - Indicate the author's title and full bibliographic details,
    - Provide a link to the item record (metadata),
    - Clearly state any copyright or rights statement attached to the item,
    - The content is not changed in any way.

5.5.1.4 Principal Languages: English, Bengali (although other languages will be accepted).

5.5.2 Content Licensing

Contents of NDRS must have content licensing either creative commons or content specific license. A Creative Commons (CC) license is one of several public copyright licenses that enable free distribution of a copyrighted work. A CC license is generally used when an author wants to give people the right to share, use, and build upon a work that they have created ("Creative Commons license," 2016). NDRS requires individual depositors to confirm copyright information while submission. That means all submitted items must be ensured content licensing. Unpublished content should be followed creative common license while the published contents follow the licensing agreement of the publisher.

5.5.3 Metadata policy

Metadata can be used free of charge. But some metadata may require right permission for accessing, preservation and redistribution.

5.5.4 Submission Policy

Submission policies involves with the policy of submission of any contents to repository. Considering various issues and practice done by other well-known IRs, following policies have been incorporated for NDRS.

5.5.4.1 Eligible Depositors

- Content may only be deposited by the concerned author(s), or by the authors' delegated agents, or by an agent delegated by institution.
- Content can be deposited at any time, but will not be made publicly visible until any publishers' or funders' embargo period has been expired.

5.5.4.2 Deposition Rules

- Author(s) may only submit their own work for archiving.
- Eligible depositor(s) must submit bibliographic metadata of their publications.
- Eligible depositor(s) must deposit full texts of all publications.
- In case of publisher restricted contents to re-distribution, digital storage and open access, author can submit the bibliographical data of the content and there should be direction of availability and original sources of the content.

5.5.4.3Moderation

The administrator may vet items in case of:

- Relevance to the scope of the repository.
- Valid layout & format.
- The exclusion of spam.

5.5.4.4 Content Quality Control

Ensuring the validity and authenticity of the content of submissions is the sole responsibility of the depositor/author(s).

5.5.4.5 Publishers' and Funders' Embargos

While submitting contents to NDRS, author(s)/depositor must follow the embargo policy of the concerned publisher or funder. NDRS will not be responsible for violation of any policies by author(s)/depositor.

5.5.5. Preservation policy

Preservation is one of the most important functions of any digital resources for ensuring long-term access and management. Preservation policy must be compatible with future technological, management change and other issues. Accordingly, following preservation policy have been taken into consideration for NDRS.

5.5.5.1 Systematic preservation

All contents will be preserved in a high configured server. Alternative copies may be preserved in other external hard-drive.

5.5.5.2 Retention Period

- Items will generally be retained indefinitely, or for a period of time agreed with the copyright holder.

5.5.5.3 Functional Preservation

- NDRS will try to ensure continued readability and accessibility. In this regard:
  - Items will be migrated to new file formats if required.
  - Software emulations will be provided to access un-migrated formats.
- The repository may take help from external partners to:
  - Convert or migrate file formats.
  - Develop and implement software emulations for old file formats.
  - Record preservation metadata.
  - Backup items in external storage media.

5.5.5.4 File Preservation

- The NDRS will regularly back-up the files.
- In case of upgradation, the original bit stream will be retained for all items.
- Items may be preserved in CDs/DVDs, microfilm and other portable drive for long-term preservation.

5.5.5.5 Version Control

- Deposited items may not be changed with any reason.
- Error and correction lists may be included with the original record if required.
- If necessary, an updated version may be deposited. In that case:
  - The earlier version may be withdrawn from public view.
  - The item's persistent URL will be always link to the latest version.
  - There will be links between earlier and new versions.
  - Items are allocated a checksum to facilitate the detection of alterations.

5.5.5.6 Closure Policy

- In case of NDRS being closed down, the database will be transferred to another appropriate archive as necessary.
- The original bit stream is retained for all items, in addition to any upgraded formats.

5.5.6 Copyright Policy

Copyright is the intellectual property right that protects the expression of ideas or information. Copyright policy ensures privilege to the contribution of any intellectual creation. At the same time, it also imposes some restriction to redistribution or reuse of the same. As the copyright policy differs from publisher to publisher, author(s)/depositor are themselves needed to check the publisher policies to ensure re-distribution compliance. For smooth growth of NDRS, author/depositor must sign and agree to the copyright policy so that no compliance arises here after relating to copyright violation. Any copyright violations are entirely the responsibility of the depositor. If the repository receives proof of any types of copyright violation, the relevant item will be removed immediately.

5.5.7 Withdrawal policy

Generally, submitted items may not be withdrawn from the NDRS. However, the acceptable reasons for withdrawal may include:

- Breaches of legal requirements and violations of Intellectual Property Right (IPR).
- Ethical or moral concerns.
- Falsified research.
- In interests of national security.
- Legal requirements and proven violations.
- Proven copyright violation or plagiarism.
- Where a journal/publishers' rules are breached.
- Complain from publishers or other copyright owners.
- Queries from copyright owners of embedded material.
- Complain from co-authors.

In case of withdrawal of content in any reason following policy will be followed:

- If the record is withdraw entirely, a statement describing reason of removal will be placed using the original links to the NDRS-based entry.
- Withdrawn items are not deleted from NDRS database, but are removed from public view.
- The identifiers or URLs of withdrawn items are retained indefinitely.
- The metadata of withdrawn items will not be searchable.
- URLs will continue to point to 'tombstone' citations, to avoid broken links and to retain item histories, with:
    - a link to a replacement version, where available.
    - a note explaining the reasons for withdrawal.

5.5.8 Legal Issues

If there are any concerns regarding the legibility of any issues of NDRS, the designated administrator will solve the issues with relevant international scholarly communication as well as creative commons license procedures. All dispute will be handled with Berline Declaration on Open Access (“Berlin Declaration,” 2003), Budapest Open Access Initiative (“BOAI,” 2002) , Bethesda Statement (Bethesda Statement, 2003) policies.

5.5.9 Publisher Policies

NDRS will try to maintain publisher policy while archiving and making publicly available of any issues. Accordingly, before submitting any items the submitter will have to check the Publisher's policy of each individual item prior to submission. SHERPA/ROMEO database, administer and maintain by University of Nottingham may be a helpful tool for submitters. The RoMEO project (Rights MEtadata for Open archiving) of SHERPA is a web-based service with default copyright and archiving policies of scientific journals and publishers ("SHERPA/RoMEO - Publisher copyright policies & self-archiving," 2016). The service also provides links to publishers' web sites and their copyright guides. SHERPA/RoMEO is a good tool to find out whether any publications are allowed to archive in open access repository or not. Anyone can search Sherpa/RoMEO database with the journal title or its ISSN number. Besides, journals of the concerned publisher might apply copyright and self-archiving policies and conditions that differ from one another and the publisher's default policy.

Besides, in case of any research output carries out under the financial support of any agency or funding organizations, the depositor has to follow the funder's policy and guidelines while submitting the result to NDRS. Moreover, the NDRS administrator will check the research funder's policies as regards to ensuring open access to research results and publications arising from their funding. In this regard, the Research Funders Archiving Mandates and Guidelines of SHERPA/JULIET database ("SHERPA/JULIET - Research funders' open access policies," 2016) will be used as a major decision support tool.

5.5.9.1 Making a complaint

Any legitimate grounds to complain about any item of NDRS, show cause may be issued with the reasons of complaint by email to NDRS administrator. The reason may be any or more of the following circumstances:

1. If it is belief that inclusion of the item infringes any copyright.
2. Infringes any moral rights.
3. The entry is defamatory.
4. The content is otherwise illegal or unlawful.

5.5.9.2 Outcome of a complaint

In case of any complaint occurs in any ground NDRS administrator will make an initial assessment of the complaint. If it is found that the initial stage has legitimate grounds of complaint, NDRS may take initiative to remove the item from the public access portion. In that case, the administrator will investigate the complaint deeply. In some case the NDRS administrator may seek professional legal advice from external sources if required. At the same time, administrator may inform the depositor of the item about the nature of the complaint and give them an opportunity explain their position. If the investigation finds reasonable ground, the administrator may finally remove the item from the repository permanently.

5.6 Functional overview

NDRS is supposed to maintain a pre-defined workflow hierarchy. The workflow encompasses three major steps namely:

I. Submission workflow

II. Review Workflow, and

III. Management Process.

The figure 5.15 illustrates the functional workflow of NDRS.

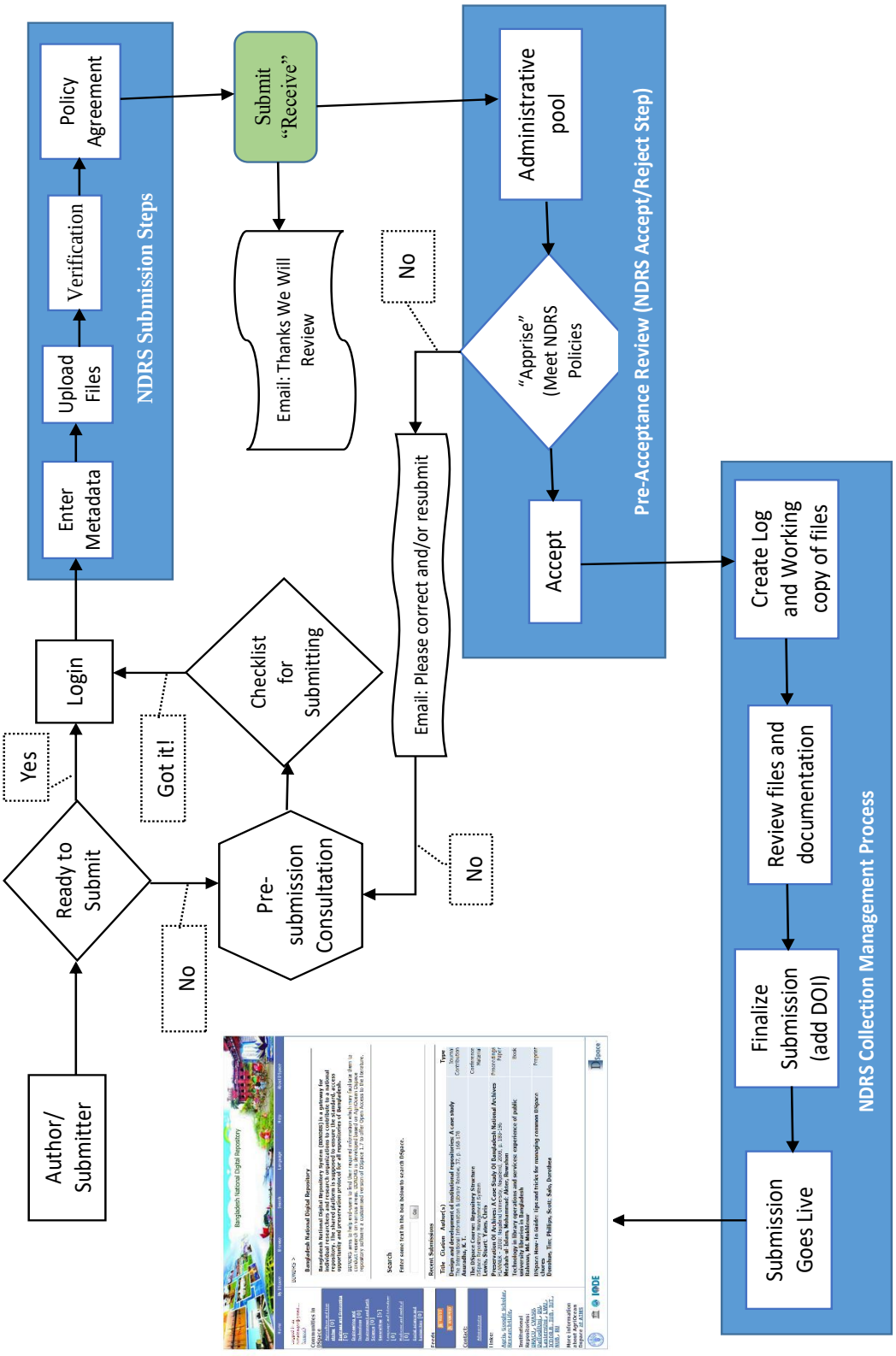


Figure 5. 1 NDRS Workflow diagram

The detail workflow steps are described in the following pages.

5.6.1 Content Submission Workflow

Content submission is important part for developing contents of NDRS. NDRS allows researcher/author to directly submit their research output to its repository. In case of direct submission following steps have to be follow:

1) Click on **'My DSpace'**
2) Login to MyDSpace

Figure 5. 156 NDRS Login Interface

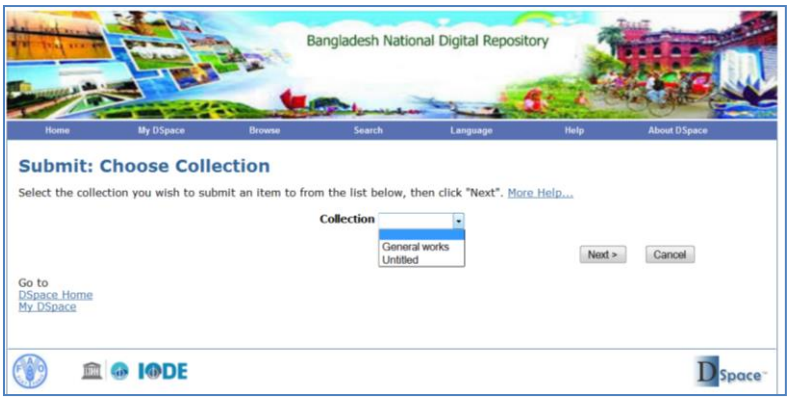
3) Click **Start a New Submission**

Figure 5. 167 NDRS user profile

4) Choose collection

- Click Collection.
- Select suitable collection name from the drop-down list.
- Move mouse to the collection to add item and click.
- Click on the "next" button to proceed, or "cancel/save" button to stop and save or cancel submission.

Figure 5. 178 NDRS collection selecting screen



5) Select content type from the drop-down list as below and describe content as below screens.

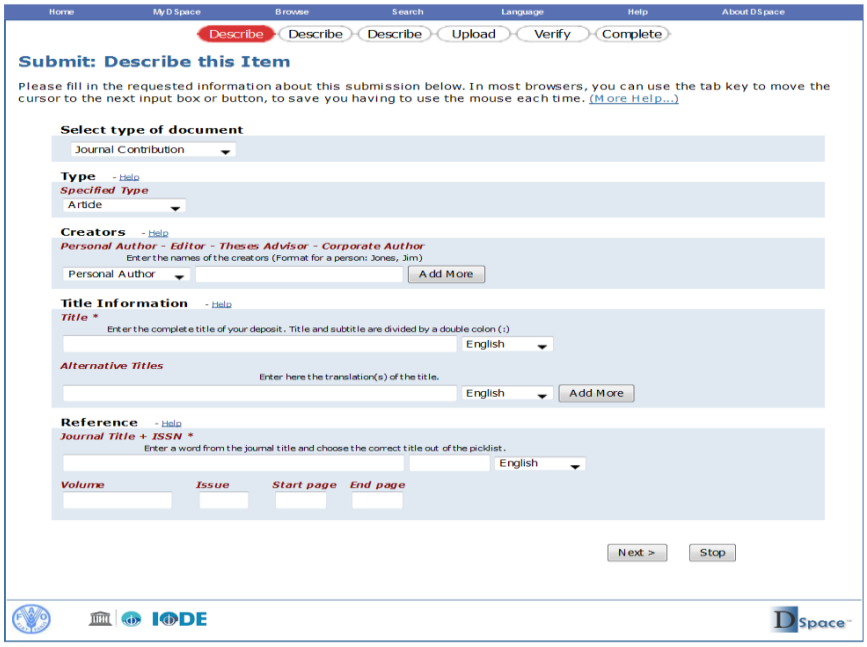
File Description

While submitting content in NDRS, submitters must be conscious about file description. In a submission there may be different types of file including main article, images, data set etc. The description of file will help users to understand the type of information available in each file.

File Format

For archiving content to NDRS it is essential to know the appropriate file format. There is some predefined file format available in NDRS namely "PDF", "HTML", or "Microsoft Word". After uploading the content, the system will automatically identify the file format. If the system does not automatically recognize the format of the uploaded file, submitter will be asked to describe it. If the format of the file appears in the list offered, click on it and then on "Submit". Otherwise, submitters need to select, "format not in list" and description needed format in the provided text box.

Figure 5. 189 NDRS item submission description



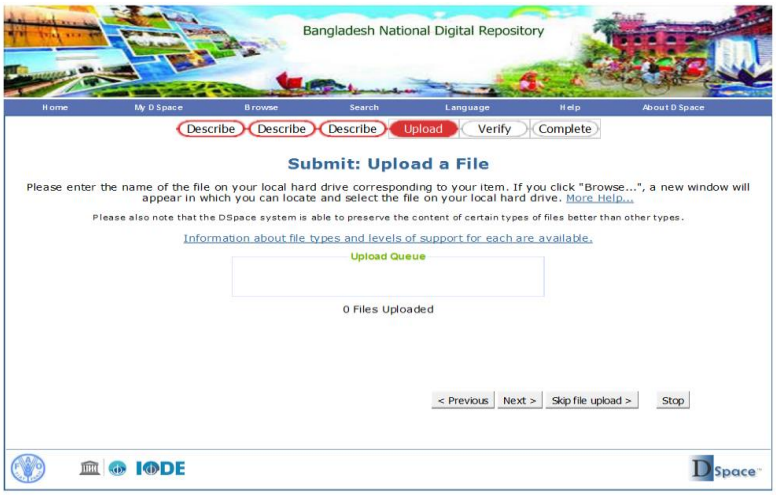
Upload a file

Methods to enter name of file

There are two methods of entering name of file in NDRS:

1. Type the full path and file name into the box and click on the "next". **2**. Click on the "browse" button and select appropriate file from the directory. Double-click on the selected file name, and the name will be entered into the input box. Once the correct file name is in the input box, click on the "next" button to proceed.

Figure 5. 20 NDRS item submission - content upload



Verify upload

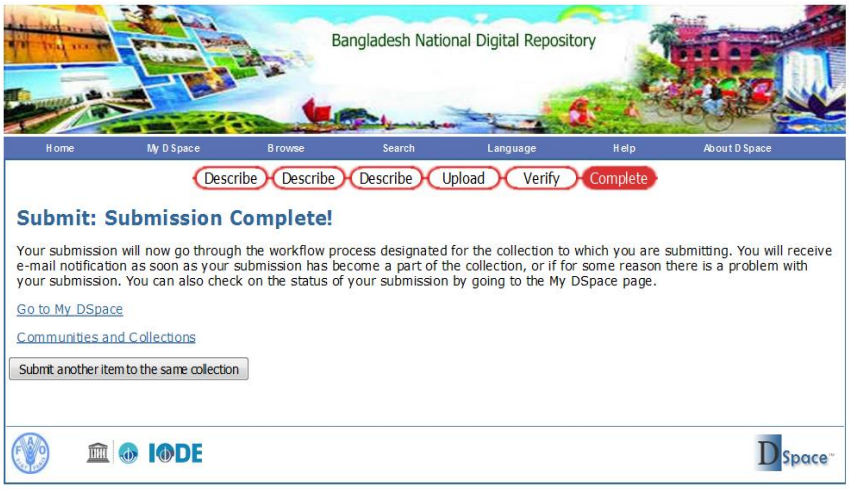
After uploading a file, it is necessary to check the information in the table to make sure it is correct. In that case by clicking 'verify' button, submitter can check all information of the uploaded file and make any change if required.

Figure 5. 21 NDRS item submission - Verify

Submission complete

After successful upload, the content will go through the workflow process designated for the collection. Some collections require editing or review steps while others may immediately accept the submission. Submitter will receive e-mail notification as soon as the item has become a part of the collection. Submitters will also be able to check the status of submission by login to the My DSpace page.

Figure 5. 192 NDRS item submission - Complete



Following the above steps author or designated personal can submit content to NDRS.

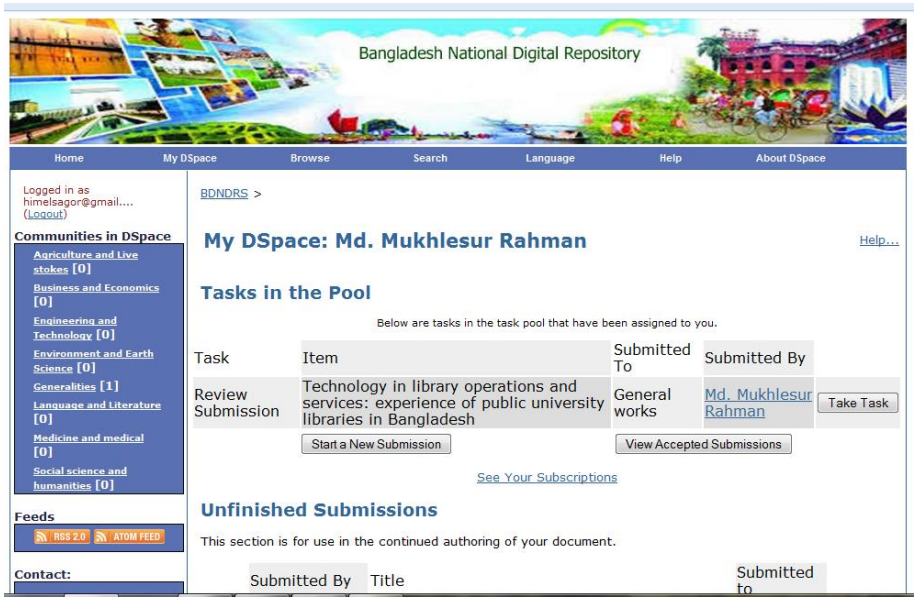
5.6.2 Pre-Acceptance Review

After author's submitting files to NDRS platform, the next step is to review option. All types of submitted work are stored in administrative pool for necessary action. The review activities are mainly conducted by assigned E-people. Following screens describes different stages of review activities involved after user submitting content to NDRS.

Task in the Pool

After login to NDRS with any administrative credential, administrator will see a list of pending jobs that requires action for final approval.

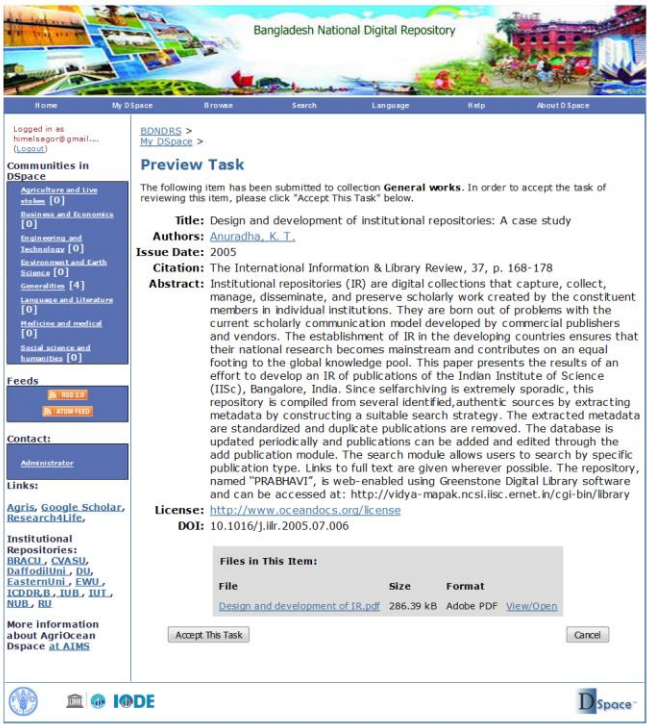
Figure 5. 203 NDRS Task Pool for Review



- Click **Take Task** to start action to any pending submitted item.

Following screen will appear with description of the content for further action. Administrator has the choice to view/open, accept the task or cancel that for the time.

Figure 5. 214 NDRS Task Pool for Review – Preview Task

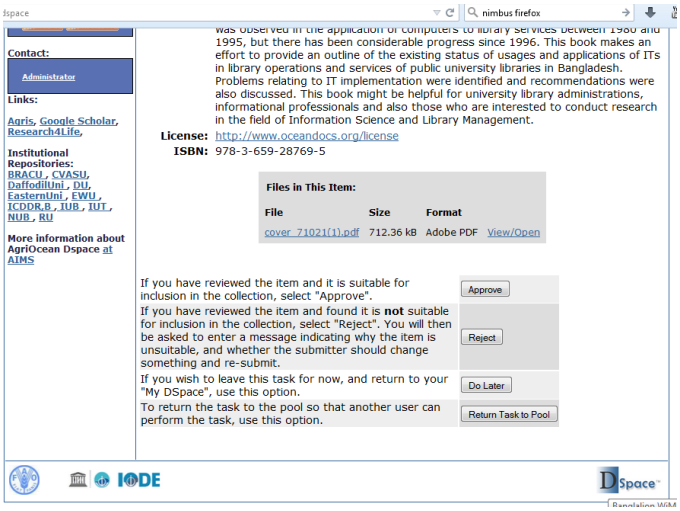


In case the administrator is interested to accept the job click **Accept This Task.**

Figure 5. 225 NDRS Task Pool for Review – Perform Task

In the task pan there are options for Approve, Reject, Do later, Return task to pool. It is required to Accept this task to accept as collection.

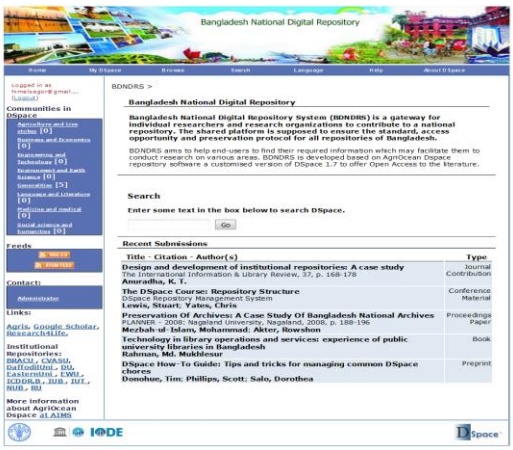
Figure 5. 236 NDRS Task Pool for Review – Commit Task



5.6.3 Collection Management Process

This is the final step of repository management in NDRS. After the acceptance of collection, the responsible staff needs to assign log files, review files and documentation as well as assign Digital Object Identifier (DOI) for each items. After making all the formalities the item goes to live. The Figure 5.27 displays the final layout of NDRS platform.

Figure 5. 247 NDRS Final Layout



Finally, the document will be in main stream of NDRS. Accordingly, anyone will be able to search, browse, read, download of the item.

5.7 Summery

Digital repositories have become an established component in an increasingly complex scholarly communications landscape. There are many reasons behind this trend. First of all, academic institutions are facing budgetary crisis to meet up the ever increasing price of subscribed journal. Secondly, availability of open source repository management software and web 2.0 technologies triggered the use of digital repository. Accordingly, digital repositories are being increasingly deployed in academic institutions to manage a variety of digital content including educational, research, and archival materials. Moreover, digital repositories contribute to increase knowledge sharing, control over the digital assets of the university, and preservation. With this changing trends of scholarly communication, many institutions in Bangladesh are taking advantages of IR for preservation and management of their institution's intellectual output as well as marketing the same. In this case different institutions are adopting IR as per demand and capacity. Many organizations are willing to avail the opportunity but facing shortage of infrastructural facilities meeting the needs. In this regard, NDRS may be a good solution for them. Step by step discussion and implementation process discussed in this chapter will be very helpful for policy makers and administrator. Besides, content submission workflow mentioned in this chapter will be a helpful tool for researcher and scholar to deposit intellectual resources to any open access repository database. Moreover, the policies discussed herewith will be very helpful for IR providing organizations who implemented IR but do not have any formal policy.

Chapter 6: Discussion and Conclusion

6.1 Introduction

6.2 Summary of the Finding

6.3 Development Strategies of NDRS

6.4 Implementation Plan

6.5 Limitation of the Study

6.6 Further Research

6.7 Conclusion

6.1 Introduction

Information and Communication Technology (ICT) brought radical changes to scientific communication. These technologies provide means to publish research output through numerous channels, including non-peer-reviewed sources, fully open access journals and open-access options from printed journals. Researchers must be aware of the trends of scholarly publishing and adapt themselves as much as possible to get maximum benefit from their research output. The use of ICT tools and technology in research and development activities helps to promote research, ensures global standards and other among different research organizations. Researchers must be competent to take advantage of accessing and reaching the global community with the help of ICT. Open access publishing can serve as a tool for knowledge creation, sharing, utilization and a means to advance knowledge at the individual, organizational, and national levels. Open Access to information and knowledge is an innovative mode of scholarly communication within the digital environment aimed at the achievement of universal access to information and knowledge (Das, 2008). Open access to scientific and technical knowledge can help policy-makers, researchers, and government and non-government organizations to access and use relevant documents to accelerate research and sustainable development.

6.2 Summary of the Finding

The study identified many issues regarding the existing scenario of repository management including possibilities of implementing NDRS framework in Bangladesh. Some of the key findings of the study are mentioned below:

Scenario of repository management

One of the basic aim of the study was to identify the present scenario of repository management practice in Bangladesh. Accordingly, the study found that both libraries and individual researchers have different types of intellectual resources. For example, it is found that around 50% users possess journal articles, more than 85% libraries have thesis and dissertation while 82.86% libraries have conference papers and 80% libraries have annual report and other collections. However, in terms of management and dissemination of scholarly output, the situation is not satisfactory. It is identified that a large number of researchers (40%) preserve their research output in personal computers and around 34% researchers disseminate their research output by e-mail to the fellow colleagues and other concern. Majority (48.31%) of the repository management system is done with partially automated and 42.22% organizations manage their repositories through IT Centres. Around 38.89% of librarians are neither satisfied nor dissatisfied with the existing repository management system.

Use and Demand of IR

The study also identified the use and demand of IR in the view of scholars and library administrators. The summery of the finding revealed that 38.68% and 29.72% researchers have strong and very strong ideas respectively about the scope and opportunities of IR. Moreover, 48.31% researchers think having IR in their respective organizations is very important. Accordingly, more than 83% researchers like to preserve their research output in their respective IR. Most of the users (59.91%)

strongly agree that with the help of IR archiving of their scholarly resources will be very easy. At the same time, only 40% respondents are moderately concern about the copyright implication while depositing their research content to other digital storage and re-distribution media. However, for more people oriented services more than 50% respondents agreed on publicizing the benefits of IR to other concerned scholars, beneficiary and other stockholders whereas 49.29% users agreed for advocating university/organization in initiating IR in their respective organizations.

Problems and Prospects of IR

Being a developing country the educational infrastructure of Bangladesh is not very strong. Hence, it is difficult to initiate and implement sophisticate technology by a single hand. Though the infrastructural development in different sectors is growing rapidly, the education section sector is not so rich in using technology. Establishing IR services requires both infrastructure and human support. But most of the case these support is unavailable. In some cases, negligence and lack of administrative cooperation is acute for establishing web-based repository management services. The summery of the study identified that 44% library head suffers lack of IT support stuff is the most challenging factor for establishing IR in Bangladesh. In addition, 45.71% library heads think ‘inadequate financial support’ and ‘inappropriate infrastructure facilities’ hinders IR development in their respective organizations. Besides, 45.71% library heads think ‘inappropriate infrastructure facilities’ is obstacle for establishing IR. However, it is matter of hope that almost three forth i.e. 71% libraries are very much hopeful to establish IR in their organization. Accordingly, it may be expected that though there are a lot of difficulties at this moment, the prospects of IR is very high in Bangladesh.

Needs of NDRS

The study tried to identify the need of NDRS in the view of researcher and library professionals. It is found that most of the librarian/library in-charges (68%) think that NDRS is very important for Bangladesh. Besides, more than 77% librarians/library in-charges assume that NDRS will be very useful for their organizations. Most of the librarians/library in-charges (69%) are strongly in-favour of joining NDRS framework. The study also required suggestion for making the NDRS success. It is identified that most of the librarians are strongly agreed for 'Awareness-raising campaign(s) among academicians' and 'Training on using and managing repository' which is 83.33% and 61.11% respectively. Most of the library heads and researchers strongly believe that NDRS will maximise the visibility, usage and impact of the their research output by maximising online access to it for all would be users and researchers worldwide.

From the above discussion, it is very clear that with the changing pattern of global scholarly communication process, Bangladeshi scholars and information providers are adopting and diverting their traditional intellectual output management system to new technological ground. Once only printed journal article is leaving way for online and open access journal platform. Now libraries and information centre are not confined to only printed journal rather subscribing digital content. Researchers are also publishing their research output to open access journal hoping to reach much global audience. Accordingly, many organizations in Bangladesh implemented IR services in their respective organization while a lot of other organizations are in pipeline to implement the same. But as a common barriers prevailing in other developing countries, the infrastructural facilities of many organization is very inadequate for establishing IR. Unavailability of adequate qualified human resources is also a major concern.

As technology is always changing leaving traditional one for new, up-to-date and more advance opportunities, information management is now very easy than ever before. Many countries implemented multi-institutional repository management services for providing more advanced services aiming to reduce cost and save user time and energy. Bangladesh should implement such initiative. Establishment of NDRS not only save user time and energy but also ensure quality. Many organizations who have no adequate infrastructural facilities to implement and manage IR, can easily submit and preserve their intellectual output to the national repository platform.

6.3 Development Strategies of NDRS

For the smooth functioning and maximum benefit from NDRS the study recommended following strategies.

6.3.1 Training

Training is one of the most important function for making the NDRS a success. The training may be required for both researcher and administrator. The administrator may include library personnel including IT professional who mainly deal institutional liaison for submitting institutional content and guiding individual researchers. The researcher may be required training on various issues of submitting content to NDRS. Moreover, training may be arranged for motivating researcher to submit content to NDRS.

6.3.2 Connecting to existing IRs

NDRS is considered as the aggregation of individual IRs. In this regard, all existing IRs should be inter-connected with NDRS. However, if any organization like to main its own IR, they will be allowed to do so. But a copy of content should be submitted to the NDRS. Accordingly, Memorandum of Understanding (MoU) should be signed with all existing IR providers to submit their content to NDRS so that information seekers can get all types of available content scattered in different sources in a single search interface. This initiative will save user time and energy a lot.

6.3.3 Authentication of Content

As NDRS is an open access repository platform the content authentication is very important. The content of NDRS may be authenticate in two ways. It may be either by organization level for the submitters involved in any organization or by individual user level who are not involved with any organizations but have research content. To ensure authentication organizations should designate one of its officers as organization coordinator for NDRS. The designated person will check the authenticity of the content. After necessary verification the concerned official will submit the content to NDRS framework. In the case of thesis/dissertation the concerned official may take help from the research supervisor of the thesis to verify or certify that the student has submitted complete, correct and verified version of thesis. For individual contributors who are not involved with any organizations may directly submit content to NDRS framework. In this case concerned official of NDRS will check and verify the content and approve/reject on the basis of legitimate ground.

6.3.4 Promotion and Advocacy

Content development and popularizing is the most challenging factor for sustaining NDRS. Different level of initiatives must be taken for making the NDRS well-resourced and popular. Accordingly, following strategies may be followed for promoting NDRS:

I. Representatives from each department, schools, universities and organizations should be appointed to demonstrate various facilities of NDRS and to encourage researchers and other concerned to submit content to NDRS platform.

II. As some journals do not allow re-distribution of content to other open access platform, scholars should be encouraged to submit pre-prints before submitting any peer reviewed journals.

III. Functions of NDRS should address the needs and working patterns of researchers. Functional overview should be made as easy as possible for them to contribute. Besides, step-by-step demonstration is strongly required.

IV. There should be set up a project web site that will link different IRs and various features of NDRS. This can act as a focus for developments and news.

V. To develop public awareness regarding NDRS and to promote NDRS facilities and services, postering and other advertising may be initiated through university magazines, newsletter, electronic and print media, the distribution of literature about the value of IR, and presenting at departmental meetings and university committees etc.

6.4 Implementation Plan

Implementation of NDRS is a major concern for various reasons. In general, individual IRs is mainly implemented by the concerned organizations. But, as the NDRS is not confined to any individual organizatrions or group of organizations government should take the initiatives. However, considering the benefit of a central NDRS any of the following organizations/affiliated body can take the responsibility.

- ***Under UGC Consortium***

University Grants Commission (UGC) of Bangladesh is the custodian of all public universities in Bangladesh. UGC provides guidelines and financial allocations to run public universities smoothly. At the same time though private universities do not get any financial support from UGC, they are supposed to follow the rules and guidelines proposed by UGC. International universities are administered and managed by international cooperation bodies, but they are also bound to follow UGC rules. Hence, UGC is the main accrediting body to monitor and promote all types of educational and other research and development activities of all public, private and international universities. Hence, any initiative undertaken by UGC is highly acceptable for all higher educational institutions in Bangladesh. In this regard, if UGC sponsor NDRS and form a consortium for administering and managing NDRS under the umbrella of UGC, all types of educational institutions will join the platform which will help to share and promote research activities in Bangladesh and build NDRS a great success.

- ***National Library***

National library serves as a bibliographic hub of all intellectual publications of any country. In Bangladesh, the National Library of Bangladesh (NLB) is serving as the legal depository of all new books and other printed materials published in Bangladesh under the copyright law of Bangladesh. NBL aims to develop and maintain a comprehensive national collection, to ascertain equitable access of citizen to that collection in view of enhancing learning capacity and total competitive power of the nation as a whole in addition to collect and preserve the intellectual creative printed materials. In this regard, if NDRS is formed under the platform of National Library of Bangladesh, it will be more sustainable in terms of access and management.

- ***Ministry of Education***

The Ministry of Education (MoED) is the ministry responsible for secondary, vocational and tertiary education in Bangladesh. MoED also serve to promote education in the country. In this regards, MoED can take initiatives to set up and development of NDRS for Bangladesh.

- ***Any government/non-government organizations/agencies.***

Many government agencies in Bangladesh are working to accelerate living standard and other facilities to meet up the demands of technological advancement. Besides, many Non-Government Organizations (NGOs) and developing agencies are working to foster the socio-economic development of Bangladesh. They are initiating many new services to promote education, preserving cultural heritage and developing intellectual communication among the scholars and policy makers. NGOs are taking many initiatives in the field of agriculture, poverty alleviation, environment, health and population, education. The NGOs have concentrated their efforts on eradicating illiteracy through functional education. NDRS may be formed and developed under the custody of any government, NGOs or developing agencies.

6.5 Limitations of the Study

While completing the research work, the researcher identified some limitations which are as follows:

Firstly, the research is done through sampling of the universities situated in Dhaka city. Representation of universities is below 50% comparing to number of universities in Bangladesh. More representation would give better reliability of the research.

Secondly, many new universities were established after 2013. Some of the universities are running smoothly with adequate infrastructural facilities. But those newly established universities were not considered in the study.

Thirdly, many literatures on the topic were available in several databases which were not accessible freely. Availability and access to those literatures may help to produce more enriched research foundation.

Fourthly, reaching to library users particularly the faculty members was difficult. Faculty members are well informed about IR and their remarks regarding IR is highly valuable. More participation from faculty member may produce better output.

Fifthly, some users were not fully aware about IR while answering the questions. But, their response reflected on count and average.

6.6 Scope of future works

The proposed model linked the existing IR with its interface. Information seekers have to go through in each individual IR site to search or browse resources available at each IR. Sometimes it is very time consuming. Besides, users may not know the content disciplines of IRs of different organizations. Integrating Federated search with the NDRS search interface would reduce time and effort for searching information from multiple IRs. In this regard, further research may be conducted on implementing Federated search in NDRS search interface.

6.7 Conclusion

ICT facilities and services are increasing rapidly in Bangladesh. These technologies have been using in research and development activities for promoting research, ensuring global standards and developing competitions among different research organizations. Government already influencing to get maximum benefit from using technologies in all spheres of life. Accordingly, "Different initiatives for reducing the digital divide have already been taken and a number of institutions have established their network to work on it" (Islam & Tsuji, 2011). Open access repository is an essential tool for end-users to find their required information to accelerate research on various national interests. Besides, an open access repository platform may help policy makers and analysts, academicians, training institutions, researchers and government and non-government organizations to know which research is already done in a particular topic, where to get the output or whom to contact. Users will be also able to search, browse and download full text report free of cost. Moreover, by collaboration with leading online search engines viz. Google and Google Scholar, National Digital Repository System will increase the international visibility of research originating from Bangladesh. Open access to scientific literature will increase h-index of a scientist or scholar. It will also reflect the aggregated research output of all fields of the country. National Digital Repository System for Bangladesh will act as a focal point for Research and Development (RD) as well as scholarly activities in Bangladesh.

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Date:

To

Subject: **Research Questionnaire**

Dear Sir/Madam,

Greetings.

This is Md. Mukhlesur Rahman, a Ph.D. student in the Department of Information Science and Library Management, University of Dhaka, Bangladesh. I am doing research on "**Design and Development of a National Digital Repository System (NDRS) for Bangladesh**". The proposed research aims to develop a national digital repository platform which will serve as gateway for intellectual community to search, browse, preserve and contribute scholarly output in a single interface to foster further research and development.

This research requires data from the users and Librarian/Library In-Charge of different organizations in Bangladesh. I believe, this task will remain inconclusive without your significance help and assistance. Your cooperation is highly expected in pursuing this research work.

Your kind completion of the enclosed questionnaire for the above purpose will be highly appreciated. The response provided by you will be used only for research purpose and kept confidential.

Thank you very much for your kind cooperation in advance.

Yours Sincerely,

Md. Mukhlesur Rahman
Ph.D. Student
Cell: 01819517595
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Supervisor:

Professor Muhammad Mezbah-ul-Islam, P*h.D.*
Professor
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User Survey on Institutional Repository (IR) for Managing Digital Resources

Dear Sir/Madam,

Greetings.

*This is Md. Mukhlesur Rahman, a PhD student in the Department of Information Science and Library Management, University of Dhaka undertaking a research on "**Towards building up a framework for National Digital Repository System (NDRS) in Bangladesh**" under the supervision of Dr. Muhammad Mezbah-ul-Islam, Professor, Department of Information Science and Library Management, University of Dhaka.*

*An **Institutional Repository (IR)** is an online archive for collecting, preserving, and disseminating digital copies of the scholarly output created by faculty members, scholars, students and other concerned of an institution, particularly a higher education/research organization. IR benefits researchers, institutions, nations and society as a whole by increasing visibility, usage and impact for research work.*

In order to get comprehensive knowledge on the understanding and needs of Institutional Repository from the users' side, I need your cooperation in pursuing this research work. May I request you to spare me some of your valuable time in undertaking the questionnaire. Your response will be used for assessing User's view regarding developing a framework for NDRS in Bangladesh.

Thanking you for your cooperation.

Background Information

1. **Your organization:** _____

2. **You are:**
   - o Faculty
   - o Research Scholars
   - o Professional
   - o Student
   - o Other (Please specify) _____

3. **Scholarly materials created by you-** *[Select all that apply]*

☐ Journal Article	☐ Primary datasets	☐ Annual report
☐ Book chapter	☐ Image	☐ News clipping
☐ Theses/Dissertation	☐ Video	☐ Teaching material
☐ Conference paper	☐ Music	☐ Course catalogue
☐ Working paper	☐ Map	☐ Other

4. **How do you preserve your publication?** *[Please mark all that apply]*
   - ☐ Take a print out
   - ☐ Store soft copy in your PC
   - ☐ Store in your Institutional Repository
   - ☐ Store personal CD
   - ☐ Do not preserve
   - ☐ Not sure

5. **How do you disseminate/share your research output to other group/peers/end-users?** *[Select all that apply]*

☐ E-mail network	☐ Personal blog
☐ Using social media	☐ Micro blog
☐ Communities' website	☐ Personal website
☐ Affiliate's Website	☐ Other (please specify)----------

IR for Managing Digital Resources

6. **What is your idea about IR?** *[Select one]*

Very Strong ○ Strong ○ Moderate ○ Poor ○ Very Poor ○

7. **Important to have IR in your organization-** *[Select one]*

Extremely Important ○ Very Important ○ Important ○ Less Important ○ No Important ○

8. **Would you like to preserve your research output at IR?** *[Select one]*
   - ○ Yes
   - ○ No

9. **How much you concern about copyright law?** *[Select one]*
   - ○ Very concern
   - ○ Moderately concern
   - ○ Do not know
   - ○ Poor concern
   - ○ No concern

10. **State your perceived benefits of depositing research output to IR?**

[Please state Strongly Agree (SA), Agree (Ag), Neutral (Ne), Disagree (DA), Strongly Disagree (SD)]

	SA	Ag	Ne	DA	SD
Archiving will be easy	○	○	○	○	○
Citation will be increased	○	○	○	○	○
Encourage open access	○	○	○	○	○
Enhance university prestige/reputation	○	○	○	○	○
Ensure cost saving	○	○	○	○	○
Ensure enhanced-access	○	○	○	○	○
Ensure long term preservation	○	○	○	○	○
Increase visibility and citations for the publications	○	○	○	○	○
New service to learning community	○	○	○	○	○
Promote scholarly communication	○	○	○	○	○
Reduce time between discovery and dissemination	○	○	○	○	○
Reduce user dependency on library	○	○	○	○	○

11. **Suggestion for promoting IR.** *[Select one from each raw]*

[Please state Strongly Agree (SA), Agree (Ag), Neutral (Ne), Disagree (DA), Strongly Disagree (SD)]

	SA	Ag	Ne	DA	SD
Awareness-raising campaign(s) among academicians	○	○	○	○	○
Advocating University/organization in establishing IR	○	○	○	○	○
Promotional activities should be increased	○	○	○	○	○
Publicizing the benefit of IR	○	○	○	○	○
Coordination IR and departments should be increased	○	○	○	○	○
IR staff should act as liaison between depositor and IR	○	○	○	○	○
Training on using and managing repository	○	○	○	○	○

12. **Any other suggestion/comments regarding how author can ensure access, preservation and dissemination of research output?**

Thank you very much for your response

Towards Design and Development of a National Digital Repository System (NDRS) for Bangladesh

Questionnaire for Librarians/Library In-Charge

Please spare me some of your valuable time in undertaking the questionnaire. Your response will be used for assessing Librarian's view regarding a framework for NDRS in Bangladesh.

Organizational Background

1. **Name of your Organization:** ☐
2. **Year of establishment:** (a) Organization ☐ (b) Library ☐
3. **Nature of your Organization:** ☐ Public ☐ Private ☐ Autonomous ☐ NGO ☐ Other (please specify):
4. **Does your library have own server(s)?** ☐ Yes ☐ No If yes, how many: ☐
5. **Your Library is:** ☐ Fully automated ☐ Partially automated ☐ Hybrid ☐ Manual ☐ Other
6. **Does your library have digital archives?** ☐ Yes ☐ No
7. **Number LIS professional in your library**: ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21 or more
8. **Number personnel having IT degree:** ☐ None ☐ 1-2 ☐ 3-5 ☐ 6 or more

Scenario of Repository Management

[A repository is a collection of institutional records, intellectual output and other resources created by members of any institution to support research, learning, and administrative processes.]

9. **What types of REPOSITORY RESOURCES are available in your institution?** *[Select all that apply]*

☐ Journal Articles	☐ Primary datasets	☐ Annual reports
☐ Books/ book chapters	☐ Images	☐ News clippings
☐ Theses/Dissertation	☐ Videos	☐ Teaching materials
☐ Proceedings	☐ Music	☐ Course catalogues
☐ Working papers	☐ Maps	☐ Other

10. **Subject coverage of REPOSITORY RESOURCES:** *[Select all that apply]*

☐ Agriculture and Live stokes	☐ Medicine and medical sciences
☐ Business and Economics	☐ Pure Sciences
☐ Engineering and Technology	☐ Social science and humanities
☐ Environment and Earth Science	☐ Other
☐ Language and Literature	☐

11. **Your institution's repository system is managed by:** *[Select all that apply]*
    - ☐ Library
    - ☐ IT Centre
    - ☐ Concerned department
    - ☐ Concerned faculty members
    - ☐ Others

12. Repository Management system is: *[Select only one]*

- o Fully automated
- o Partially automated
- o Hybrid
- o Manually
- o Other

13. Your level of SATISFACTION in present Repository Management system is: *[Select only one]*

Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
○	○	○	○	○

Existing Institutional Repository (IR)

[An Institutional Repository (IR) is a tool for collecting, preserving, and disseminating digital copies of the scholarly output created by students, faculty members, scholars, researchers, scientists and other concerned body affiliated to any institution, particularly a research institution.]

14. Does your library have IR?

- o Yes
- o No

[If yes, answer questions no 15-19. If no, answer question no 20-21]

15. Year of commencement- ☐

16. URL- _____

17. Your IR is-

- o Active
- o Inactive
- o Other (Please specify) _____

18. Software used-

- o DSPace
- o E-Print
- o GreenStone
- o Fedora
- o Other (Please specify) _____

***19.* ISSUES used to tackle in IR?** *[Select all that apply]*

- ☐ Lack of interest from the depositor
- ☐ Lack of intellectual resources
- ☐ Copyright issues of parent publisher
- ☐ Lack of institutional policy for mandatory depositing
- ☐ Maintenance problem/staff shortage
- ☐ Resource security issues
- ☐ Intellectual property law
- ☐ Bureaucracy in decision making
- ☐ Lack of cooperation between library and departments

20. Do you have any plan to establishing IR in

- o Yes
- o No

21. **If no, what are the CONSTRAINTS for establishing IR?** *[Select all that apply]*

- ☐ Inadequate financial support
- ☐ Inappropriate infrastructure facilities
- ☐ Lack of reliable software packages
- ☐ Lack of IT support stuff
- ☐ Lack of initiatives
- ☐ Lack of interest of the decision makers
- ☐ There is no official policy
- ☐ Administrative complexities
- ☐ Fear of loss of autonomy
- ☐ Other

Needs of NDRS

[NDRS is a multi-institutional repository framework that is supposed to serve as hub of digital repository to preserve, promote, disseminate and manage digital content, intellectual output and creative commons]

22. How IMPORTANT it is to have NDRS in Bangladesh? *[Select only one]*

- o Very Important
- o Slightly Important
- o Somewhat Important
- o Neutral
- o Not at all Important

23. USEFULNESS of NDRS for your organization? *[Select only one]*

- o Very useful
- o Slightly useful
- o Somewhat useful
- o Neutral
- o Not at all useful

24. Your REMARKS to join NDRS framework? *[Select only one]*

- o Strongly in-favour
- o Slightly in-favour
- o Neutral
- o Slightly against
- o Strongly against

25. BENEFITS of your organization for joining NDRS framework? *[Select one from each raw]*

[Please state Strongly Agree (SA), Agree (Ag), Neutral (Ne), Disagree (DA), Strongly Disagree (SD)]

Benefits	SA	Ag	Ne	DA	SD
Archiving will be easy	○	○	○	○	○
Encourage open access	○	○	○	○	○
Enhance university prestige/reputation	○	○	○	○	○
Ensure cost saving	○	○	○	○	○
Ensure enhanced-access	○	○	○	○	○
Ensure long term preservation	○	○	○	○	○
Increase visibility and citations for the publications	○	○	○	○	○
New service to learning community	○	○	○	○	○
Promote scholarly communication	○	○	○	○	○
Reduce time between discovery and dissemination	○	○	○	○	○
Reduce user dependency on library	○	○	○	○	○

Policies & Issues of NDRS

26. **POLICIES should be incorporated in NDRS framework:** *[Select one from each raw]*

[Please state Strongly Agree (SA), Agree (Ag), Neutral (Ne), Disagree (DA), Strongly Disagree (SD)]

Policies	SA	Ag	Ne	DA	SD
Coordination policy	○	○	○	○	○
Policy to safeguard the long-term preservation	○	○	○	○	○
Policy of depositing materials	○	○	○	○	○
Content policy	○	○	○	○	○
Copyright policy	○	○	○	○	○
Submission policy	○	○	○	○	○
Licensing policy	○	○	○	○	○
Access management policy	○	○	○	○	○

27. DEPOSITING POLICY should be followed in NDRS framework? *[Select only one]*

- ○ Mandatory depositing
- ○ Partly mandatory depositing
- ○ Voluntarily depositing with strong encouragement
- ○ Voluntarily depositing
- ○ Other

28. Your SUGGESTION for promoting NDRS framework? *[Select one from each raw]*

[Please state Strongly Agree (SA), Agree (Ag), Neutral (Ne), Disagree (DA), Strongly Disagree (SD)]

Suggestions	SA	Ag	Ne	DA	SD
Awareness-raising campaign(s) among academicians	○	○	○	○	○
Advocating University administration to join and contribute to NDRS	○	○	○	○	○
Publicizing benefits of joining NDRS	○	○	○	○	○
Organization's infrastructure should be given priority	○	○	○	○	○
IR should be integrated/linked with NDRS	○	○	○	○	○
Mandatory joining for all universities/higher education institutions	○	○	○	○	○
NDRS should be run under the umbrella of UGC/Govt. apex body	○	○	○	○	○
Unique metadata standard should be formed	○	○	○	○	○
Training on using and managing repository	○	○	○	○	○

29. If you have any other SUGGESTION/COMMENT regarding NDRS please mention below:

_____

_____

_____

_____

_____

_____

_____

Thank you very much for your time and help.

Appendix 3: Installation

Detailed steps of Installation of Agri-Ocean DSpace for building National Digital Repository System in Windows platform.

1. **Installation JAVA JRE (jre-8u73-windows-i586.exe)**

   - Click the .exe file and followed the installation instruction and click **Install**.

Java Standard Edition-Setup

Java Setup - Progress

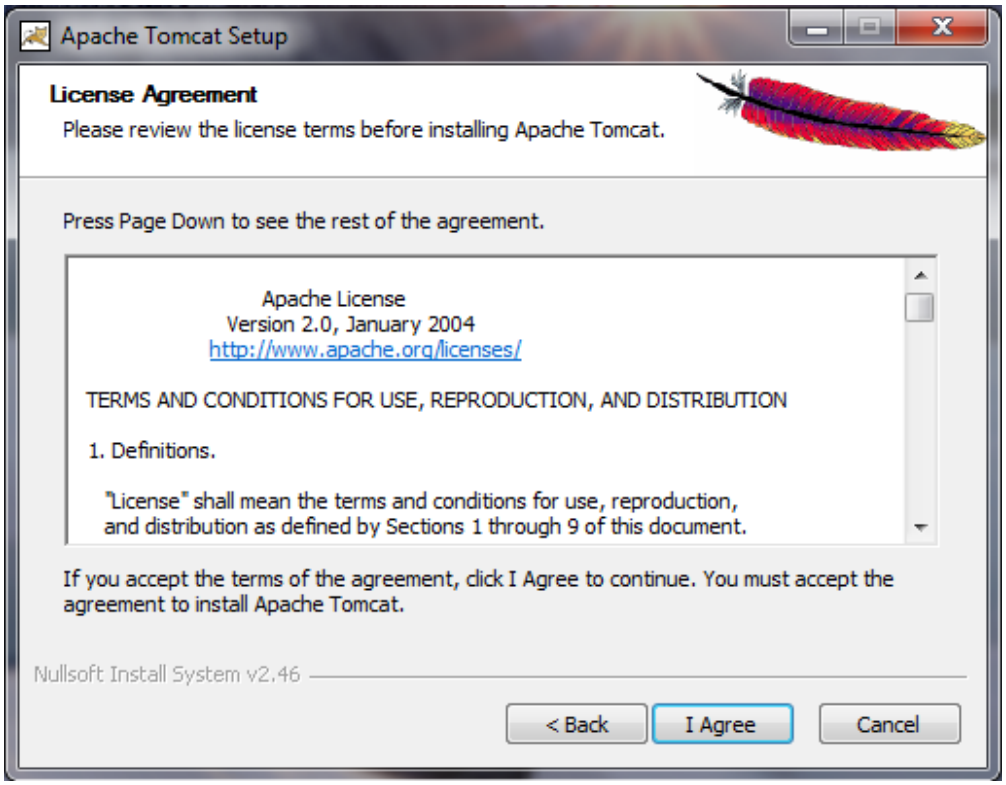
Java Setup - Complete

2. Installation of Apache Tomcat

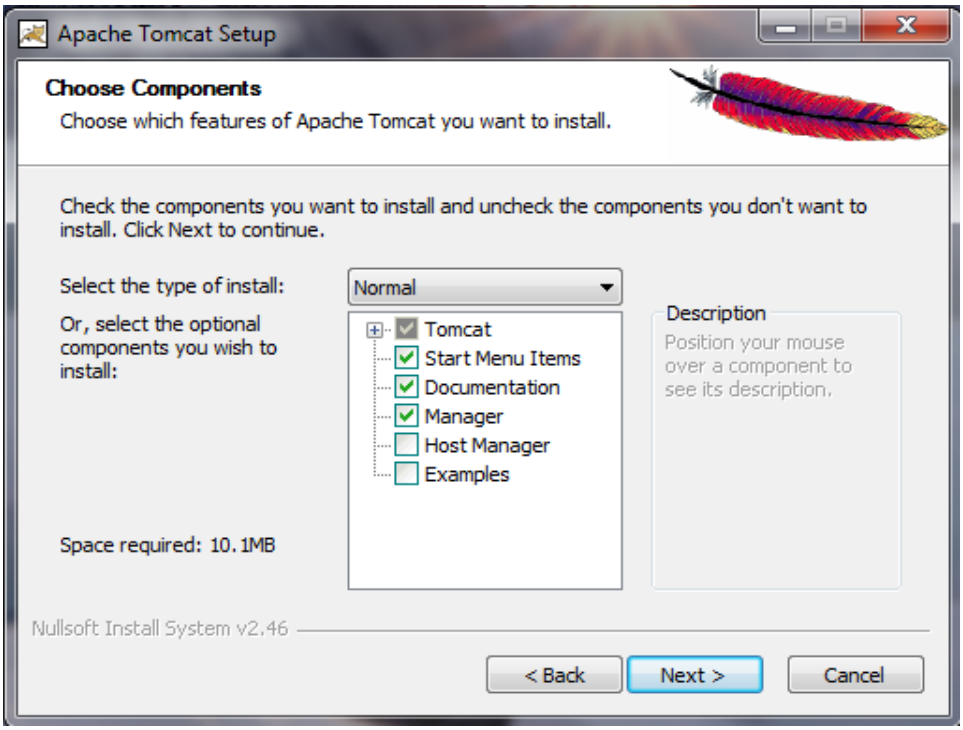
- Click the **apache-tomcat-7.0.68.exe**

Apache Tomcat Setup Wizard

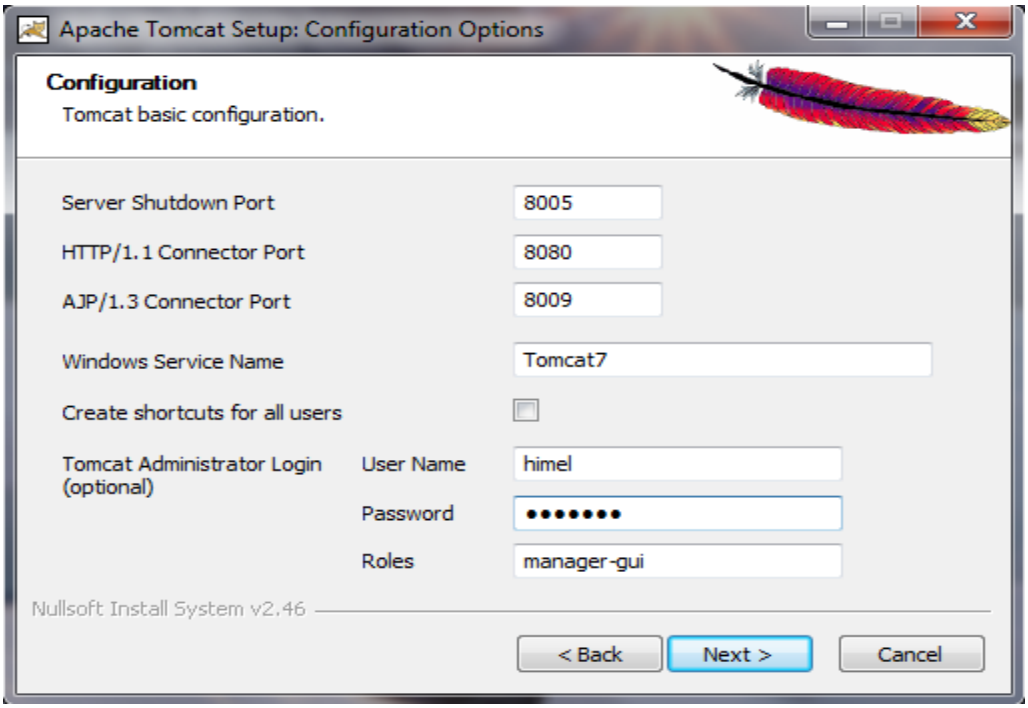
Apache Tomcat License Agreement



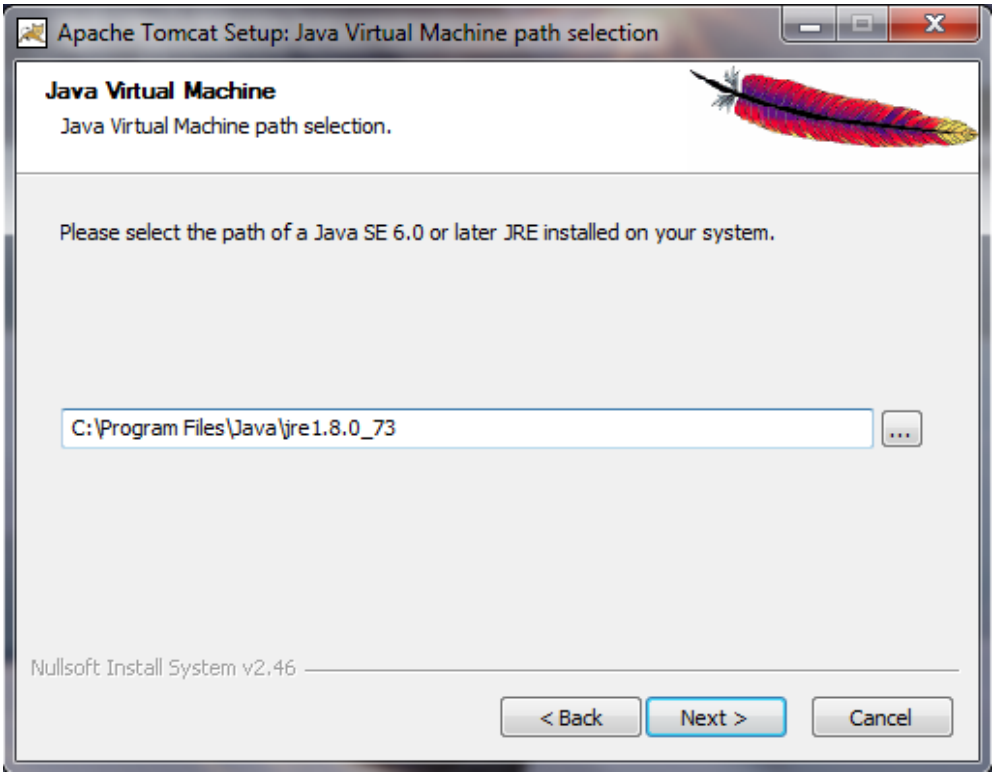
Apache Tomcat customize feature setup



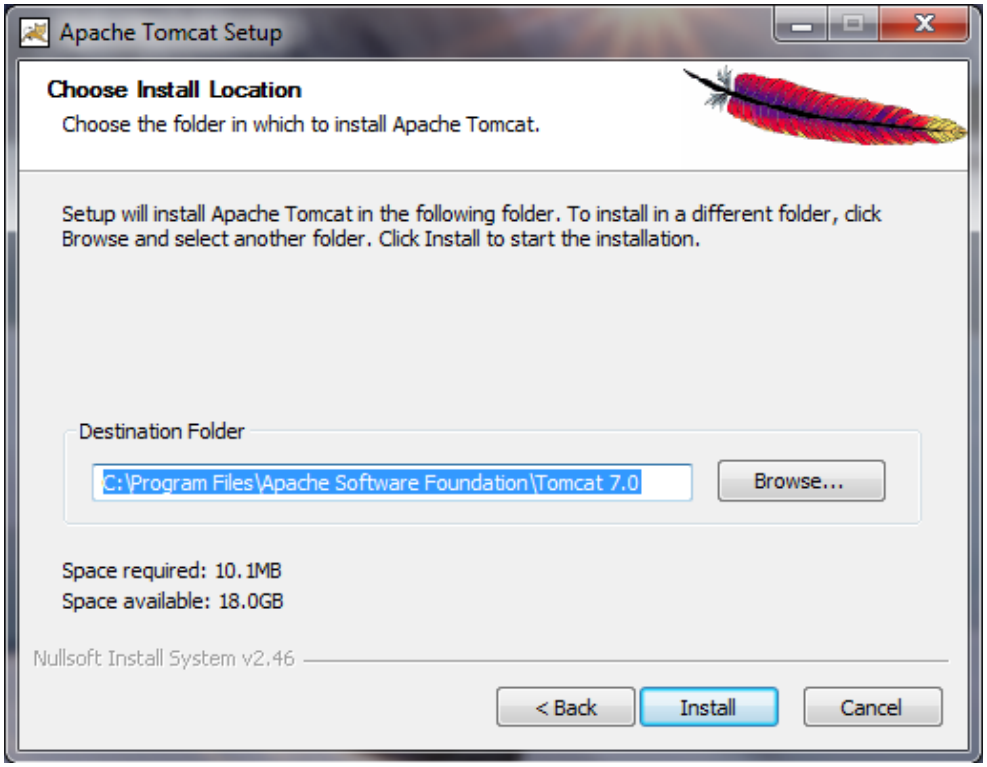
Apache Tomcat configuration



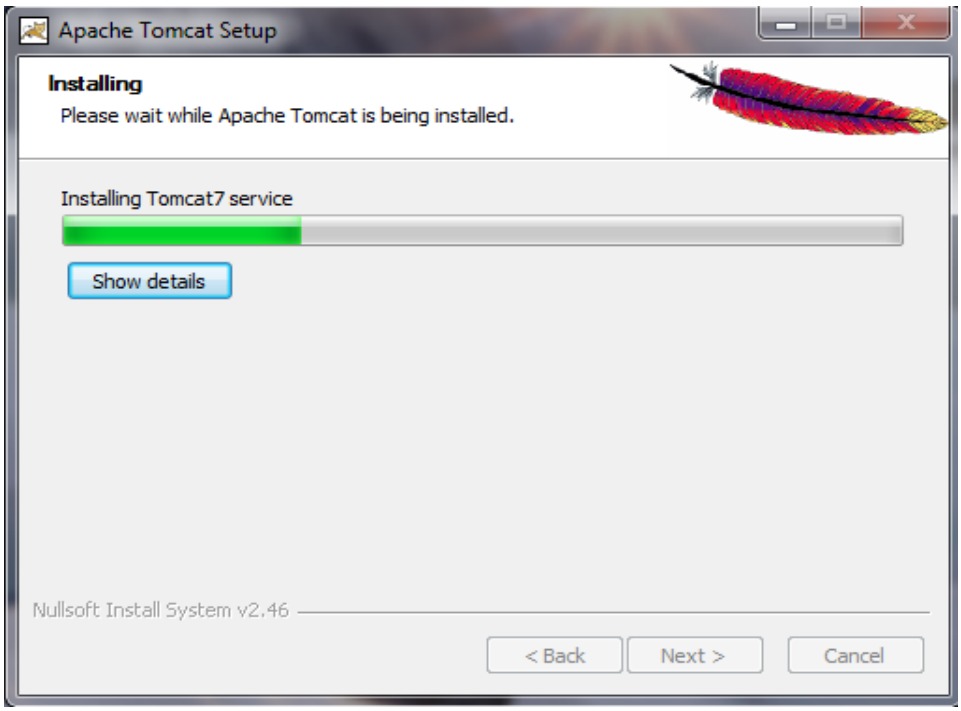
Apache Tomcat Java virtual path selection



Apache Tomcat destination folder selection



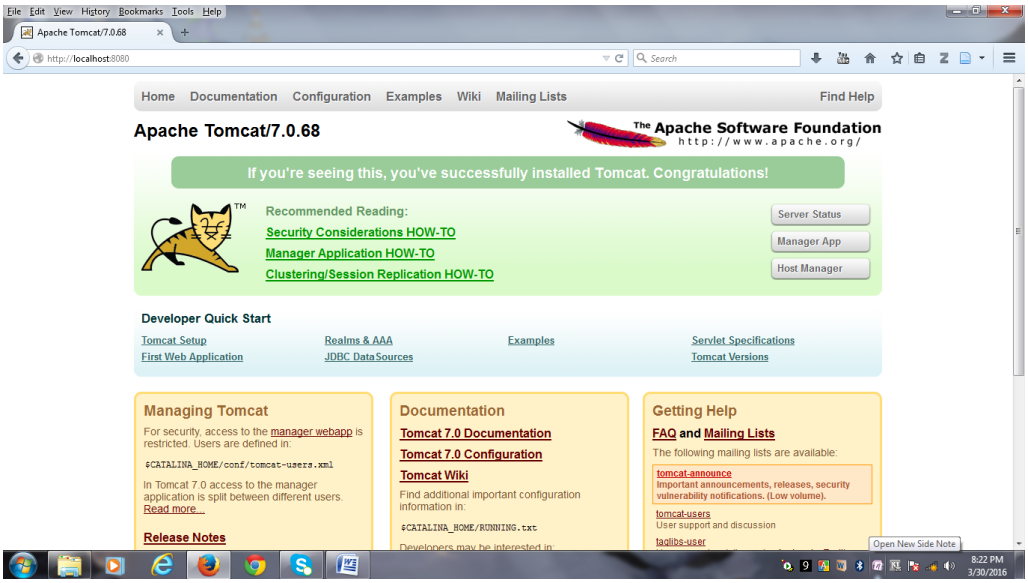
Apache Tomcat Installation progress



Apache Tomcat Installation Complete

After following the above step by step Apache installation process it is required to check whether Apache is properly installed or not. To check the installation of Apache, it is required to use the default address i.e. http://localhost:8080 in web browser. After running the command the following screen shows that web server is running well.

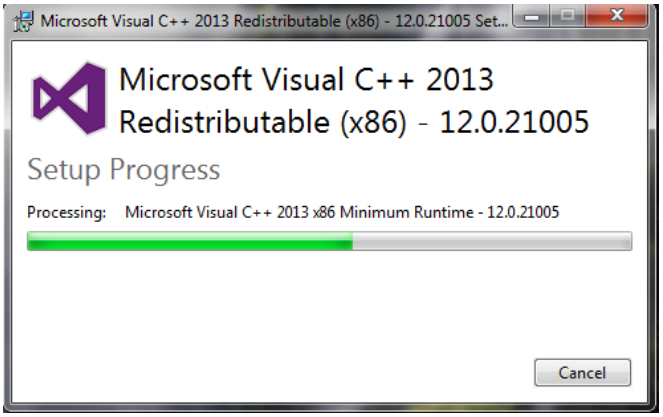
Apache Tomcat home screen



3. Installation of PostgreSQL Database

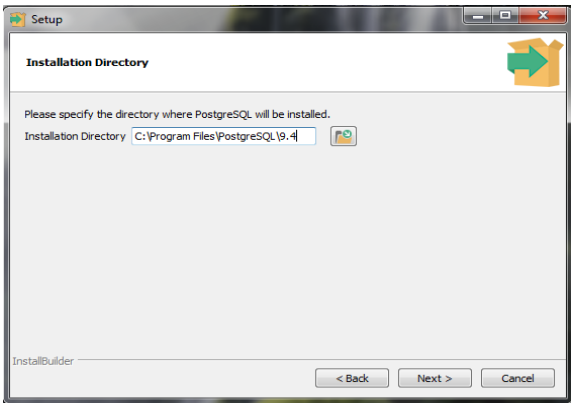
- Click the **postgresql-9.4.6-1-windows.exe**

Microsoft Visual C++ 2013x 86 installations

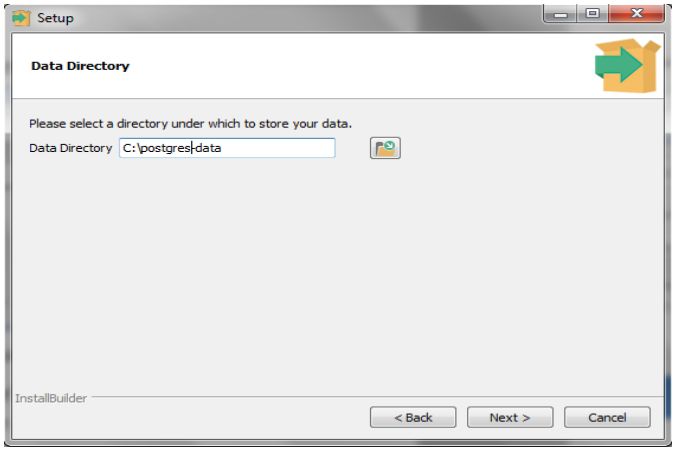


PostgreSQL Setup Wizard

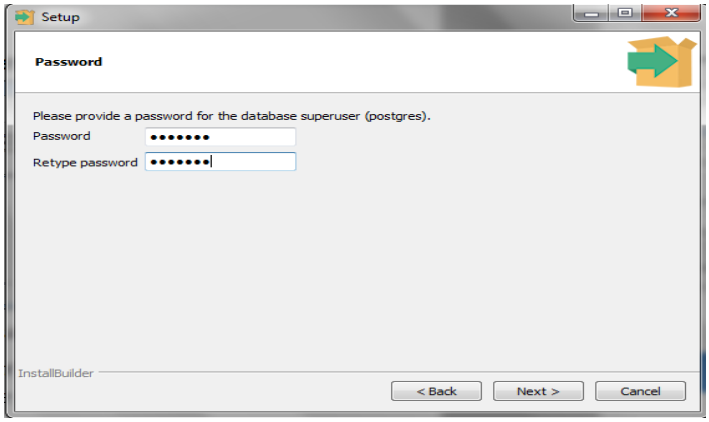
PostgreSQL Installation Directory



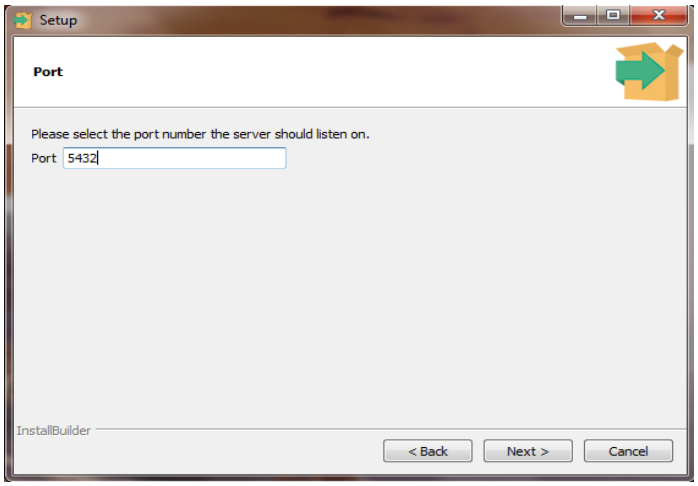
PostgreSQL Data Directory



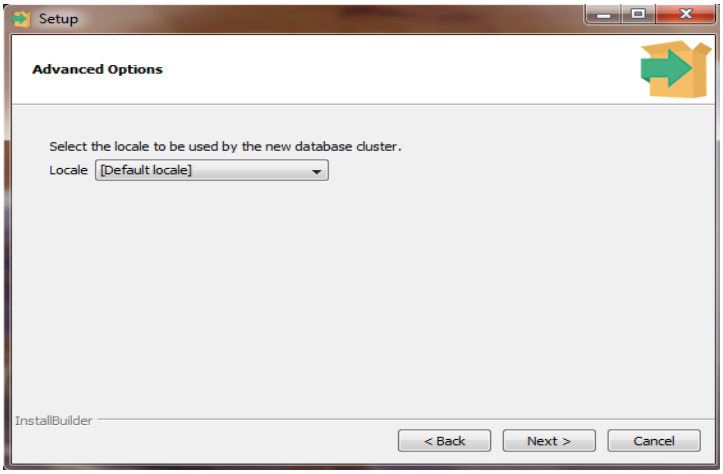
PostgreSQL Super User and Password Setup



PostgreSQL Port Selection



PostgreSQL Advance Option (Optional)



PostgreSQL Ready to Install

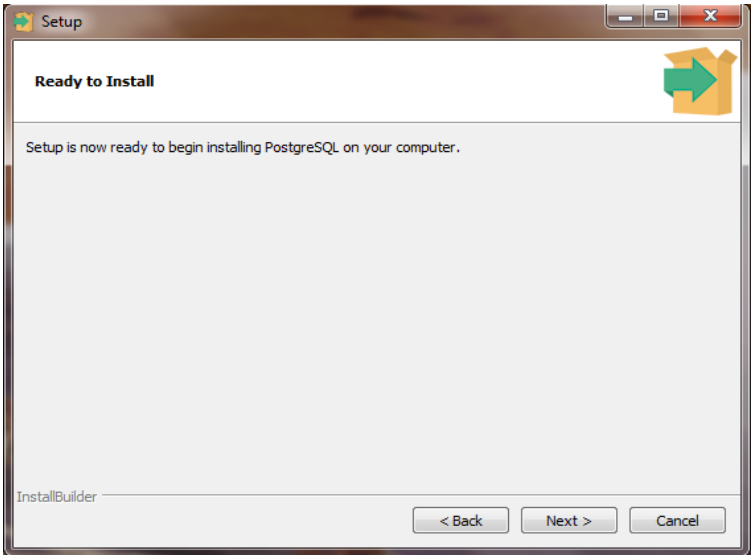
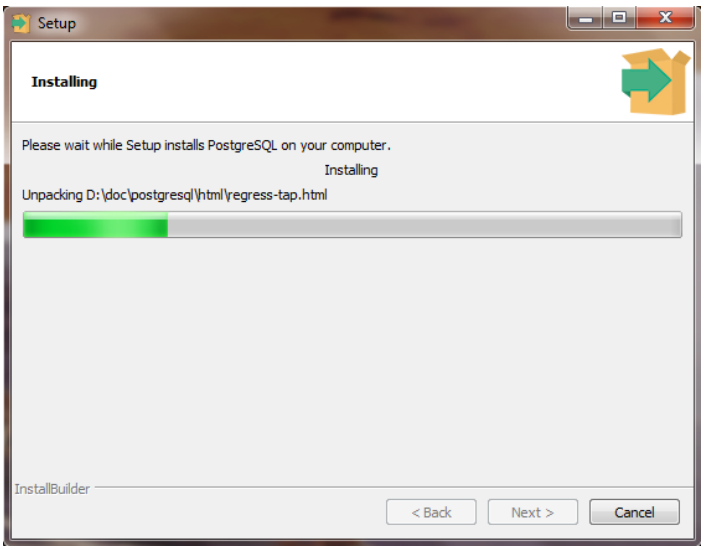
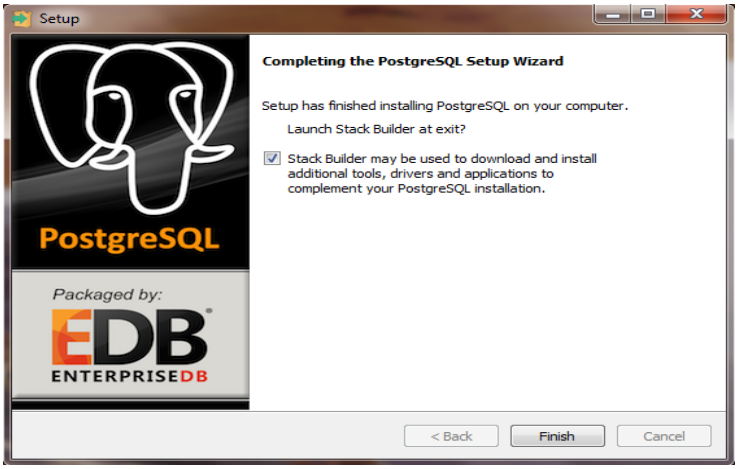


Figure 5. 1: PostgreSQL Installation Progress



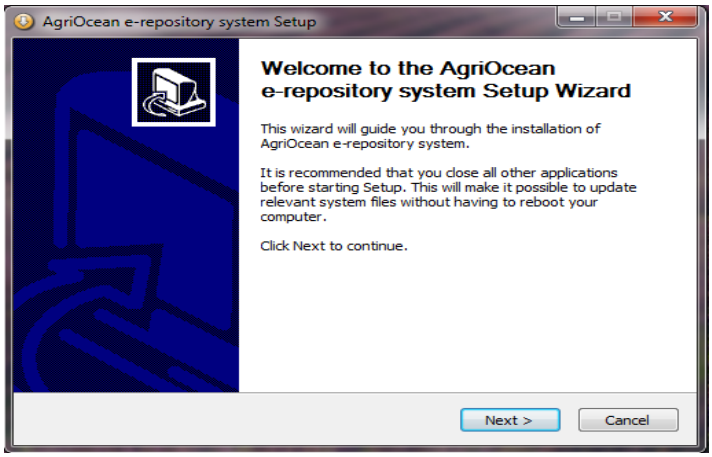
PostgreSQL Installation Complete



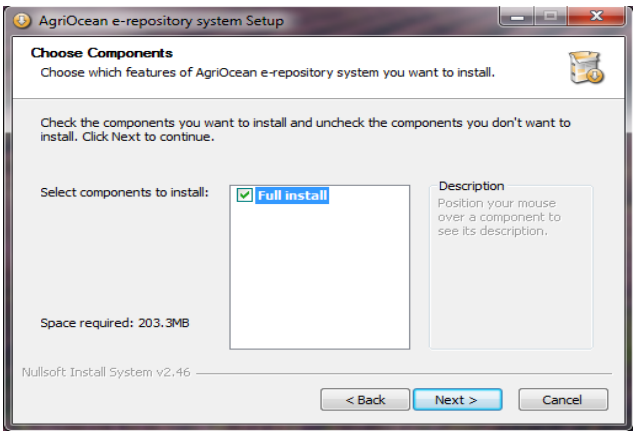
4. Installation of AgriOcean DSpace

- Click the **AgriOceanSetup-1-2.exe**

AgriOcean e-repository system Setup Wizard

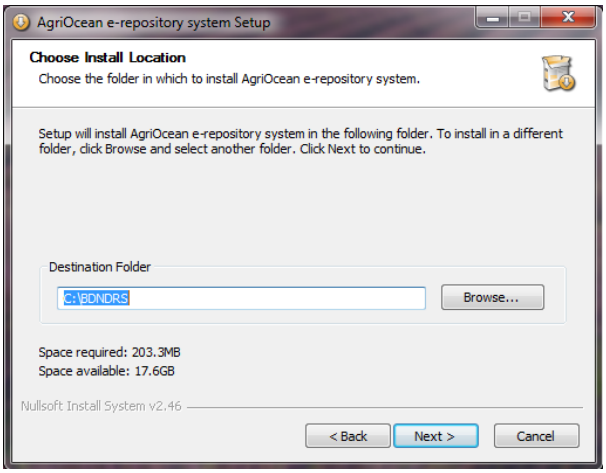


AgriOcean e-repository system Setup - components selection

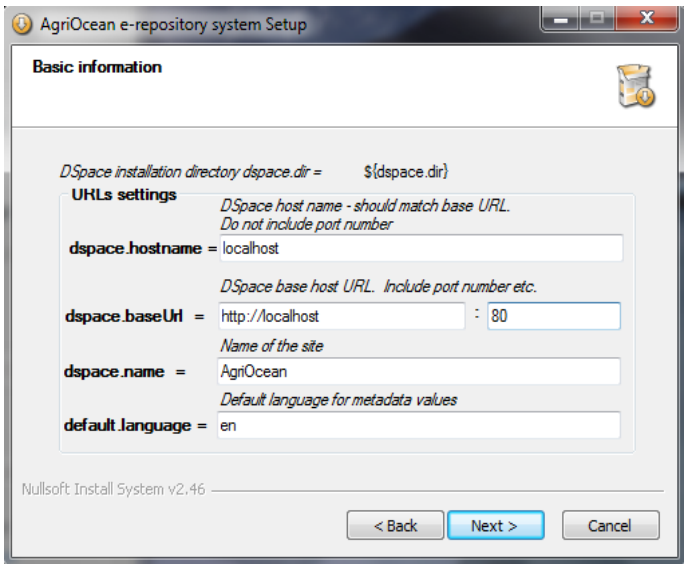


AgriOcean e-repository system Setup – User selection

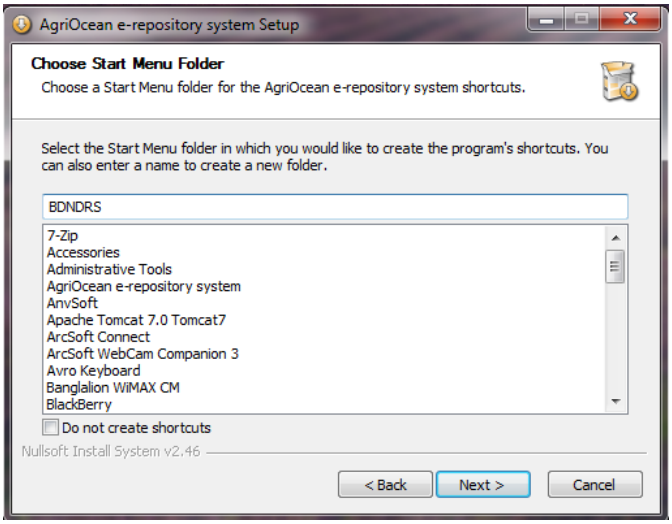
AgriOcean e-repository system Setup – Destination folder selection



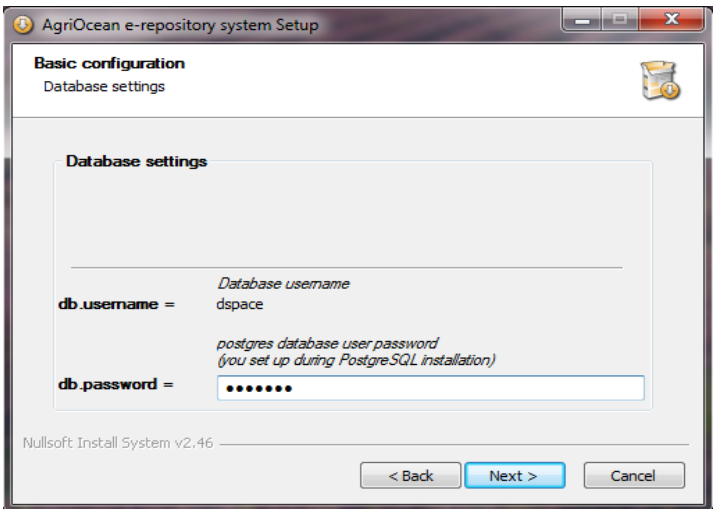
AgriOcean e-repository system Setup – Basic configuration



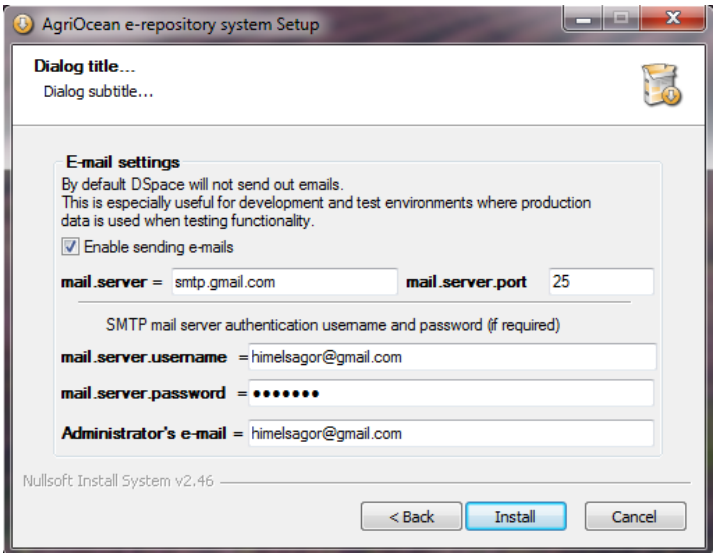
AgriOcean e-repository system Setup – Start Mane Folder



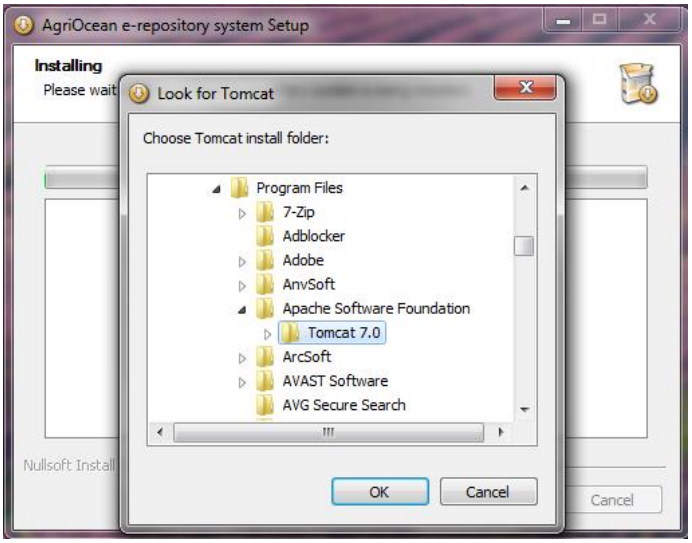
AgriOcean e-repository system Setup – Database configuration



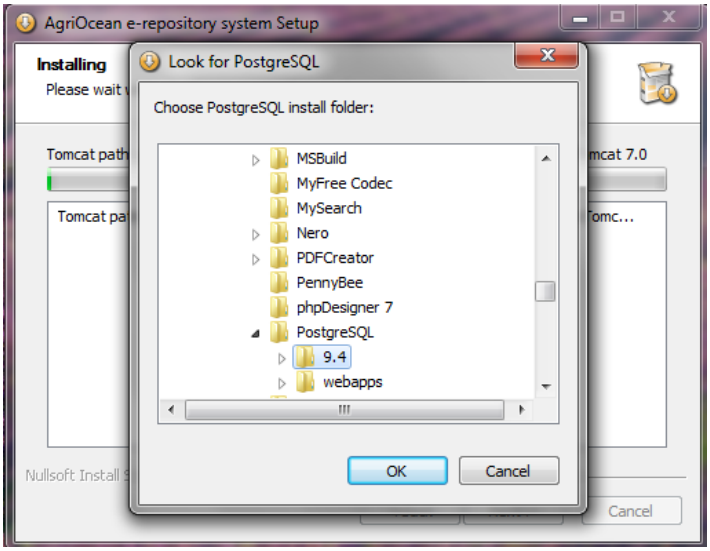
AgriOcean e-repository system Setup – Mail Server Setup



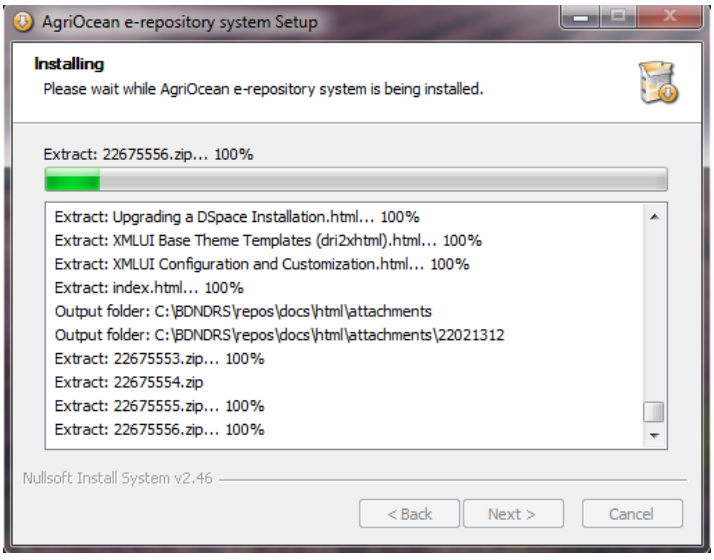
AgriOcean e-repository system Setup – Application Server Connection



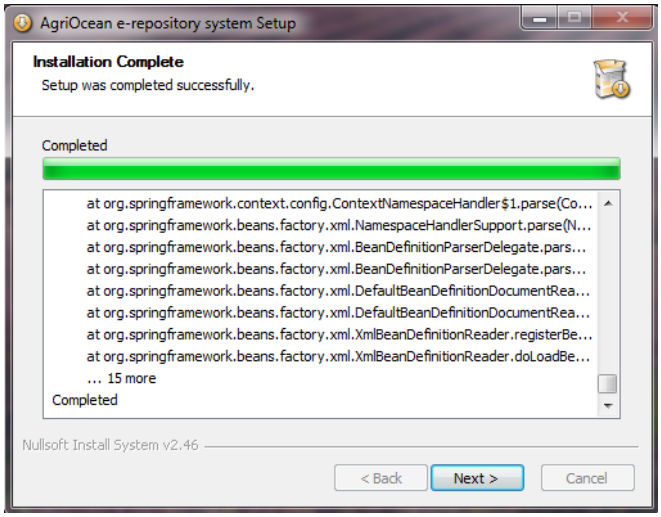
AgriOcean e-repository system Setup – Database Connection



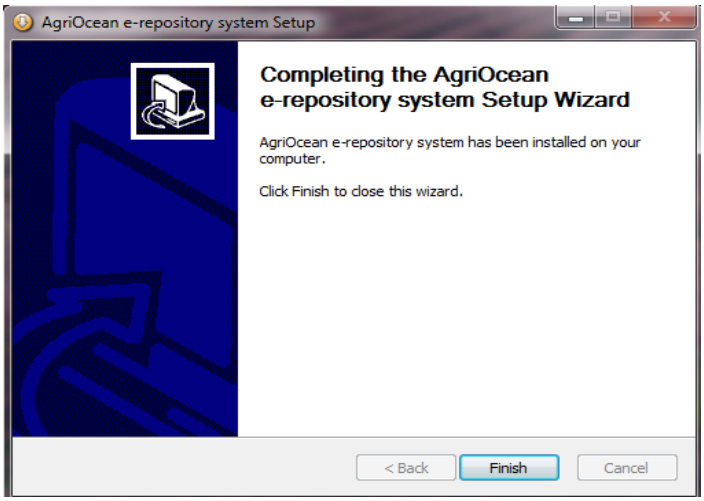
AgriOcean e-repository system Setup – Installation progress



AgriOcean e-repository system Setup – Installation Complete



AgriOcean e-repository system Setup – Installation finish

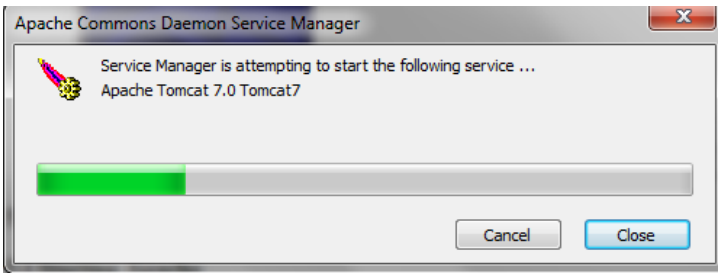


5. Starting up the AgriOcean Dspace application.

5.1 Starting Apache

- Go to Start>Apache Tomcat 7.0 Tomcat 7> Monitor Tomcat
- Right click Apache Tomcat 7.0 Tomcat icon>Start services (following progress bar will be appeared)

Starting Apache Service Manger



5.2 Running AgriOcean Dspace

After successful completion of all above steps write http://localhost:8080/dspace in address-bar of any browser. Following default screen will be displayed.

Figure 5. 2: AgriOcean DSpace Default Homepage

References

Easy Installer for AgriOcean DSpace available at http://aims.fao.org/sites/default/files/legacy_files/1_installation_agriocean-dSpace-1_1-Vista-7-Beta.pdf