



## Krishikosh: A digital repository to disseminate agricultural knowledge

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### ABSTRACT

Krishikosh is a versatile open access digital repository catering to the needs of Indian National Agricultural Research and Education System (NARES) and has architecture of centralized hosting of content but decentralized management. The Krishikosh has been designed using open source software Dspace and an efficient Integrated Content Management System (ICMS), which has suitability and configuration to meet the requirements of NARES and created dependable digital repository. Each institution in NARES has been configured as community in Dspace having its own collections and logo. Each community and collection can be given independent rights to registered users for uploading and managing the contents. Effectively Krishikosh is a collectively managed, centrally aggregated repository with integrated search facility. Krishikosh is a huge repository of theses, reports, articles etc. Keeping track of all the information is hectic and difficult for the user, which results in low usage of the Krishikosh site. Thus, an application with push notification was developed in order to involve the user with the Krishikosh, by sending messages regarding the new upload. Google Cloud Messaging (GCM) server were utilized for implementation of push notification which take the data from the PostgreSQL database, which is most advanced open source database. PHP script is used to connect the java programming in android studio, the database and the GCM server. In this study, usage statistics of Krishikosh were also analyzed.

**Key words:** Agricultural knowledge, Digital Repository, Dissemination, Krishikosh

Right information at right time is crucial for every development. Agriculture is no exception. Access to right and timely information is as important input as seeds, soil, water, pesticides and other inputs for any successful farm operation. Today, quick access to authentic information has become absolutely important to optimize the agricultural output per unit land/inputs, mitigate the effects of abrupt climate changes, sustainability of natural resources and ensuring quality for nutritional security. Therefore, the demand for fast access to authentic and credible digital information sources have risen in agriculture sector be it research, education or extension. End to end value chain development requires quick access to diverse type of information. In the present competitive world, moving towards what we perceive as knowledge society, the access to right information at anytime, anywhere, about anything has gained high significance. This does not mean that the earlier societies were not aware of importance of information or were not knowledgeable. The information played very important role even in ancient time when people of the sub-continent evolved into agri-

pastoral society, domesticated plants, animals and learned farming using draught animals, inventing tillage, seeding, intercultural operations, harvesting, and primary processing and prospered as interregional/international traders. They were knowledgeable enough to evolve into present day society. The crucial difference now is the speed with which you can access information, the magnitude of available information and removal of geographical boundaries to access information. The developments in computer technology itself revolutionized the world and the sudden growth in telecommunication methodologies provided the necessary synergy to create a catastrophic change breaking every boundary and connecting the planet into one giant network of information and knowledge. In such a scenario, the demand for authentic and credible digital information sources has risen in agriculture sector, be it research, education or extension. End to end value chain development requires quick access to diverse type of information. International organization had also worked on developing their own digital repository; creating a service dedicated to students, teachers and all the researchers (<http://onlinelibrary.wiley.com>/<http://onlinelibrary.london.ac.uk/>). Indian Government Organization has also took initiatives in digital library to conserve the knowledge for long time (<https://ndl.iitkgp.ac.in/>, <http://mhrd.gov.in/digital-library>). ShodhGanga (<http://shodhganga.inflibnet.ac.in/>) provides a platform for researchers and students to deposit their

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Ph D theses and make it available to the entire scholarly community in open access. ICAR took several major digital initiatives to reform the way research and development is done in our traditional system in Agricultural Research and Education System (Consortium of e-Resources in Agriculture (CeRA); RKMP (Rice Knowledge Management Portal); Agroweb; Agripedia; etc.). CeRA is a platform for digital access to commercially subscribed research journals in consortium mode providing access to latest research all over the world directly from publisher websites through an aggregator (Chandrasekharan *et al.* 2012). In addition to commercially available knowledge, the organizational knowledge available free within NARES is equally important for informed growth of research and education in agriculture sector in the country. Realizing this subproject E-Granth was initiated under National Agricultural Innovation Project (NAIP) under the aegis of Indian Council of Agricultural Research (ICAR) to enable digital access to vast amount of information available in the Indian National Agricultural Research and Education System (NARES), one of the largest agricultural research and education system in world (Jain *et al.* 2014 and NAIP 2014). The objective of this project is to capture, collate and disseminate the organizational knowledge available in the form of research theses, various technical reports, unpublished work, old valuable books and journals locked in libraries because of depleted condition, all kind of institutional publications and other knowledge resources. The details of architecture, viz. storage, logical and application, methodology for mobile application and usage statistics of Krishikosh were explained in following section.

## MATERIALS AND METHODS

Krishikosh platform is an Institutional Repository for collecting, preserving, and disseminating information in digital form for the intellectual output of an institution. It has been designed using open source software Dspace which has an efficient Integrated Content Management System (ICMS), suitability configured to meet the requirements of NARES and created dependable digital repository. In this repository, some important terminology such as Community, Sub Community, Collection, Item and Bitstream needs to be understood. The flow chart for above mentioned terms is presented in Fig 1. Community is the highest level in the hierarchy of Dspace logical model, which can be organizations/institutions/Universities. A community is organized into collections which consist of books, institutional publications, proceedings, reports, reprints, theses and other publications for a specific community. The relationship between community and collection is many to many, i.e. a community has many collections and vice-versa. The item is a single unit which means it consists of articles, theses, reports, books etc. Each item has its respective Dublin Core metadata record. The Dublin Core is a schema which comprises of small set of vocabulary terms that can be used to describe the physical resources of item such as books, theses, reports

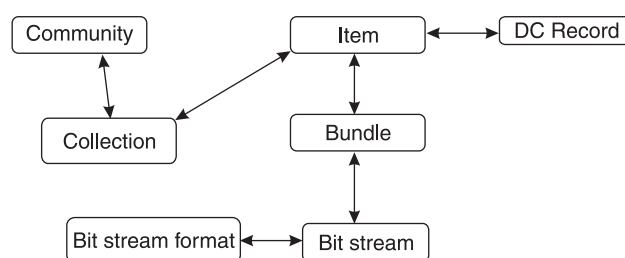


Fig 1 Logical Dspace data model

etc. Other metadata (copyright policy and non-exclusive distribution license) is stored in an item itself in the form of bitstream but the Dublin core metadata is further useful in interoperability and easy navigation of an item. The metadata that is information about the data of an item is first organized into bundles which consist of closely related information and then they form a bitstream. Every item has its bitstream. Each bitstream is then linked with one bit stream format for example if it is PDF/A or not. PDF/A format is international standard format not dependent on Adobe. The relationship between bitstream format and bitstream is one to many which means there can be only one bit stream format for a particular bitstream but many bitstream exists which has same bitstream format. These relationships are established to avoid duplication of content and easy management of system (Bass *et al.* 2002).

Dspace is based on three-layer architecture which consists of storage layer, logical layer, application layer and each layer includes different components as depicted in Fig 2. The storage layer is responsible for physical storage of metadata and content. The logical layer managing the content of the archive, users of the archive (e-people), authorization, and workflow. The application layer contains components that communicate with the world outside of the individual Dspace installation.

The lowest layer is the storage layer which consists of relational database, viz. postgresQL (Structured Query Language) and bitstream storage module for storing the data and metadata respectively. The relational database management system (postgresQL) is an open source licensed software, i.e. there will be no barriers to implement Dspace anywhere or if the system deals with multiple instances (Dspace reference manual;2002). JDBC (Java Database Connectivity), which defines how a user may access postgresQL. Bitstream storage systems are to provide storing the content by two different means, viz. File system and Storage Resource Broker (SRB). The two units (postgresQL and bitstream storage module) of the storage layer have Application Programming Interface (API) which is required to access the upper layer of the architecture.

The architecture of logical layer consists of several modules such as core tools, administration toolkit, authorization, browsing tools, E-group/person, workflow, handle manager, content manager, history record etc. This layer deals with managing these contents. Each module has its own API through which the upper layer can be accessed. These APIs together is termed as Dspace public API. Core

Classes consist of Configuration Manager, constants, context and log manager. Configuration Manager is responsible for reading the main Dspace configuration properties file, managing the 'template' configuration files for other applications such as Apache, and for obtaining the text for e-mail messages. Constants are used to represent types of object and actions in the database. Any code that uses API in the logic layer must first create itself a Context object. Log Manager consists of a method that creates a standard log header, and returns it as a string suitable for logging. Content Management API, contains Java classes for reading and manipulating content stored in the Dspace system. The workflow system models the states of an Item in a state machine with various stages (submit, granting of license, archiving). The Submission workflow Manager is invoked by events as per Collection and its steps are defined by creating corresponding entries in the List named workflow group. Administration Toolkit contains classes for administering a Dspace system. To create Administrator class, a simple command-line tool was executed via /Dspace/bin/create administrator, that creates an administrator E-person with information entered from standard input. E-person/Group Manager class tracking the registered users in Dspace. The class has methods (set and get) to create an EPerson details such as first and last names, email, and password.

There are methods to search an EPerson by email (which is assumed to be unique,) or to find all e-people in the system. The authorization system in Dspace gave the 'policy state' for security purpose. The policies are attached to resources with the details who can perform the actions (READ, WRITE, ADD, etc.) through e-Person groups. The ADD and REMOVE actions must require this policy state. For creating an item ADD permission are granted for Collection, which contains Items. Separate policy checks for items and their bitstreams enables policies that allow publicly readable items, but parts of their content may be restricted to certain groups. Handle Manager/Handle Plugin creates and organizes components (plugins), and helps select a plugin in the cases where there are many possible choices. HandleManager is used to create and look up Handles, and HandlePlugin is used to expose and resolve Dspace Handles for the outside world via the Corporation for National Research Initiatives (CNRI) Handle Server code. Handles are stored internally in the handle database table. Search API is the Lucene search engine which involves searching of task by indexing. It is the class, which contains index Content as an Item, Community, or Collection. Browse API maintains indices of dates, authors, titles and subjects, and allows users to extract parts of these items. The purpose of the history recorder is to capture a time-based record

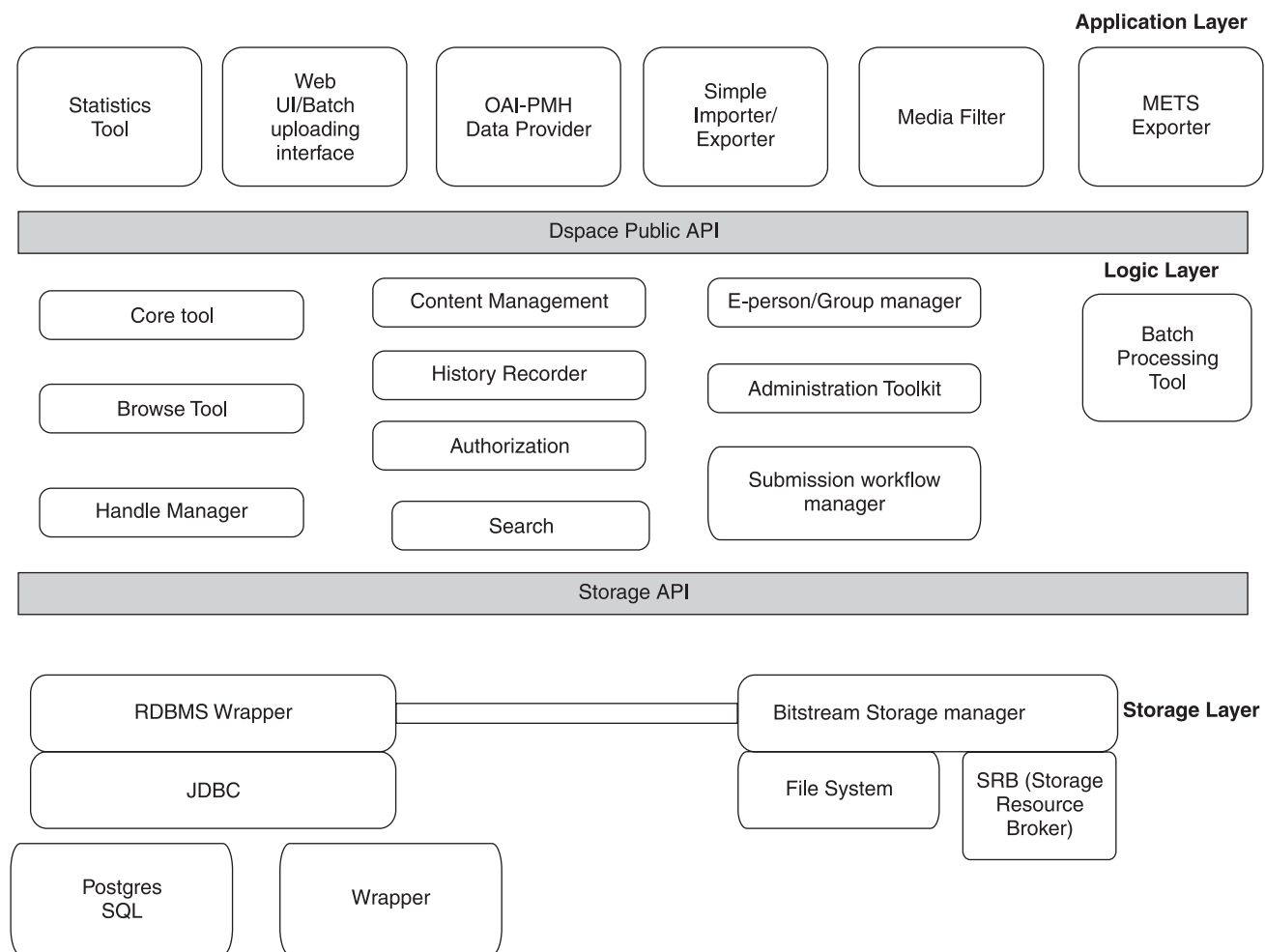


Fig 2 Architecture of Dspace

of significant changes in Dspace, in a manner suitable for repurposing. Batch processing tool is a new addition to the Dspace architecture to help the user processing previously collected jobs in as single batch. In this, user has an advantage to upload multiple items in a collection through browsing into Krishikosh repository.

The uppermost layer is the application layer which communicates with end user as it consists of web user interface. It also consists of web related services namely Statistical tools, OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting) data Provider, Simple importer/exporter, media filter and METS (Metadata Encoding and Transmission Standard) Exporter. The web user interface of Dspace is built on java servlet and JSP (Java Server Page) Technology, which allows user all over the world to access Dspace conveniently. OAI-PMH can be used to harvest bitstreams and metadata into Dspace from an external server. The layers only invoke the layer below it, for example the application layer can't invoke the storage layer directly. It helps in preparing digital resources and metadata by creating METS export. Media filters are used for transformation of file/bitstreams into a new content which may use for full text searching, it also creates thumbnails for an item that contained images. A batch uploading interface is created in the new version of Dspace, In this interface user has to fill CSV sheet according to the template provided in the repository. The purpose of the template is to have no redundancy and no error while uploading the batch files. User then creates a zip file which consists of CSV file along with the pdf file of the documents to be uploaded. In the submission option provided in the user interface of application layer, user may upload the zip file, this process will validate with the csv file, if it is found correct then the document will be uploaded in the selected community.

Krishikosh website is mobile responsive site which means that the design of the system responds or adapts depending upon the layout of the device (different mobile phones, tablets etc.). The responsive website improves the usability of the site. Making website responsive does not only mean fitting the entire application on the users device but it also means to provide user a great experience while using the application and smartly pruning amount of information displayed. The entire Krishikosh website is converted into mobile application by generating web view through the codes. The generated web view provides user the unique experience of visiting the Krishikosh website as a mobile application. It is a fully functional web view in the application, user can register themselves on Krishikosh, can login and upload the documents, can view other reports and theses anytime, anywhere from the application on their mobile. Just viewing the Krishikosh repository as a mobile application doesn't solve the purpose of getting more and more user engagement on this repository. User need an application which continuously pin them about the new uploads on Krishikosh. As it is a huge repository of theses, reports, articles etc., keeping track of all the information is

very hectic and difficult for the user, which results in low usage of the Krishikosh site. Thus, an application with push notification was developed in order to engage the user with the Krishikosh, by sending messages regarding the new upload. It is implemented using GCM. For the testing purpose a sample database of the Krishikosh is taken and is implemented in Postgre SQL, it is the most advanced open source database. PHP script is used to connect the java programming in android studio, the database and the GCM server. The process of push notification is explained as follows: 1. First of all android device sends sender ID and application ID to the GCM server for registration. 2. When the devices are successfully registered with GCM, it will provide registration ID to android device. 3. After receiving registration ID, device will send this registration ID to the application server. 4. The application server will then store the registration ID into the database for later usage as and when required. (a) Whenever new document is uploaded on the Krishikosh website, a push notification is needed, the application server then sends a message to GCM server along with the device registration ID (stored in the database). (b) GCM server will deliver the message to respected device using device registration ID.

The pictorial representation of push notification process is presented in Fig 3.

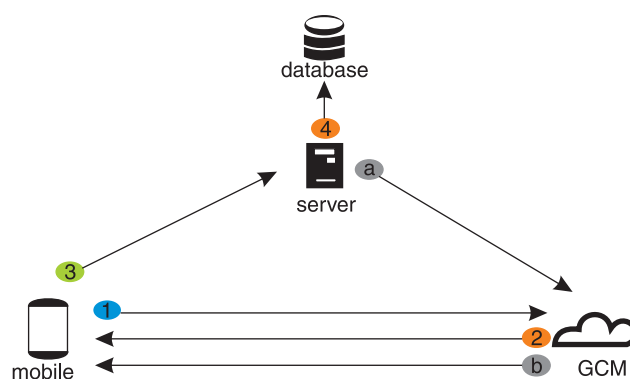


Fig 3 Architecture of Push Notification

In Krishikosh repository as a new document is submitted by any organization a unique ID is generated for that document, which is known as handler\_id and it stored in database. For linking notification message and uploaded document, PHP script is use to connect with database and send handler\_id from database to server, this create communication between client (android application) and server for retrieval of handler\_id. Where, web service read handler\_id and sent it to the client side and create URL through java programming in android studio.

Basically Handler\_id uses to make URL through which the particular document can be viewed by users of Krishikosh. This URL of uploaded document is linked with its push notification which is sent by server to all registered users. So that user can directly open recently uploaded document by taping on received notification of particular document rather than opening Krishikosh. This process

makes application more reliable and faster for the users.

For the development of Krishikosh android application, android studio version 1.5 was used. This version was installed initially on windows 7 operating system having 2 GB RAM and Java Development Kit (JDK) 7 to develop entire application before shifting it to main server and then on Linux platform as Krishikosh main server is installed on Linux platform. Required packages for Krishikosh mobile application were installed using Android SDK (Software Development Kit) manager. Figure also highlights the package Google APIs (x86 System Image) which is necessary to form the emulator device having Google APIs functionality.

Code compilation on android studio is much better than other available software. Gradle integration in android studio is another great advantage to group all application files into one compressed file called Android Packages (APK). It is a Java Virtual Machine (JVM) based build up system, which facilitates the developer to write their own script in Java, i.e. we can customize the codes according to the features needed in Krishikosh Mobile Application. Inside Android Studio, a new project is created for Krishikosh repository, there is its build.gradle file where we had wrote the java script to automate the task, this also has an unique package with which it get registered with the Google Console. Android studio also offers tools for integrating applications, running server side code locally for the testing purpose.

Usage statistics for community, collection, items are configured with Dspace to provide the usage details of the server to the administrators of Krishikosh (<http://wiki.duraspace.org>). Statistics on total visits of the communities, collections, items, etc.; countries along with cities from where the visits originate are available on this repository. The month wise details of bitstream views, item views, and searches performed, collection views, community views and user logins from June 2014 to Dec 2016 are utilized for analysis of data.

## RESULTS AND DISCUSSION

### *Krishikosh digital repository of NARES*

Krishikosh (<http://Krshikosh.egranth.ac.in>) is a versatile open access digital repository catering to the needs of NARES and has architecture of centralized hosting of content but decentralized management. Krishikosh is hosted at data center of ICAR-Indian Agricultural Research Institute (IARI), the premier research institute and deemed university under NARES. The hardware, software and connectivity is managed by Agriculture Knowledge Management Unit (AKMU) at ICAR-IARI and each institute or university can manage and administer it's own repository which is integral part of Krishikosh. Krishikosh is collectively managed, centrally aggregated repository with integrated search facility. Krishikosh is a digital Institutional Repository of important institutional publications including rare books and old journals, books, reprints, reports and theses under open access policy of ICAR (<http://icar.org.in/en/node/6609>). The implementation of Krishikosh improves the accessibility

coupled with preservation of institutional repository. This was achieved to create dependable digital storage and an efficient Integrated Content Management System (ICMS), an open source software Dspace. It provides following functionalities:

*Improve accessibility:* The ICMS makes the holdings more accessible to scholars, teachers, academics and the general public, both within the premises as well as to those who cannot personally visit the NARES libraries but want to access the contents through the internet, under open access policy.

*Enhanced search ability:* All holdings are grouped communities and collections based on institutions, subjects, themes or other criteria making large amount of information easily available on any subject matter for teaching, research and development. Any researcher looking for content on any subject or themes can have a unified access to content on all media types (manuscripts, photographs, audio-video, etc.) thereby making the searching much easier and faster.

*Preservation:* Preservation of all the rare documents in electronic form is an important objective. Also, once the documents are scanned and digitized, preservation of the originals can be ensured for a much longer period as the need to handle the physical documents is eliminated or minimized to a great extent since document are made available through the ICMS.

*Content selection:* High power committees of subject matter experts have identified the content of intellectual and academic value to be included in the repository. Other institutions have identified the content in consultation with subject matter experts approved by the Directors/Vice-Chancellors. The identified content was then harmonized centrally to avoid duplication.

Various types of archival material at NARES comprises of rare books, old journals, reports, newsletters, annual reports, success stories, special bulletins, convocation addresses, endowment lectures, author's collections, preprints, reprints, patents, manuscripts, periodicals, grey literature, photographs, existing digital content, audio-video recordings.

It is NARES's intention to make the Metadata for all records (and categories) freely available to all, however the actual records would be accessible based upon its access category.

All of NARES's holdings are classified under the following three access categories:

*Public access:* Any record that can be made available to public at large scale shall fall under this category.

*Privileged access:* Records classified under this category shall be accessible to only to those individuals or organizations that have a privileged status with NARES (such as other national/state archives/research and academic institutes/eminent researchers etc.). Others (the world at large) would have to seek prior permission/approval from IARI to access any Record classified as Privileged Access.

*Prohibited access:* Records which are accessible ONLY to NARES authorized officials, due to their confidential and

sensitive nature as defined by statutory rules and regulation.

Thus, Krishikosh is a unique repository of knowledge in agriculture and allied sciences, having collection of old and valuable books, institutional publications, technical bulletins, project reports, lectures, preprints, reprints, theses, records and various documents spread all over the country in different libraries of Research Institutions and State Agricultural Universities (SAUs).

#### *Salient features of Krishikosh*

(i) Krishikosh is a digital repository platform capable of Decentralized Management of Content but Centralized Hosting and maintenance for convenience of multiple users. (ii) Each institution has its own repository with full control without effort of maintaining hardware/software which is centrally managed at IARI. (iii) Krishikosh Institutional repository of NARES provides open access to institutional knowledge. (iv) At present Krishikosh has more than 25 million digitized pages in 112000 digital items (volumes) like old books, old Journals, reports, proceedings, reprints, research highlights, training manuals, historical records. (v) Includes more than 63000 theses plus other digitized contents for various centres. (vi) Agrotags developed at IIT Kanpur has been integrated for semantic search. (viii) Krishikosh uses PDF/A format (ISO19005-1:2005) which is international standard format not dependent on Adobe and is suitable for archiving as it has all the dependencies build into the document for proper display even with the future technologies. (ix) Krishikosh provides ready software platform, similar to 'Cloud Service' for individual institution's self-managed repository with central integration of all the individuals repositories. (x) Krishikosh is an open access Institutional Repository which has been developed by customizing open source software Dspace. (xi) It is full text searchable open access repository. Semantic search enabled through the integration of Agrotags. (xii) Comprehensive search and browse options are available. (xiii) Easy to register for additional facilities. (xiv) User feedback provision for continuous improvement. (xv) Subscribed users can get collection updates. (xvi) Institutional users can administer their own repository and can upload, remove, set embargo on their institutional content.

Krishikosh platform is an Institutional Repository for collecting, preserving, and disseminating information in digital form for the intellectual output of an institution. In this repository, some important terminology such as Community, Sub Community, Collection, Item and Bitstream needs to be understood. The explanations of these terminologies are given below.

**Community:** Community is the top level reference term which describes the University/ICAR Institute group. Generally the right to create a Community is with the Administrator of the Krishikosh.

**Sub community:** This is second level of hierarchy. It may describe departments/division under the University/ICAR Institute.

**Collection:** Collection is a part of Community or Sub-community in which we can add different categories like books, theses, journals, newsletters etc. Creating collection is necessary to post the document under Krishikosh.

**Item:** The record/document which is uploaded in collections is termed as item.

**Bitstream:** It is the file which will be uploaded in the Krishikosh preferably a searchable pdf/a or pdf file.

#### *Mobile application*

Large number of documents were maintained by Krishikosh repository. To enhance the user experience in accessing the documents a mobile application with push notifications was developed. This will enhance the usability of the Krishikosh and on clicking the message; the required document can be seen by the user. In the later stage of development of mobile application user also have an advantage of categories the document based on community, subject etc.

#### *Usages of Krishikosh*

Usage statistics for community, collection, items are configured with Dspace to provide the usage details of the server to the administrators of Krishikosh (<http://wiki.duraspace.org>). Statistics on total visits of the communities, collections, items, etc.; countries along with cities from where the visits originate are available on this repository. Institute-wise total items in various collections up to 112 000 are shown in Table 1. The table shows that Professor Jayashankar Telangana State Agricultural University (6465), Hyderabad and Indian Agricultural Research Institute, New Delhi (4603) has the highest number of theses in this repository as on 23 Jan 2018.

Krishikosh analytics during the period 1 April 2016 to 31 December 2017 show that there were about 2159316 users who have been using the Krishikosh website. It also shows that during this time new user were 80.5% of the current user. There were about 3482167 page views and 2.36 lakh session is equal to whatever user does on Krishikosh website (e.g. browser pages, reading, downloading Krishikosh app etc.) before they leave. USA alone counts for 7.9 lakh user followed by India and China having 6.61 lakh and 1.29 lakh users respectively. Krishikosh analytics indicate that the highest users (43 987) who has visited the Krishikosh website is on 31 October 2017.

The top ten countries who visited Krishikosh during June 2017 to Oct 2017 are presented in pie chart (Fig 4). In Fig 5, The top ten community in Krishikosh are present, this indicates Professor Jayashankar Telangana State Agricultural University, Hyderabad ranked one while Indian Agricultural research Institute, New Delhi and Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur ranked two and three respectively.

The month wise theses submitted in Krishikosh are present in Fig 6. In Google analytics, the number of active users on Krishikosh can be determined. It may also be observed that there were 52% of active mobile users and

Table 1 Institute wise total items in various collections

Institute	Theses	Books	Journals	Reports	Others
Acharya N G Ranga Agricultural University, Guntur	227	0	0	0	0
Agriculture University, Kota	4	0	0	0	0
Anand Agricultural University, Anand	1773	91	6	1	339
Assam Agricultural University, Jorhat	115	0	0	0	0
Bidhan Chandra Krishi Viswavidyalaya, WB	279	0	0	0	0
Bihar Agricultural University, Sabore	89	15	152	1	
Birsa Agricultural University, Ranchi	546	0	0	0	0
Central Institute of Fisheries Education, Mumbai	531	211	18	49	
Chaudhary Charan Singh Haryana Agricultural University, Bihar	2985	18	125	0	210
Chaudhary Sarwan Kumar Himachal Pradesh Agriculture University, Palampur	245	0	3	1	0
Chhattisgarh Kamdhenu Vishwavidyalaya, Durg	90	0	0	0	0
CSA University of Agriculture and Technology, Kanpur	186	0	0	0	0
Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli	543	0	1	0	5
Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola	179	0	0	0	0
Dr Rajendra Prasad Central Agricultural University, Pusa	181	0	0	0	0
Dr Y S Parmar University of Horticulture & Forestry, Solan	1421	0	0	0	0
Dr Y S R Horticultural University, Venkataramannagudem	277	0	0	0	0
Govind Ballabh Pant University Of Agriculture and Technology, Pantnagar	1134	256	0	0	0
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana	95	0	0	0	0
Indian Agricultural Research Institute, New Delhi	4603	4845	5731	70	280
Indian Veterinary Research Institute, Izatnagar	1106	800	2399	45	0
Indira Gandhi Krishi Vishwavidyalaya, Raipur	2439	6	14	101	13
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi	452	0	0	3	0
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur	4570	0	1	7	0
Junagadh Agricultural University, Junagadh	1673	25	13	0	36
Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar	426	0	0	10	12
Kamdhenu University, Gandhinagar	4	0	0	0	0
Kerala Agricultural University, Thrissur	1003	0	0	0	0
Kerala University of Fisheries and Ocean studies, Ernakulam	5	0	0	0	0
Kerala Veterinary and Animal Sciences University, Wayanad	48	0	0	0	0
Lala Lajpat Rai University of Veterinary & Animal Sciences, Hisar	554	0	0	0	0
Maharana Pratap University of Agriculture and Technology, Udaipur	1495	5	0	0	0
Maharashtra Animal and Fishery Sciences University, Nagpur	2385	0	1	0	0
Mahatma Phule Krishi Vidyapeeth, Rahuri	3435	1805	2	28	4
Nanaji Deshmukh Veterinary Science University, Jabalpur	95	0	0	0	0
Narendra Deva University of Agriculture & Technology, Faizabad	118	0	0	0	0
National Dairy Research Institute, Karnal	2312		1342	36	11
Navsari Agricultural University, Navsari	705	0	0	8	0
Orissa University of Agriculture and Technology, Bhubneswar	1238	155	0	0	0
Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura	340	0	0	0	0
Professor Jayashankar Telangana State Agricultural University, Hyderabad	6465	1961	1045	112	49

Cond.

Table 1 (Concluded)

Institute	Theses	Books	Journals	Reports	Others
Punjab Agricultural University, Ludhiana	1826	0	0	3	0
PVNR Telangana Veterinary University, Hyderabad	143	0	0	0	0
Rajasthan University of Veterinary and Animal Sciences, Bikaner	252	0	0	0	0
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior	1342	0	0	0	1
Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu	198	0	0	0	0
Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir	336	0	0	0	0
Sri Karan Narendra Agriculture University, Jobner	500	0	449	5	30
Sri Venkateswara Veterinary University, Tirupati	1128	0	13	2	0
Swami Keshwanand Rajasthan Agricultural University, Bikaner	55	0	0	0	0
Tamil Nadu Agricultural University, Coimbatore	1429	963	364	70	0
Tamil Nadu Fisheries University, Thoothukudi	121	0	28	0	1
Tamil Nadu Veterinary and Animal Sciences University, Chennai	2624	282	2469	95	7677
University of Agricultural & Horticultural Sciences, Shivamogga	3	0	4	2	0
University of Agricultural Sciences, Bengaluru	3267	970	6030	656	287
University of Agricultural Sciences, Dharwad	2161	0	1	3	0
University of Agricultural Sciences, Raichur	74	0	0	0	0
University of Horticultural Sciences, Bagalkot	78	0	1	18	1
Uttarakhand University of Horticulture and Forestry, Bharsar	61	0	0	0	0
Uttar Banga Krishi Viswavidyalaya, Cooch Behar	192	0	0	7	0
Vasantryao Naik Marathwada Agricultural University, Parbhani	400	0	0	0	47
West Bengal University of Animal & Fishery Sciences, Kolkata	487	0	0	9	0
Other ICAR Institute	0	0	0	0	6582
Sub - Total	63048	12408	20212	1342	15585
Total			112595		

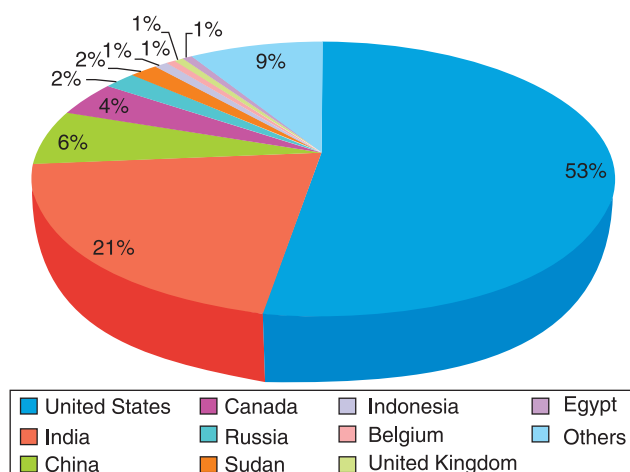


Fig 4 % of Krishikosh website visit-Internationally

rest are desktop users, which also confirms the increased usability of the mobile application developed for Krishikosh. This analytics is from 20 Sept 2017 to 22 Oct 2017 which depicts that after the release of Krishikosh mobile application, users are now opting mobile for accessing

Krishikosh more often now.

#### Conclusion

ICAR has recently declared an Open Access policy. Krishikosh provides ready software platform to implement all aspects of the open access policy, similar to 'Cloud Service' for individual institution's self-managed repository with central integration of all individual repositories. At present Krishikosh has 25 million digitized pages in more than 112 000 digital items (volumes) like old books, old journals, reports, proceedings, reprints, research highlights, training manuals, historical records, including 63 000 theses digitized at various centers. The Krishikosh digital repository which provides digital platform for publishing can help and advice on IPR issues, research programme formulation and efficient management of institutional information assets. A customized digital repository platform for users of NARES Institutions was developed, where they can upload and manage their own contents for compliance to open access policy of ICAR. Thus Krishikosh is a user-friendly platform to deposit, manage and access for Institutional information, viz. books, reports, reprints,

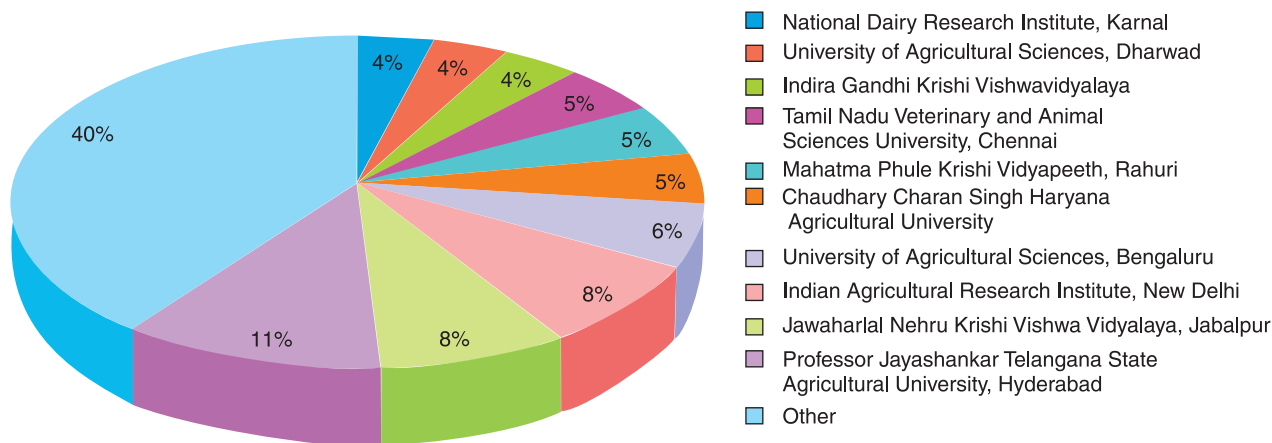


Fig 5 Theses contribution of top 10 Communities in Krishikosh

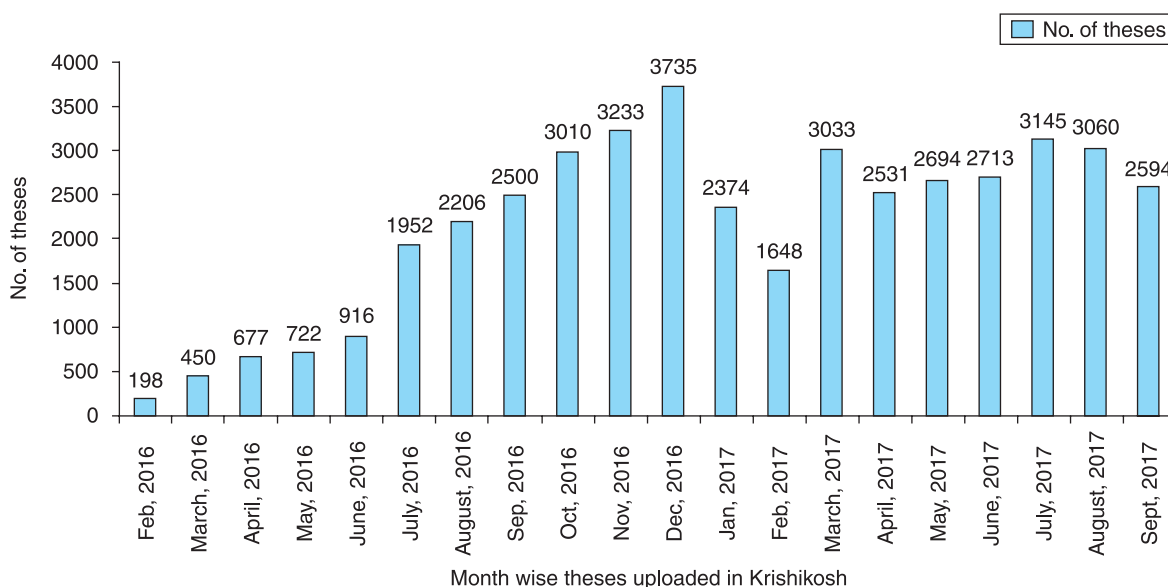


Fig 6 Month wise submission of theses in Krishikosh

proceeding, theses and Institutional publications produced by NARES researchers.

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