Web Impact Factor and Link Analysis of Indian Council of Agricultural Research (ICAR) Organizations

Kutty Kumar*

ARTICLE INFO

Article history:
Received 13 November 2017
Revised 2 March 2018
Accepted 3 March 2018

Keywords:
Webometric,
Link Analysis,
ICAR,
Web Impact Factor,
link topology

ABSTRACT

There have been extensive studies done on webometrics, particularly on the impact of websites and the web impact factor. The present study analyzed the websites of ICAR organizations, according to the webometrics indicator. It examines and explores the 92 ICAR organizational websites in India and identifies a number of web pages and link pages, and calculates the Overall Web Impact Factor (WIF) and Absolute Web Impact Factor (WIF). In this study, all websites were analyzed and data extracted using Google search engine. It suggests that Web Impact Factors can be calculated as a way of comparing the attractiveness of web sites or domains on the Web.

1. Introduction

In addition to user studies, there have been attempts to extract new kinds of information from the Web: examining, for example, the relationship between areas of the Web by counting the number of hyperlinks between them (Ingwersen, 1998). These kinds of studies, called "webometrics," have grown out of bibliometric analyses of the citations in published journal articles (Borgman et al., 2002). Link analysis, like citation analysis in bibliometrics, has emerged as a research area of webometrics in recent years (Chu et al., 2005). There are different ways of calculating Web Impact Factors (WIFs), which use different definitions of the links involved (Kretschmer et al., 2008). Thelwall et al. (2005) classify three types of links depending on where links originate that are: inlinks, outlinks and self links. Most studies give two values of the WIF based on the number of inlinks and self links, which are sometimes combined into an overall WIF. Due to the limitations of existing data sources, Thelwall & Wilkinson (2003) used their own crawler for data gathering when comparing UK universities.

The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers

* Assistant Professor, Library and Information Science, College of Veterinary Science, Sri Venkateswara Veterinary University, India (kumarkkutty@gmail.com)
International Journal of Knowledge Content Development & Technology, 8(1): 5-23, 2018.
http://dx.doi.org/10.5865/IJKCT.2018.8.1.005

Welfare, Government of India. The vast network of ICAR includes Institutes, Bureaux, National Research Centres & Project Directorates. The present article examines Indian Council of Agricultural Research (ICAR) Organisations through a webometric study. The paper studies the link relationship and Alternative Document Model (ADM) count summary among organisations through various webometric indicators like simple Web Impact Factor (WIF), Self Link Web Impact Factor (SLWIF), External Link Web Impact Factor (ELWIF) and In-link Web Impact Factor (ILWIF).

2. Review of Literature

Based on web links or download numbers (Webometric) new evaluation methods have emerged as alternatives to the traditional citation-based metrics (Basili et al., 2016). Peker et al. (2016) statistically explores the relationship between web usability and web presence of the Turkish universities. The findings of the study revealed that Universities can estimate their web usability levels by investigating their web presence rankings and, can also raise their rankings in Webometric ranking system. Using the bibliometrics method, Sun et al. (2016) attempted to provide a comprehensive picture of national innovation studies based on data derived from the Web of Knowledge. The results were useful for understanding and promoting the field of national innovation. Chakravarty et al. (2015) calculated web impact factor (WIF) and R-WIF (Revised WIF) of top ten library websites of HEIs (Higher Educational Institutes) of India and further correlated both the formulas with Spearman's Rank Correlation. It was found that WIF and R-WIF are correlated and associated which depicts that there is very less difference between the two ranking methods. Noroozi et al. (2014) investigated the link and networks of Iranian research institute websites using webometrics and the link analysis method. The network diagram showed the mutual link strength and existing pattern among the set of research institute websites in Iran. Shukla et al. (2012) analyzed web presence of Indian State Universities (173) on the World Wide Web (WWW) and also found ways to get high web links that further help to improve presence on Web. The data was collected from Yahoo Site Explorer and Google Scholar. WISER ranking method was applied to assess the visibility and connectivity of universities on the Web. A WebCrawler Socscibot 4 was used to examine the pattern of link visibility and to create ADM Count Summary. The study showed that some state universities have more visibility than others. Thomas et al. (2000), Yazdi et al. (2013) described a link analysis of websites associated with departments of librarianship and information science (LIS).

3. Research Design and Methodology

3.1 Objectives

Some alternative indicators have advantages for scientometric data, reflecting a different type of impact or being available before citation data (Thelwall et al., 2016). The primary objective of the present study is to examine the siginficance of web impact factor and to find out the link

patterns among selected oranisations under study. It will:

- ➢ Calculate various types of webimpact factor for Indian Council of Agricultural Research Oragnisations.
- ➢ Analyse suitability of using various types of WIFs for ranking the ICAR organisation based on their external web impact factor.
- ➢ To find out the link patterns among the Deemed Universities, Institutitons, National Research Centers, National Bureux and Project Directorates of ICAR.
- ➢ General Micro-Link Typology among similar kind of ICAR organistions using appropriate webometric tool.

3.2 Limitations

- ➢ The study covers only Indian Council of Agricultural Research Organisations (ICAR).
- ➢ The study includes only those organsiations which has active web sites.

3.3 Methodology

The Indian Council of Agricultural Research comprises a total of 100 different organizations: 4 Deemed Universities, 60 Institutions, 15 National Research Centers, 6 National Bureaux and 15 Directorates. It is clear from Table 1 that 92 orgnaisations have their own websites and rest of the organisational websites are not available or non-fuctional as of August 2015 to September 2015.

Table 1. Sample Size

S.No	Types of ICAR-Organisations	Total Websites	Available Website
1	Deemed Universities	04 (4.00)	04 (4.35)
2	Institutitons	60 (60.00)	53 (57.61)
3	National Research Centres	15 (15.00)	15 (16.30)
4	National Bureaux	6 (6.00)	6 (6.52)
5	Directorate/Project Directorates	15 (15.00)	14 (15.22)
Total		100 (100.00)	92 (92.00)

(Figures in the Parenthesis indicate percentage) Response Rate 92%
(Source: http://www.icar.org.in/en/node/325 dated 23.08.2015 to 08.09.2015)

In addition to data extraction from web sites for webometric purposes (e.g. link analysis, ranking of Web sites, etc.), LexiURL searcher presents information on the arrangement of links among

different web sites (Taram et al., 2015). In exploring hyper-linking behaviour of the web and retrieving relevant information, search engines and web crawlers play a predominant role as data sources (Jalal et al., 2015). Web search engines, and Google in particular, have created a generation of searchers who favor simple search engines available on the open free web (Jan Brophy et al., 2005). For this study data were retrieved using Google Search Engine and a personal Web Crawler Sociobiot 4.0 Version, since it is widely used and tested by many webomatricians for their studies in academic institutions.

Knowledge maps are tools that help visualize information. If bibliographical data are taken as the basis for network, Pajek become a simple means of getting to the crux of highly specific areas. (Garcia et al., 2015; Ruas et al., 2014; Cantos et al., 2014; Nagarkar et al., 2015; Kozak et al., 2015). The data are taken from a series of online snapshot searches over a single month (August 2015 to September 2015) performed on the Google by keeping various search conditions constant. Figure 1 denotes webometric query syntax.

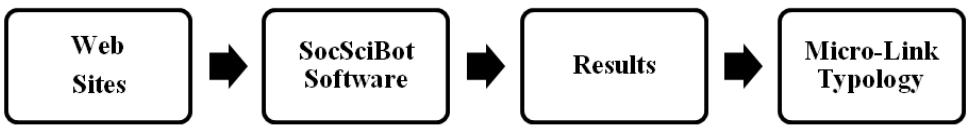

Fig. 1. Webometric Query Syntax

Web page classification (Onan et al., 2016) is the process of assigning a web page to a particular predefined category based on labelled data. It serves for several other web mining tasks, such as focused web crawling, web link analysis and contextual advertising. The following Figure 2 explains webometric query syntax and results.

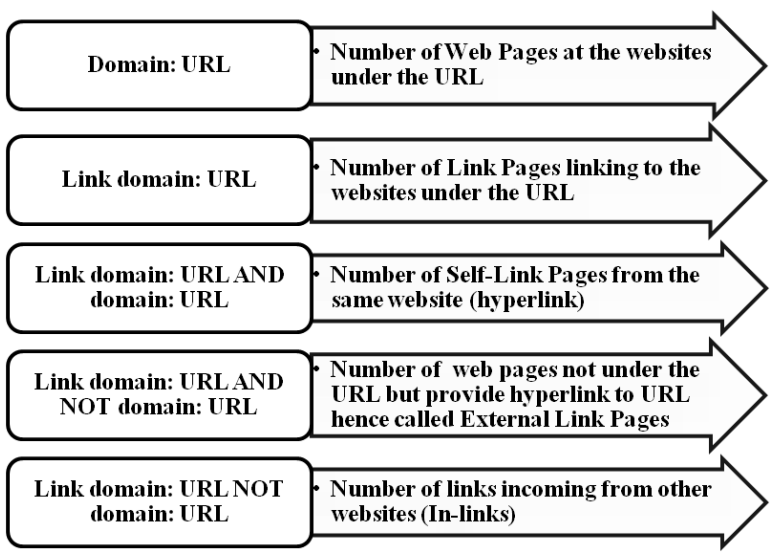

Fig. 2. Webometric query syntax supported by Google with results

4. Data Analysis and Interpretation

Numerous studies of Webometrics (Babu et al., 2010; Maharana et al., 2012; Vijayakumar et al., 2012; Jeyshankar et al., 2009) concerned measuring aspects of the web: websites, web pages, parts of web pages, words in web pages, etc. Link analysis is highly effective in detecting relationships between different institutions, relationships that are stronger the greater in their geographical proximity (Ontolba et al., 2016). Eight out of 100 ICAR organisations were excluded from the study due to server problems during the study period or non-availability of websites. Therefore, 92 organisationsal websites were considered. Table 2 shows the acronyms and explanations used in this article for calculating web impact factor.

Table 2. Acronyms and explanations used in study for web pages

S.No.	Acronym	Expansion	Web Impact Factor	Calculation
1	NWP	Total No. of Web Pages (A)		
2	LWP	Link Web Pages (B)	SWIF (Simple Web Impact Factor) =	$\frac{\text{No. of Link WebPages (B)}}{\text{Total No. of Web Pages (A)}}$
3	SLWP	Self-Link Web Pages (C)	SLWIF (Self-Link Web Impact Factor) =	$\frac{\text{No. of Self-Link Web Pages (C)}}{\text{Total No. of Web Pages (A)}}$
4	ELWP	External Link Web Pages (D)	ELWIF (External-Link Web Impact Factor) =	$\frac{\text{No. of External Link Web Pages (D)}}{\text{Total No. of Web Pages (A)}}$
5	ILWP	In-Link Web Pages (E)	ILWIF (In-Link Web Impact Factor) =	$\frac{\text{No. of In-Link Web Pages (E)}}{\text{Total No. of Web Pages (A)}}$

Table 3. Distribution of Total Number of Web pages, Link, Self-Link, External, In-Link Web Pages

S.No	Types of ICAR-Organisations	Total No. of Web Pages (A)	Total No. of Link Web Pages (B)	Total No. of Self-Link Web Pages (C)	Total No. of External Link Web Pages (D)	Total No. of In-Link Web Pages (E)
1	Deemed Universities	124960	129790	175900	181080	132690
2	Institutitons	584308	699481	469627.5	535923.5	413404.5
3	National Research Centres	130012	219365	118675	118044	92148
4	National Bureaux	29280	61335	24569	32445	25797
5	Directorate/Project Directorates	90739	120236	38907	41444	42800

Table 3 shows the distribution of total number of web pages, link, self-link, external link and in-link web pages. It is clear from the table that ICAR-Institutions ranked first with 5,84,308 total

web pages; 6,99,481 total links; 4,69,627.5 total self links; 5,35,923.5 total external links and 4,13,404.5 total in-links. ICAR-National Research Centres with 1,30,012 total web pages and 2,19,365 total links are in second postiton. ICAR-Deemed Universities holds third position in having 1,75,900 total self-link; 1,81,080 external links and 1,32,690 in-links. Project Directorates and National Beuroux are in fourth and fifth position with respect to distribution of web pages and links of all aspects. The WIF is useful in clarifying the significance of inlink (or total link) frequencies. However, the greater the number of link pages to a web site, the greater the WIF will be.

4.1 Alternative Document Model (ADM)

Webometrics deals with the application of infometric and other quantitative techniques for the analysis of Web documents (Jalal et al., 2009). There is a need for collecting data not only through commerical search engines but also academic web crawlers to overcome any bias. The advantage of an academic crawler is that it is possible to cover an individual website comprehensively within specified parameters. It is not possible for web crawlers to cover large web areas for which search engines are most appropriate. With a great deal of analysis for the data collected from search engines, Young et al. (2009) found the efficacy of the ADM approach in evaluating the metric data containing extreme outliers. Thelwall suggested an Alternative Document Model (ADM) to collect the link data for universities. The four parts of Alternative Document Model are reflected in Figure 3. The ADM count summary for ICAR organisations given in Annexure 1.

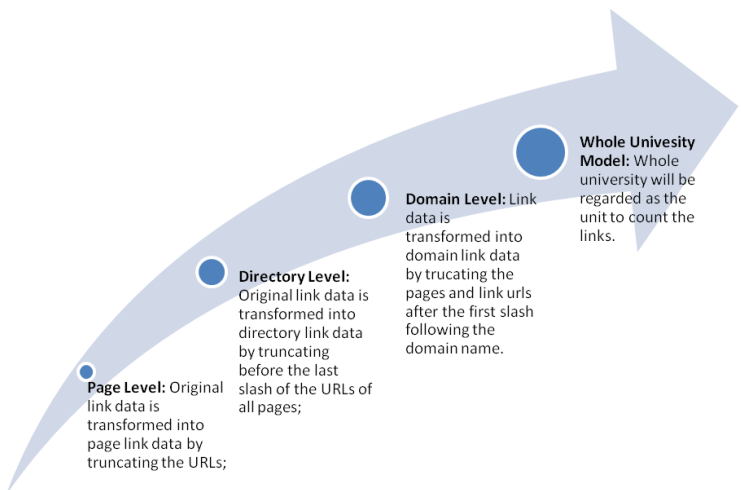

Fig. 3. Four parts of the Alternative Document Model (ADM)

4.2 Link Topology for ICAR-Deemed Univeristies

Some of the ICAR Institutes have acquired the status of 'Deemed University' because of their achievements. It is obvious from Figure 4 that websites of Deemed universities are not well connected

with that of the Main Institution. For example, ICAR, New Delhi posess 64 page out-links, 2 Directory links, 2 Domain out-links and 1 site out-link. It is surprising to note that National Dairy Institute, Karnal and Central Institute on Fisheries Education, Mumbai do not have any weblinks whatsoever.

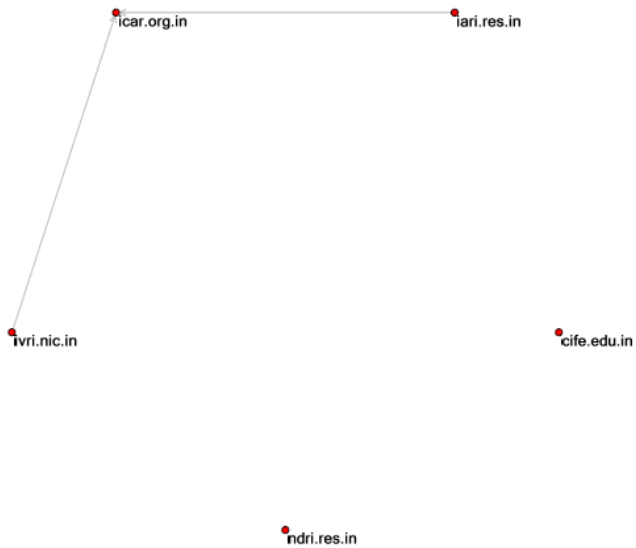

Fig. 4. Link Topology for ICAR-Deemed Universities

4.3 Link Topology for ICAR-Institutions

ICAR Institutions are established as Agriculture is a major sector of the Indian economy. They contribute greatly to GDP and provide more than 50% of employment. ICAR institutes are connected through Agricultural Research Information System (ARIS), a WAN with other ICAR institutions like universities, zonal agricultural stations, project directorates and others. These organizations collaborate in training and education for manpower and development. Figure 5 shows that ICAR-Indian Agricultural Statistics Research Institute, New Delhi have more number of weblinks than any other ICAR-Institutions. IASRI, Delhi has 44 page in-links, 37 directory in-links, 32 domian in-links, 17 site in-links, 1 page out-link, 1 directory out link, 1 domain out-link and 1 site out-link respectively. It should be noted that the following institutions have remarkable number of weblinks: Central Arid Zone Research Institute, Jodhpur; Central Research Institute of Dryland Agriculture, Hyderabad; and Indian Institute of Soil Sciences, Bhopal. The Figure clearly reflects that most of the institutes have inter relationship with ICAR, New Delhi, and ICAR-Indian Agricultural Statistics Research Institute, New Delhi also possess inter-relationship with ICAR-institutes such as Central Potato Research Institute, Shimla; Central Research Institute for Jute; Allied Fibres, Barrackpore; Indian Institute of Water Management, Bhubaneshwar; and Indian Institute of Horticultural Research, Bengaluru.

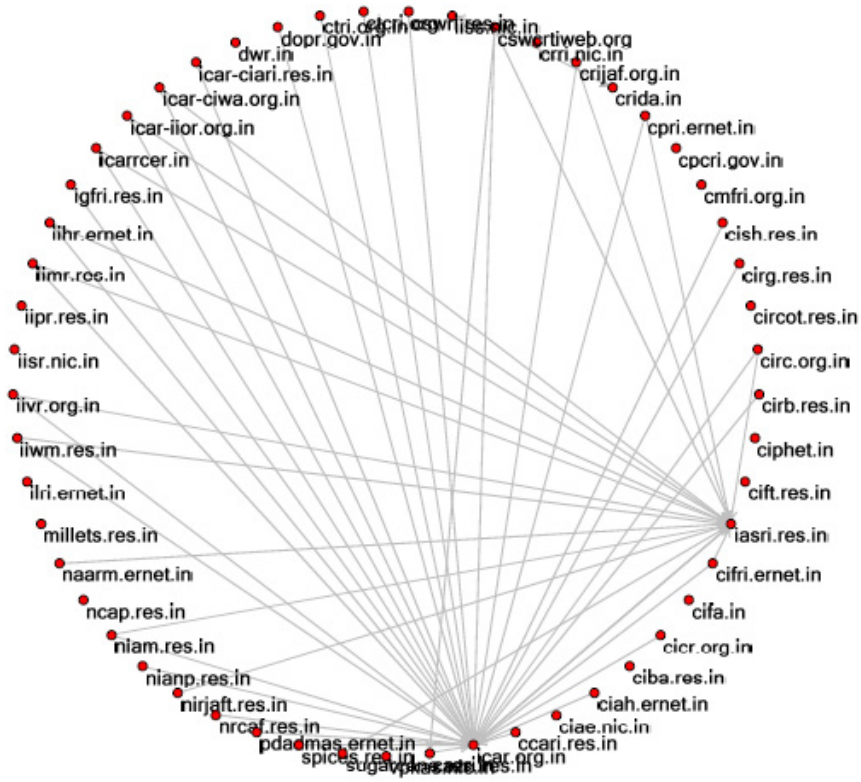

Fig. 5. Link Topology for ICAR- Institutions

4.4 Link Topology for ICAR-National Research Centres

ICAR-National research centers is mandated to provide a research base to improve the productivity of important agri-horticulture, livestock and fisheries, poultry research as well as development activities in cotton technology, techno-economically viable and sustainable culture system for finfish and shellfish in brakishwater and so on. Certain regional research centers and stations were also merged to widen their scope towards agriculture development. While some of the older institutes existed as separate entities, some have been initiated by ICAR itself. Those agriculture research institutes which worked independently came under the governance of ICAR due to their experienced knowledge base. Figure 6 denotes Link topology formed among the ICAR-National Research Centers. Most of the National Reserch Centres have web links. National Research Centres for Banana, Trichy has 12 pages out-links while ICAR-National Research Centre for Citrus, Nagpur and National Research Centre on Camel, Bikaner each have 15 page out-links.

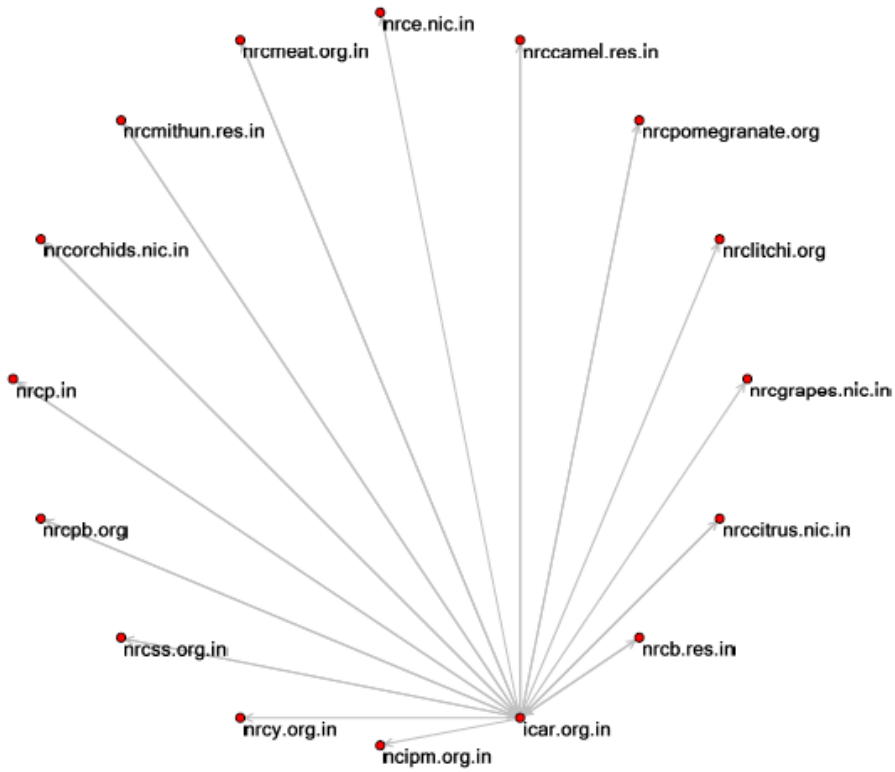

Fig. 6. Link topology formed among the ICAR-National Research Centers

4.5 Link Topology for ICAR-National Bureaux

Realizing the unique significance of agricultural and animal resources and their potential utilization at global level, a need was felt for an organization which could undertake the responsibility of evaluating, certifying and conserving the country's rich and varied resources. Thus, the establishment of ICAR-National Bureaux from sustained efforts made by the leading researchers in India over the years. The Bureaux has traveled a long journey in striving for excellence in innovative research to identify the uniqueness and genetic potential of the country's vastly distributed livestock biodiversity and its sustainable development. Among the major achievements to its credit are the phenotypic and genetic characterization of the majority (> 90%) of the registered breeds of cattle, buffalo, sheep, goat, equines, camel and poultry. Figure 7 reflects that there prevails a good relationship among National Bureaux under ICAR. It is interesting to note that National Bureau of Agriculturally Important Micro-organisms, Mau, Uttar Pradesh have web link distributions with Fish Genetic Resources, Lucknow, National Bureau of Plant Genetics Resources, New Delhi and National Bureau of Animal Genetic Resources, Karnal.

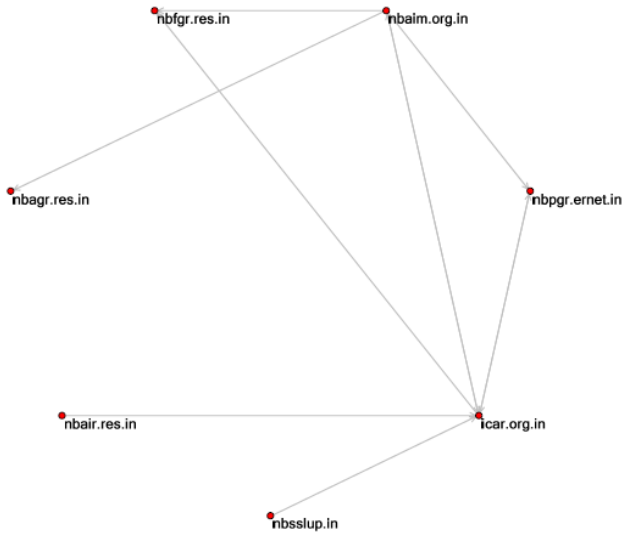

Fig. 7. ICAR-National Bureaux

4.6 Link Topology for ICAR-Project Directorates

The basic mandates of Project Directorates are strategic and adaptive research on agricultural productivity and quality. They provide access to information, knowledge and genetic material to develop improved technology and enhance agricultural production. Figure 8 shows the visualized network of ICAR-Directories Project. From the figure, it could be understood there exists a progressive network between ICAR and other directorates. Only the Directorate of Rice Research, Hyderabad and ICAR-Directorate of Seed Research, Mau have a web link relationship.

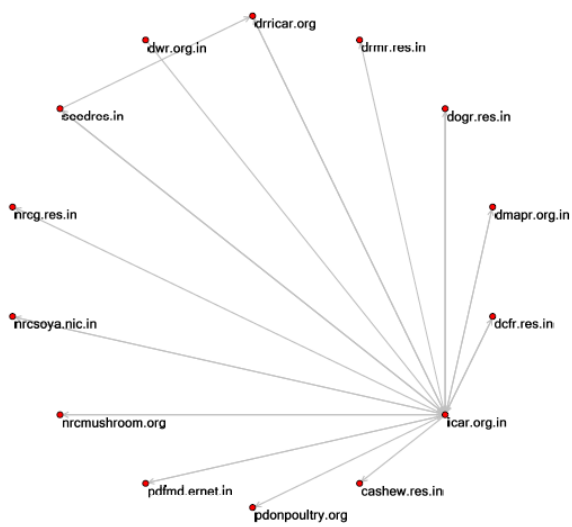

Fig. 8. ICAR-Directories project

5. Major findings and Suggestions

In the present research system, the role of ICAR at the national level in aiding, promoting and coordinating research and education activities across the country is of significant importance. Since independence, there has been a substantial growth in the Indian agricultural research system. ICAR is the chief public body at the national level for directing and endorsing agricultural research and education in the country. Likewise, State Agricultural Universities are responsible for doing the same at the state level. In this study, the Web Impact Factor (WIF) for each ICAR organisation has been calculated in four levels. Simple Web Impact Factor (SWIF) considering all the link pages, Self-link Web Impact Factor (SWIF) considering only self link pages, External-link Web Impact Factor (ELWIF) considering only external link pages and In-link Web Impact Factor (ILWIF) considering only in-link pages. Since it is the true refelection of the degree of impact of the domain spaces on the WWW, Web Imapct Factors for each ICAR Organisations are caculated based on formula given in Table 2. The report revealed that National Beuraux occupied first place with simple web Impact factor of 2.09. Deemed Universities procured first place with self-link web impact factor of 1.74; external-link web impact factor of 1.45 and in-link web impact factor of 1.06. National Research Centres are ranked second with respect to SWIF of 1.69; SLWIF of 0.91 and second, third rank concerning to ELWIF of 0.91 and ILWIF of 0.71. ICAR-Institutions occupied fourth place with respect to SWIF of 1.20; SLWIF of 0.08 and ELWIF of 0.92. Project directorates were in fifth rank concerning to SLWIF of 0.43 and ELWIF of 0.46

The study also focused on .link analysis which is a recognized focus within webometrics. It normally uses counts of links between sets of web sites or to sets of web sites. These link counts are derived from web crawlers or commercial search engines with the latter being the only alternative for some investigations (Thelwall, 2011). The results clearly show that almost all National Bureaux have link with ICAR-New Delhi. ICAR-National Bureaux of Plant Genetics Resources, New Delhi has more in-links and out-links compared to the rest of the National Bureaux. It is important to notice that ICAR-National Bureau of Animal Genetic Resources, Karnal does not have a direct link with ICAR, New Delhi; instead they have a link with National Bureau of Agriculturally Important Micro-organisms, Mau, Uttar Pradesh. The study found that ICAR-Directorate of Rice Research, Hyderabad has more web links, followed by Directorate of Mushroom Research, Solan and ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand. The Radar plot in figure 9 shows distribution of overall links with ICAR-Organization.

It could be understood from the figure that ICAR-Institutions hold first position with respect to 68 pages in-link, 45 directory in-links, and 33 domain in-links. National Research Centres are ranked second concerning to 67 page in-links, 23 Directory in-link, 11 Domain in-links, 10 site in-links and 27 page out links, and they secure first place related to 22 directory out links, 15 domain out link and 15 out links. National Bureaux holds third position pertaining to 15 Directory in-links, 8 Directory out links, 3 domains out links and 3 sites out links; they are placed fourth with respect to 38 page in-links, 5 Domain in-links, 4 site in-links and they secure first position with 33 pages out links among ICAR-Organizations.

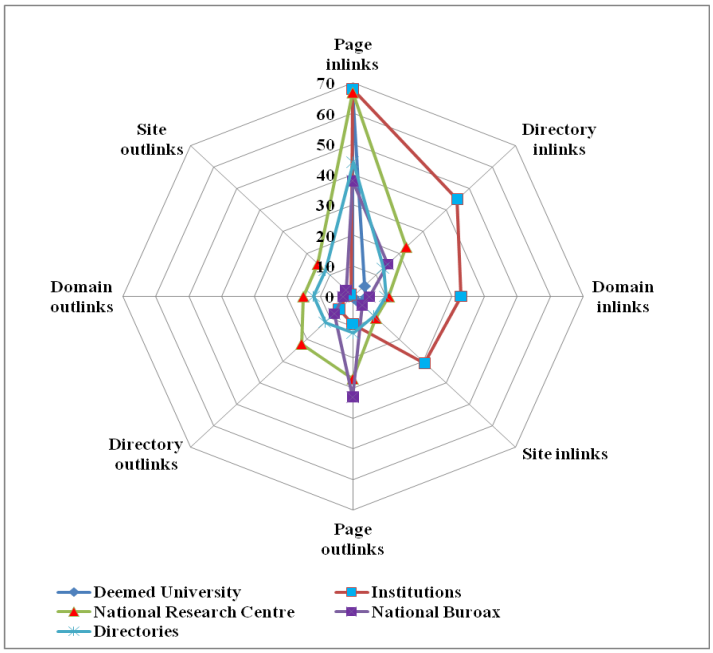

Fig. 9. Distribution of Overall link with ICAR Organizations

6. Conclusion

One of the original objectives of ICAR was to undertake aid, promote, and coordinate agricultural education in the country. At present, ICAR plays a central role at the national level and it aids, promotes, and coordinates research and education activities throughout the country. The research and education responsibilities at the state level rest with the State Agricultural Universities. Webometric analysis offers an evaluation measurement that is lacking in bibliometrics when an institution is the analytical unit; however Webometric research must be conducted with caution, because both the data source (i.e., Web-based data) and data collection instruments (i.e., Web search engines) have obvious deficiencies (Chu et al., 2001). This paper explored the application of various forms of web impact factors as a method of ranking ICAR Organizations. There is scope for future Webometric research in this area. It would be useful to carry out a more comprehensive study comparing more ICAR organizations and comparing web with conventional publication output and indicators of academic and technological development.

References

Ahmadian Yazdi, F., & Deshpande, N. J. (2013, February). Evaluation of selected library associations' web sites. In *Aslib Proceedings* (Vol. 65, No. 2, pp. 92-108). Emerald Group Publishing Limited.

Babu, B. R., Jeyshankar, R., & Rao, P. N. (2010). Websites of Central Universities in India: A webometric analysis. *DESIDOC Journal of Library & Information Technology, 30*(4), 33.

Basili, C., & De Biagi, L. (2016). Academic blogging consequences for Open Science: a first insight into their potential impact. *Grey Journal (TGJ), 12*(2), 91-95.

Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. *Annual review of information science and technology, 36*(1), 1-53.

Borthakur, A., & Singh, P. (2013). History of agricultural research in India. *Current Science*, 587-593.

Brophy, J., & Bawden, D. (2005, December). Is Google enough? Comparison of an internet search engine with academic library resources. In *Aslib Proceedings* (Vol. 57, No. 6, pp. 498-512). Emerald Group Publishing Limited.

Chakravarty, R., & Wasan, S. (2015). Webometric analysis of library websites of higher educational institutes (heis) of india: A study through google search engine. *DESIDOC Journal of Library & Information Technology, 35*(5), 325-329.

Chu, H. (2001). A Webometric analysis of ALA accredited LIS schools' Websites. In *ISSI-2001: International Society for Scientometrics and Informetrics. International conference* (pp. 117-126).

Chu, H. (2005). Taxonomy of inlinked Web entities: What does it imply for webometric research?. *Library & Information Science Research, 27*(1), 8-27.

Chung, Y., Yu, S., Kim, Y., & Kim, S. (2009). Characteristics and link structure of a national scholarly Web space: The case of South Korea. *Scientometrics, 80*(3), 595-612.

García, A., Brown Ibanez, A., Ferrer Sapena, A., Peset Mancebo, M. F., & González-Moreno, L. M. (2015). Bibliographic data analysis tools and mapping of knowledge: Bibexcel and Pajek. *IDB texts university library and information science*, 34.

Gisela, C. M., Zulueta, M. A., Benjamin, V. Q., & Zaida, C. R. (2014). Spanish evolutionary study of stem cell research. Visualization and identification of the main lines of research. *The Information Professionals, 23*(3), 259-271.

ICAR details. (n.d). Retrieved from http://www.icar.org.in/en/aboutus.htm

ICAR-Deemed Universities. (n.d). Retrieved from http://www.yourarticlelibrary.com/education/role-of-the-indian-council-of-agricultural-research-icar-functions-and-types/45186/

ICAR-Institutions. (n.d). Retrieved from https://targetstudy.com/icar-institutes.html

ICAR-National Bureaux. (n.d). Retrieved from http://www.nbagr.res.in/

ICAR-National Research Centres. (n.d). Retrieved from http://www.indiaeducation.net/agriculture/research-institutes.aspx

ICAR-Project Directorates details. (n.d). Retrieved from http://nrcsoya.nic.in/

Ingwersen, P. (1998). The calculation of Web Impact Factors. *Journal of Documentation, 54*(2), 236-243.

Jalal, S. K., Biswas, S. C., & Mukhopadhyay, P. (2009, November). Webometric analysis of Central Universities in India: A study. In *Internet Technology and Secured Transactions, 2009. ICITST 2009. International Conference for* (pp. 1-9). IEEE.

Jeyshankar, R., & Babu, B. R. (2009). Websites of universities in Tamil Nadu: a webometric study. Academic Journal. *Annals of Library & Information Studies, 56*(2), 2-2.

Kozak, M., Bornmann, L., & Leydesdorff, L. (2015). How have the Eastern European countries of the former Warsaw Pact developed since 1990? A bibliometric study. *Scientometrics, 102*(2), 1101-1117.

Kretschmer, H., & Havemann, F. (2008). Proceedings of WIS 2008: Fourth International Conference on Webometrics, Informetrics and Scientometrics & Ninth COLLNET Meeting. In *DEUTSCHE NATIONALBIBLIOTHEK*.

Maharana, R. K., Panda, K. C., & Sahoo, J. (2012). Web impact factor (WIF) and link analysis of Indian Institute of Technologies (IITs): A webometric study. *Academic Journal. Library Philosophy & Practice*. 1-11.

Nagarkar, S. P., & Kumbhar, R. (2015). Text mining: An analysis of research published under the subject category 'Information Science Library Science'in Web of Science Database during 1999-2013. *Library Review, 64*(3), 248-262.

Noroozi, Z., & Hashemzadeh, M. J. (2014). A Link Network Analysis of Iranian Research Institute Websites&58; Overt and Covert Relationships. *Iranian journal of Information Processing & Management, 29*(1), 211-232.

Noruzi, A. (2006). The web impact factor: a critical review. *The electronic library, 24*(4), 490-500.

Onan, A. (2016). Classifier and feature set ensembles for web page classification. *Journal of Information Science, 42*(2), 150-165.

Ontalba-Ruipérez, J. A., Orduna-Malea, E., & Alonso-Arroyo, A. (2016). Identifying institutional relationships in a geographically distributed public health system using interlinking and co-authorship methods. *Scientometrics, 106*(3), 1167-1191.

Peker, S., Kucukozer-Cavdar, S., & Cagiltay, K. (2016). Exploring the relationship between web presence and web usability for universities: a case study from Turkey. *Program, 50*(2), 157-174.

Ruas, T. L., & Pereira, L. (2014). How to build Science, Technology, and Innovation Indicators using Web of of Science, Derwent World Patent Index, Bibexcel, and Pajek?. *Perspectivas em Ciência da Informação, 19*(3), 52-81.

Shukla, S. H., & Poluru, L. (2012). Webometric analysis and indicators of selected Indian state universities. *Information Studies, 18*(2), 79-104.

Sun, Y., & Grimes, S. (2016). The emerging dynamic structure of national innovation studies: a bibliometric analysis. *Scientometrics, 106*(1), 17-40.

Taram, K., & Doulani, A. (2015). A webometric analysis of major keywords and expressions in biochemistry using LexiURL Searcher. *The Electronic Library, 33*(6), 1163-1173.

Thelwall, M. (2001). Results from a web impact factor crawler. *Journal of Documentation, 57*(2), 177-191.

Thelwall, M. (2011). A comparison of link and URL citation counting. *Aslib Proceedings, 63*(4), 419-425.

Thelwall, M., Kousha, K., Dinsmore, A., & Dolby, K. (2016). Alternative metric indicators for funding scheme evaluations. *Aslib Journal of Information Management, 68*(1), 2-18

Thelwall, M., Vaughan, L., & Björneborn, L. (2005). Webometrics. *ARIST, 39*(1), 81-135.

Thelwall, M., & Wilkinson, D. (2003). Three target document range metrics for university Web sites. *Journal of the Association for Information Science and Technology, 54*(6), 490-497.

Thomas, O., & Willett, P. (2000). Webometric analysis of departments of librarianship and information science. *Journal of information science, 26*(6), 421-428.

Vijayakumar, M., Kannappanavar, B. U., & KT, S. K. (2012). Webometric analysis of web presence and links of SAARC countries. *DESIDOC Journal of Library & Information Technology, 32*(1).

[About the authors]

Kutty Kumar, Ph.D is presently working as Assistant Professor, Department of Library and Information Science in Sri Venkateswara Veterinary University, College of Veterinary Science, Proddatur. His research focuses on Digital Library Initiatives in Engineering Educational Institutions in Rayalaseema Region of Andhra Pradesh. He has 15 years' experience in librarianship in both Engineering and Medical Educational Institutions. Around 43 articles were published in peer reviewed journals, 26 conference proceedings (both National and International) and had attended about 12 workshops and seminars. His subjects of interest include Digital Library, Web Technology, Cloud Computing, Data Mining and Computer Networks.

[Appendix-A] Alternative Doucment Model (ADM)

Table 1. Distribution of ICAR-Deemed University Web Links

S.No	Deemed University	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
	Indian Council of Agricultural Research New Delhi	**icar.org.in (Source)**	67	5	4	2	0	0	0	0
1	ICAR-Indian Agricultural Research Institute, New Delhi	iari.res.in	0	0	0	0	64	2	2	1
2	ICAR-National Dairy Research Institute, Karnal	ndri.res.in	0	0	0	0	0	0	0	0
3	ICAR-Indian Veterinary Research Institute, Izatnagar	ivri.nic.in	0	0	0	0	3	3	2	1
4	ICAR-Central Institute on Fisheries Education, Mumbai	cife.edu.in	0	0	0	0	0	0	0	0

Table 2. Distribution of ICAR-Institutional Web Links

S.No	Institutions	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
	Indian Council of Agricultural Research New Delhi	**icar.org.in (Source)**	68	45	33	31	9	6	2	1
1	ICAR-Central Island Agricultural Research Institute , Port Blair	icar-ciari.res.in	0	0	0	0	1	1	1	1
2	ICAR-Central Arid Zone Research Institute, Jodhpur	cazri.res.in	2	2	1	1	3	3	1	1
3	ICAR-Central Avian Research Institute, Izatnagar	cari.org.in	0	0	0	0	0	0	0	0
4	ICAR-Central Inland Fisheries Research Institute, Barrackpore	cifri.ernet.in	0	0	0	0	2	2	2	2
5	ICAR-Central Institute Brackishwater Aquaculture, Chennai	ciba.res.in	0	0	0	0	0	0	0	0
6	ICAR-Central Institute for Research on Buffaloes, Hissar	cirb.res.in	0	0	0	0	3	1	1	1
7	ICAR-Central Institute for Research on Goats, Makhdoom	cirg.res.in	0	0	0	0	2	1	1	1
8	ICAR-Central Institute of Agricultural Engineering, Bhopal	ciae.nic.in	0	0	0	0	0	0	0	0
9	ICAR-Central Institute for Arid Horticulture, Bikaner	ciah.ernet.in	0	0	0	0	12	3	1	1
10	ICAR-Central Institute of Cotton Research, Nagpur	cicr.org.in	0	0	0	0	2	2	1	1
11	ICAR-Central Institute of Fisheries Technology, Cochin	cift.res.in	0	0	0	0	0	0	0	0
12	ICAR-Central Institute of Freshwater Aquaculture, Bhubneshwar	cifa.in	0	0	0	0	0	0	0	0
13	ICAR-Central Institute of Research on Cotton Technology, Mumbai	circot.res.in	0	0	0	0	0	0	0	0
14	ICAR-Central Institute of Sub Tropical Horticulture, Lucknow	cish.res.in	0	0	0	0	2	1	1	1
15	ICAR-Central Institute on Post harvest Engineering and Technology, Ludhiana	ciphet.in	0	0	0	0	0	0	0	0
16	ICAR-Central Marine Fisheries Research Institute, Kochi	cmfri.org.in	0	0	0	0	0	0	0	0
17	ICAR-Central Plantation Crops Research Institute, Kasargod	cpcri.gov.in	0	0	0	0	0	0	0	0

S.No	Institutions	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
18	ICAR-Central Potato Research Institute, Shimla	cpri.ernet.in	0	0	0	0	5	5	5	2
19	ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore	crijaf.org.in	0	0	0	0	2	2	2	2
20	ICAR-Central Research Institute of Dryland Agriculture, Hyderabad	crida.in	2	2	1	1	0	0	0	0
21	ICAR-Central Rice Research Institute, Cuttack	crri.nic.in	0	0	0	0	0	0	0	0
22	ICAR-Central Sheep and Wool Research Institute, Avikanagar, Rajasthan	cswri.res.in	0	0	0	0	8	3	1	1
23	ICAR- Indian Institute of Soil and Water Conservation, Dehradun	cswcrtiweb.org	0	0	0	0	10	10	5	5
24	ICAR-Central Tobacco Research Institute, Rajahmundry	ctri.org.in	0	0	0	0	1	1	1	1
25	ICAR-Central Tuber Crops Research Institute, Trivandrum	ctcri.org	0	0	0	0	1	1	1	1
26	ICAR-ICAR Research Complex for Eastern Region, Patna	icarrcer.in	0	0	0	0	2	2	2	2
27	ICAR-Central Coastal Agricultural Research Institute, Ela, Old Goa, Goa	ccari.res.in	0	0	0	0	1	1	1	1
28	ICAR-Indian Agricultural Statistics Research Institute, New Delhi	iasri.res.in	44	37	32	17	1	1	1	1
29	ICAR-Indian Grassland and Fodder Research Institute, Jhansi	igfri.res.in	0	0	0	0	2	1	1	1
30	ICAR-Indian Institute of Horticultural Research, Bengaluru	iihr.ernet.in	0	0	0	0	4	4	3	2
31	ICAR-Indian Institute of Natural Resins and Gums, Ranchi	ilri.ernet.in	0	0	0	0	0	0	0	0
32	ICAR-Indian Institute of Pulses Research, Kanpur	iipr.res.in	0	0	0	0	0	0	0	0
33	ICAR-Indian Institute of Soil Sciences, Bhopal	iiss.nic.in	2	2	1	1	0	0	0	0
34	ICAR-Indian Institute of Spices Research, Calicut	spices.res.in	0	0	0	0	1	1	1	1
35	ICAR-Indian Institute of Sugarcane Research, Lucknow	iisr.nic.in	0	0	0	0	0	0	0	0
36	ICAR-Indian Institute of Vegetable Research, Varanasi	iivr.org.in	0	0	0	0	9	3	3	2
37	ICAR-National Academy of Agricultural Research & Management, Hyderabad	naarm.ernet.in	0	0	0	0	1	1	1	1
38	ICAR-National Institue of Abiotic Stress Management, Malegaon, Maharashtra	niam.res.in	0	0	0	0	4	4	4	2
39	ICAR-National Institute of Animal Nutrition and Physiology, Bengaluru	nianp.res.in	0	0	0	0	2	2	2	1
40	ICAR-National Institute of Research on Jute & Allied Fibre Technology, Kolkata	nirjaft.res.in	0	0	0	0	1	1	1	1
41	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Hebbal, Bengaluru	pdadmas.ernet.in	0	0	0	0	2	1	1	1
42	ICAR-Sugarcane Breeding Institute, Coimbatore	sugarcane.res.in	0	0	0	0	2	2	2	1
43	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora	vpkas.nic.in	0	0	0	0	0	0	0	0
44	ICAR-Central Institute for Research on Cattle, Meerut, Uttar Pradesh	circ.org.in	0	0	0	0	3	3	2	2

S.No	Institutions	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
45	ICAR-Indian Institute of Maize Research,New Delhi	iimr.res.in	0	0	0	0	7	7	6	2
46	ICAR- Central Agroforestry Research Institute, Jhansi	nrcaf.res.in	0	0	0	0	1	1	1	1
47	ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi	ncap.res.in	0	0	0	0	0	0	0	0
48	ICAR- Indian Institute of Wheat and Barley Research, Karnal	dwr.in	0	0	0	0	0	0	0	0
49	ICAR- Indian Institute of Millets Research, Hyderabad	millets.res.in	0	0	0	0	0	0	0	0
50	ICAR- Indian Institute of Oilseeds Research, Hyderabad	icar-iior.org.in	0	0	0	0	3	3	3	2
51	ICAR- Indian Institute of Oil Palm Research, Pedavegi, West Godawari	dopr.gov.in	0	0	0	0	1	1	1	1
52	ICAR- Indian Institute of Water Management, Bhubaneshwar	iiwm.res.in	0	0	0	0	4	4	3	2
53	ICAR- Central Institute for Women in Agriculture, Bhubaneshwar	icar-ciwa.org.in	0	0	0	0	4	3	3	2

Table 3. Distribution of ICAR-National Research Centres Web Links

S.No	National Research Centres	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
	Indian Council of Agricultural Research New Delhi	**icar.org.in (Source)**	67	23	11	10	27	22	15	15
1	ICAR-National Research Centre for Banana, Trichi	nrcb.res.in	2	2	1	1	12	1	1	1
2	ICAR-National Research Centre for Citrus, Nagpur	nrccitrus.nic.in	2	1	1	1	15	1	1	1
3	ICAR-National Research Centre for Grapes, Pune	nrcgrapes.nic.in	2	1	1	1	0	0	0	0
4	ICAR-National Research Centre for Litchi, Muzaffarpur	nrclitchi.org	1	1	1	1	0	0	0	0
5	ICAR-National Research Centre for Pomegranate, Solapur	nrcpomegranate.org	2	1	1	1	5	1	1	1
6	ICAR-National Research Centre on Camel, Bikaner	nrccamel.res.in	2	2	1	1	15	3	1	1
7	ICAR-National Research Centre on Equines, Hisar	nrce.nic.in	2	2	1	1	0	0	0	0
8	ICAR-National Research Centre on Meat, Hyderabad	nrcmeat.org.in	2	1	1	1	7	7	1	1
9	ICAR-National Research Centre on Mithun, Medziphema, Nagaland	nrcmithun.res.in	2	2	1	1	1	1	1	1
10	ICAR-National Research Centre on Orchids, Pakyong, Sikkim	nrcorchids.nic.in	1	1	1	1	1	1	1	1
11	ICAR-National Research Centre on Pig, Guwahati	nrcp.in	2	1	1	1	1	1	1	1
12	ICAR-National Research Centre on Plant Biotechnology, New Delhi	nrcpb.org	2	2	1	1	6	4	2	1
13	ICAR-National Research Centre on Seed Spices, Ajmer	nrcss.org.in	1	1	1	1	4	3	1	1
14	ICAR-National Research Centre on Yak, West Kemang	nrcy.org.in	2	2	1	1	0	0	0	0
15	ICAR-National Centre for Integrated Pest Management, New Delhi	http://www.ncipm.org.in	2	2	1	1	0	0	0	0

Table 4. Distribution of ICAR-National Bureaux Web Links

S.No	National Bureaux	URL	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
	Indian Council of Agricultural Research New Delhi	**icar.org.in (Source)**	38	15	5	4	33	8	3	3
1	ICAR-National Bureau of Plant Genetics Resources, New Delhi	nbpgr.ernet.in	44	8	2	2	16	8	1	1
2	ICAR-National Bureau of Agriculturally Important Micro-organisms, Mau, Uttar Pradesh	nbaim.org.in	1	1	1	1	52	8	4	4
3	ICAR-National Bureau of Agricultural Insect Resources, Bengaluru	nbair.res.in	0	0	0	0	3	1	1	1
4	ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur	nbsslup.in	0	0	0	0	6	4	2	1
5	ICAR-National Bureau of Animal Genetic Resources, Karnal	nbagr.res.in	13	2	1	1	0	0	0	0
6	ICAR-National Bureau of Fish Genetic Resources, Lucknow	nbfgr.res.in	14	3	2	2	0	0	0	0

Table 5. Distribution of ICAR-Project Directorate Web Links

S.No		Name	Page inlinks	Directory inlinks	Domain inlinks	Site inlinks	Page outlinks	Directory outlinks	Domain outlinks	Site outlinks
	Indian Council of Agricultural Research New Delhi	**icar.org.in (Source)**	44	13	10	9	12	12	12	12
1	ICAR-Directorate of Rice Research, Hyderabad	drricar.org	2	2	2	2	14	1	1	1
2	ICAR-Directorate of Seed Research, Mau	seedres.in	1	1	1	1	2	2	2	2
3	ICAR-Directorate of Groundnut Research, Junagarh	nrcg.res.in	1	1	1	1	0	0	0	0
4	ICAR-Directorate of Soybean Research, Indore	nrcsoya.nic.in	1	1	1	1	1	1	1	1
5	ICAR-Directorate of Rapeseed & Mustard Research, Bharatpur	drmr.res.in	1	1	1	1	0	0	0	0
6	ICAR-Directorate of Mushroom Research, Solan	nrcmushroom.org	1	1	1	1	12	2	1	1
7	ICAR-Directorate on Onion and Garlic Research, Pune	dogr.res.in	1	1	1	1	2	1	1	1
8	ICAR-Directorate of Cashew Research, Puttur	cashew.res.in	1	1	1	1	0	0	0	0
9	ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand	dmapr.org.in	1	1	1	1	4	4	2	1
10	ICAR-Directorate of Weed Science Research, Jabalpur	dwr.org.in	0	0	0	0	7	1	1	1
11	ICAR-Project Directorate on Foot & Mouth Disease, Mukteshwar	pdfmd.ernet.in	1	1	1	1	1	1	1	1
12	ICAR-Directorate of Poultry Research, Hyderabad	pdonpoultry.org	1	1	1	1	0	0	0	0
13	ICAR-Directorate of Knowledge Management in Agriculture (DKMA), New Delhi	icar.org.in	0	0	0	0	0	0	0	0
14	ICAR-Directorate of Cold Water Fisheries Research, Bhimtal, Nainital	dcfr.res.in	1	1	1	1	2	1	1	1