Availability and Accessibility of Research Outputs in NARS: A case study with IARI

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Abstract

This article focuses on the trends in publication, authorship pattern, availability, and accessibility of articles during 2008–2010 from the Indian Agricultural Research Institute (IARI), a constituent of the National Agricultural Research System in India. The data reveal that during the period of study, researchers from IARI produced 1,833 publications, most of which were jointly authored, and that the most preferred journal for publication by researchers is the *Indian Journal of Agricultural Sciences*, which is now an Open Access journal. While publications from IARI are available to subscribers of the Consortium for e-Resources in Agriculture (CeRA), public availability to IARI publications is very meager. Hence, in order to make their research output more accessible and available to a wider audience, IARI researchers should deposit their work in IARI's Open Access repository Eprints@IARI. However, making such a deposit requires an Open Access policy, which IARI is yet to adopt.

Keywords

Agriculture; India; Mass media; Open Access; Public sector; Policies; Research communications; Technological changes; Technology; Quality

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Introduction

The National Agricultural Research System (NARS) in India is the world's largest network of 97 agricultural research institutes established by the Indian Council of Agricultural Research (ICAR) across the country and 58 agricultural universities established by the state governments in their respective states. The ICAR is an apex body of NARS, coordinating research, education, and extension agriculture including horticulture, fisheries, and animal sciences for the entire country. The research in the NARS constituents is publicly funded and is being undertaken to further food and nutrition security and sustainable livelihoods in India. Hence, the knowledge of this agricultural research should be made available for the public good. The recent developments in Information Communication Technologies (ICTs) have brought drastic changes to conventional communication channels of scientific communications, information sharing, and accessing behavior of the scholarly community. The ICTs have paved the way for the global Open Access (OA) movement among scholarly communities. Open Access to science and scholarship means making scholarly research articles freely available to the public online without any restrictions (Suber, 2004).

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One of the mandates of ICAR is to act as a clearing house of research and general information relating to agriculture through its publications and other information that it disseminates. However, only recently did ICAR make two of its flagship journals (the *Indian Journal of Agricultural Sciences [IJAgS]* and *Indian Journal of Animal Sciences [IJAnS])*[1] OA while two of the universities in NARS, namely Kerala Agricultural University and University of Agricultural Sciences, Dharwad (UASD), had already made their university research journals OA much earlier. Joining the OA movement, to showcase research outputs, the Indian Agricultural Research Institute (IARI) established its institutional repository, Eprints@IARI[2] and made it live on 9th November 2009. This repository is the first OA repository to be established by an institute under NARS, though the credit for the establishment of the first Open Access repository in agricultural sciences in India goes to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)[3] a constituent establishment of the Consultative Group on International Agricultural Research (CGIAR)[4] at Hyderabad, India. Since then, three other OA institutional repositories: Eprints@CMFRI[5], Dspice@IISR[6], and E-Repository@IIHR[7] have been established in NARS by various ICAR institutes. In addition to these, one thematic repository, OpenAgri[8]; one commodity portal, RKMP[9]; two Electronic Theses and Dissertations *viz*, KrishiPrabha[10] established under National Agricultural Innovation Project (NAIP)[11] and ETD@UASD[12] established by UASD have been established in NARS. All these repositories are accessible to the public whereas KrishiPrabha is only for NARS constituents under IP address authentication. The establishment of these repositories shows that efforts are being made to make quality research articles more available and openly accessible. However, NARS needs to cultivate more awareness about OA, and create the necessary infrastructure and policy support within the organization. Earlier studies, such as Guttikonda and Gutam (2009) and Abraham et. al. (2009), give some insights into the prospects of Open Access for Indian agricultural research.

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Objectives

This article documents the results of a study undertaken by the authors in relation to work published by IARI from 2008 to 2010. The objectives of this study were:

1. To determine the volume of the work published by IARI during the study period;
2. To identify the publication pattern;
3. To examine the proportion of single authored papers compared to multi authored papers;
4. To find the citation pattern of the published articles with reference to proprietary and Open Access;
5. To emphasize the impact of open access publishing on research productivity with reference to availability and accessibility of the publications.

Indian Agricultural Research Institute (IARI)

Established in 1905 at Pusa, Bihar, and functional since 1936 at New Delhi, the IARI is the country's premier institute under ICAR for agricultural research, education, and extension in the country. It had played a crucial role in ushering the Green Revolution in India during 1960s[13] and continues to play an important role in addressing the issues related to agriculture: climate change, pests and diseases, sustainable farming, and water and land conservation. It has 20 divisions and eight regional stations under its establishment and produces voluminous research outputs that are distributed and disseminated through peer-reviewed journals, conferences, books, manuals, folders, leaflets, etc. After the establishment of Eprints@IARI, IARI's researchers started to deposit their articles into the repository.

Literature review

In the area of Indian food science and technology, Vijay (2003) has reported that collaborative research is preferred to solo research. Similarly, a study by Sharma (2009) of research articles published during 1991 to 2007 by the scientists of the Central Potato Research Institute (CPRI), a constituent establishment of ICAR, revealed that the majority of scientists of CPRI preferred to publish research papers in joint authorship (82.67%). His study showed that while there appeared to be no uniform pattern in literature growth during the period of review, factors like availability of funds, scientist recruitment and availability, as well as conferences, seminars, and other targeted events had an impact over scientific productivity and output.

Dixit and Katare (2007) studied the patterns of articles published in the journal of the Indian Society of Cotton Improvement for the period 1995–2004. Patterns related to authorship, bibliographic form, citation, contributing institutions, and subjects were analyzed. Based on those details, ranking of core journals (Indian and foreign) in the field of cotton science were identified. Al-Quallaf (2009) attempted to identify and analyze the intellectual structure of pomegranate (*Punica grantum* L.) literature and to

determine trends and patterns in specific areas in the growth of this literature, such as publication type, author productivity and patterns, subject focus, language dispersion, and characteristics of the journal literature.

According to Sarkhel and Choudhury (2010) the publication pattern indicates that Indian researchers in the agricultural field are careful to publish their research results in specialized journals, mostly of Indian origin. Muthu and Arunachalam (2011) studied papers published by Indian authors in international open access journals, and although they report that India's contribution is modest, they nonetheless suggest that Indian researchers self-archive their research publications in Institutional Repositories, which will ensure a wider exposure to and use of their research.

Methodology

We collected bibliography of all works published by IARI researchers during the years 2008, 2009, and 2010 indexed in Thomson Reuters *Web of Science* database[14]. We created a consolidated master database by adding to this pool the publications from IARI whose titles were indexed in the Google Scholar, in CeRA[15], and which were listed in IARI's annual reports and its website. All of these publications were then checked for their availability and accessibility.

In 2008 and 2009, Arivananthan et al. (2010) conducted a benchmarking study to understand ways that CGIAR agricultural research centres make their published research outputs available and accessible. We adopted their benchmarking methodology, in which they initially compiled all the published research outputs for each of their study centres from the Centre's Performance Report. The availability and accessibility of each of the outputs was evaluated by looking for them at various databases, search engines, and Centre's websites in a way an external user would try to access the research outputs.

The definitions of "availability" and "accessibility," which apply to Objective 5, and as reported by Arivananthan et al. (2010), which are based on CGIAR's ICT-KM Triple-A framework[16], are:

- Availability: Research outputs stored in open digital formats and described using public metadata standards so they can be found through structured search and access systems.
- Accessibility: Research outputs publicly available online so they can be queried, viewed and obtained in full.

For the "availability" of research outputs (abstracts and citations), we searched Google Scholar, the IARI website and IARI Annual Reports. For "accessibility" of research outputs (full text), we searched Eprints@IARI, Google Scholar and CeRA. Note that closed access articles may show availability of abstracts for example, but not accessibility to the full text.

Results and discussion

Objective 1: Volume of work published

The study revealed that during April 2009 to March 2010, IARI produced a large amount of research output in the form of journal articles, books, and conference papers. During the IARI's annual report period (April 2009 to March 2010), IARI researchers produced 1,833 publications, out of which 563 were peer reviewed journal articles, 669 were symposia/conference papers, 24 books, 266 book chapters, and 311 popular articles (i.e., unrefereed articles written for magazines and newspapers). From the consolidated indexed publications database that was created, it was found that 274, 237, and 284 peer-reviewed articles indexed in Thomson Reuters *Web of Science* database were published by IARI researchers in the years 2007–2008, 2008–2009, and 2009–2010 respectively. A total of 795 articles were published in 221 indexed journals in the subjects of horticulture, genetics, plant breeding, virology, and plant biochemistry and biotechnology, followed by environment, pest science, and food science.

Objective 2: Publication pattern

In reviewing publication patterns, the *Indian Journal of Agricultural Sciences* (IJAgS) was found to be the most preferred and popular journal, followed by *Current Science,* amongst IARI researchers during the study period. A total of 96 articles were published in IJAgS and 30 articles in *Current Science* by IARI researchers during the period of study. The IARI researchers published their articles in a total of 221 journals during the study period. However, only 13 of these 221 journals (Table 1) were found to have published more than ten articles by IARI researchers, the rest of the studied journals publishing a range of one to nine articles.

Table 1: Most preferred journals by IARI researchers for publishing in years 2008-2010

Sl. No.	Journal	ISSN	No.	Open Access	ISI JCR Impact Factor 2008	ISI JCR Impact Factor 2009	ISI JCR Impact Factor 2010	NAAS Rating 2010
1	Indian Journal of Agricultural Sciences	0019-5022	96	Yes	0.088	0.102	0.156	6.60
2	Indian Journal of Horticulture	0972-8538	43	No	0	0.062	0.229	6.40
3	Indian Journal of Genetics and Plant Breeding	0019-5200	42	No	0	0	0.141	5.10
4	Indian Journal of Virology	0970-2822 0974-0120	37	No	0	0.276	1.133	6.70
5	Journal of Plant Biochemistry and Biotechnology	0971-7811	33	No	0.143	0.323	0.412	6.80
6	Current Science	0011-3891	30	Yes	0.774	0.782	0.897	7.20
7	Journal of Environmental Science and Health Part B – Pesticides, Food Contaminants, and Agricultural Wastes	0360-1234	18	No	0.93	1.097	1.119	7.50
8	Bulletin of Environmental Contamination and Toxicology	0007-4861 1437-0800	15	No	0.93	1.097	1.119	7.40
9	Scientia Horticulturae	0304-4238	15	No	0.859	1.197	1.045	7.50
10	Environmental Monitoring and Assessment	0167-6369	11	No	1.035	1.356	1.436	7.50
11	Nutrient Cycling in Agroecosystems	1385-1314 1573-0867	11	No	1.282	1.350	1.957	7.50
12	Pest Management Science	1526-498X	10	No	2.040	2.190	2.313	7.70
13	Journal of Food Science and Technology – Mysore	0022-1155	10	No	0.221	0.318	0.477	6.80

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When we looked at the pattern of publication with respect to the Impact Factor (IF) of a journal, it appeared that the IARI authors elected to publish their articles in journals having high IFs. The IF describes the average citations for all papers in that journal over a two-year period (Wikipedia, 2012) and also provides a gross approximation of the prestige of journals in which individuals have been published (Thomson Reuters, 2012). The IF of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years (Thomson Reuters, 2012) and for this study the IF of Thomson Reuters is consulted by referring to Thomson Reuters' *Web of Science*. While the IF of IJAgS was 0.088, 0.102, 0.156, and 0.170 during 2008, 2009, 2010, and 2011 respectively, the IF of *Current Science* was 0.774, 0.782, 0.897, 0.935, during the same years. It is important to note that though *Current Science* had a higher IF, IARI authors had published more in IJAgS. Whereas *Current Science* is a multidisciplinary journal, IJAgS is a very popular and widely read journal specific to agricultural sciences and published by ICAR. IJAgS is rated highly by the India's National Academy of Agricultural Sciences (NAAS)[17].

In 2007, NAAS initiated a process of rating journals to bring uniformity in the evaluation of publication and for the assessment and recruitment of scientists. The pattern of publication was also examined with respect to this rating, although it should be noted that not all journals studied received a NAAS rating. The NAAS rating system has two categories, one category for journals that have a Thomson Reuters IF (which NAAS ranked from 6.0 to 10.0 based on their IF) and another category for journals that do not have an IF (ranked below 6.0 based on the information provided by the publishers in the prescribed proforma). So far, NAAS had published journal ratings in 2007, 2010, 2011, 2012, and 2013. The most recent ratings released by NAAS, effective from 1 January 2013 and includes about 1,992 journals, take into account changes in the 2010 IF by Thomson Reuters. Every institution within the NARS networks now adopts this rating for the assessment and recruitment of scientists. When we studied the NAAS ratings for the journals, the results showed that about 570 articles published were in journals that had a NAAS rating >7.0 and 261 were published in journals with a rating <6.0. These results clearly indicate that IARI authors choose to publish in those journals that have the highest NAAS rating, and suggest that publishing in such journals is a requirement for career advancement and assessment within their field.

Objective 3: Single authored versus co-authored articles

The majority of articles were co-authored: 428 articles (54%) listed four authors; 198 (25%) listed three authors; 137 (17%) listed two authors; and 32 (4%) were single-authored papers. The ratio of multi-authored papers to total number of authored papers (Subramanyam, 1983) was 0.95, which is an index of strong collaboration among the researchers.

Objective 4: Citation pattern

The citation pattern showed that the majority of articles (67%) were not cited by journals indexed in Thomson Reuters *Web of Science* database during the study period, and only three percent were cited more than five times. Of all the articles published during 2008–10, only one article published in *Nucleic Acids Research* (IF 7.479) was cited frequently – 62 times. This suggests either that the majority of papers are not valued for citing and/or that they are not reaching a larger audience. There are several reports stating that when articles are freely available, they are likely to be cited more than

those that are not (MacCallum and Parthasarathy, 2006; Eysenbach, 2006, Gargouri et al., 2010). For every increase in the availability of Open Access articles, citation numbers increase by a factor of 2.348 (Jingfeng, 2011).

Objective 5: Impact of Open Access

When availability and accessibility of IARI publications were examined for 2008–2010, of the 221 indexed journals, only 19 (9%) were open access journals indexed in DOAJ[18]. Additionally, 14% of the published articles could be found on Eprints@IARI. Thus, up to 23% of the published literature is available and accessible to the public.

The percentage of articles available in CeRA was 69%. This shows that a little more than 30% of the articles published were not available to the researchers in CeRA, a closed consortium model that makes articles available through subscription to NARS constituents. Through CeRA, 78% of the full texts were available online and the rest were available through a document delivery system. This means that nearly 20% of the articles from IARI were only available in print form and were not in electronic format.

These figures represent results from the years 2008–2010 only; we may presume a different picture for articles published when IARI first began. However, under the projects e-Granth[19] and E-PKSAR[20] of NAIP, which are encouraging back issue digitization, researchers may get some relief, as many of the old journal articles are being made available in open and electronic form.

Conclusion

According to information in ROAR[21], Eprints@IARI was established during November 2009; however, actual article deposition started during March 2010. Neither the IARI website nor its annual reports give full details of publications and to date, only 229 publications are deposited in the repository. Of the studied publications, only 16% of articles published by IARI are Open Access, which is very low compared with other national and international institutes. Hence, in order to make their research output more accessible and available to a wider audience, IARI researchers should deposit their work in IARI's Open Access repository Eprints@IARI. Likewise, the other researchers from other institutes of ICAR like Central Marine Fisheries Research Institute (CMFRI)[22], Indian Institute of Spices Research (IISR)[23], and Indian Institute of Horticultural Research (IIHR)[24] should deposit their work in their respective institutional repositories – Eprints@CMFRI, DSpice@IISR, and E-Repository@IIHR. The institutes/universities in NARS which do not have their own official repositories may deposit their work either in the repositories like OpenAgri, RKMP, or any other publicly available repositories like OpenMED@NIC[25] or Opendepot.org[26]. However, making such a deposit requires an Open Access policy, which is yet to be adopted by NARS institutes/universities. Even though ICAR is implementing guidelines for intellectual property management, a policy on access to research articles and data is an urgent requirement for NARS. Open Access to articles and data are essential for the advancement of science and publicly funded research should be freely available for the public good. In fact, with public availability under Open Access policy, plagiarism and unethical research practices could be curtailed. Chan et. al. (2011) claim that Open Access is sustainable, is research-driven, and builds independence and the capacity to establish a strong research base. More internally-driven deliberations on issues related to Open Access in NARS would also help in raising awareness about Open Access and, presumably, increase the availability and accessibility of NARS research.

Notes

1. The Indian Journal of Agricultural Sciences (IJAgS) and the Indian Journal of Animal Sciences (IJAnS) <http://epubs.icar.org.in/ejournal/index.php/IJAgS> and <http://epubs.icar.org.in/ejournal/index.php/IJAnS>

2. Eprints@IARI, Open Access Institutional Repository of Indian Agricultural Research Institute (IARI) <Eprints@IARI http://eprints.iari.res.in/>

3. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) <http://www.icrisat.org/>

4. Consultative Group on International Agricultural Research (CGIAR) <http://www.cgiar.org/>

5. Eprints@CMFRI, Open Access Open Access Institutional Repository of Central Marine Fisheries Research Institute (CMFRI) <http://eprints.cmfri.org.in>

6. Dspice@IISR, Open Access Institutional Repository of Indian Institute of Spices Research (IISR) <http://220.227.138.214:8080/dspace/>

7. E-Repository@IIHR, Open Access Institutional Repository of Indian Institute of Horticultural Research (IIHR) <http://www.erepo.iihr.ernet.in/>

8. OpenAgri, Open Access Agriculture Research Repository <http://agropedia.iitk.ac.in/openaccess/>

9. RKMP, Rice knowledge management portal <http://www.rkmp.co.in/>

10. KrishiPrabha, full-text database of Indian Agricultural Doctoral Dissertations <http://202.141.47.8:8080/equestthesis/>

11. NAIP, National Agricultural Innovation Project. <http://www.naip.icar.org.in/>

12. ETD@UASD, Electronic Theses and Dissertations of University of Agricultural Sciences, Dharwad (UASD) <http://etd.uasd.edu/>

13. During the Green Revolution, the semi-dwarf and high yielding lines of wheat germplasm from Professor Norman E. Borlaug of Mexico were used in the wheat breeding program by Dr. M.S. Swaminathan at IARI fields and elsewhere in the country. This intervention led India to increase tremendously its food grain production during late 1960s to 1970s and thereafter. Now India is self sufficient in food grain production and the contribution of IARI in the Green Revolution in India is widely acknowledged and appreciated.

14. The *Web of Science* database is a multidisciplinary content covers over 12,000 of the highest impact journals worldwide, including Open Access journals and over 150,000 conference proceedings of Thomson Reuters. <http://thomsonreuters.com/products_services/science/science_products/a-z/web_of_science/>

15. CeRA, Consortium for e-Resources in Agriculture established under National Agricultural Innovation Project (NAIP). <http://cera.iari.res.in/>

16. ICT-KM Triple-A framework, CGIAR's initiative. <http://ictkm.cgiar.org/what-we-do-/tripled-a-framework>

17. NAAS, National Academy of Agricultural Sciences. <http://www.naasindia.org/>

18. DOAJ, Directory of Open Access Journals. <http://www.doaj.org/>

19. e-Granth, Strengthening of Digital Library and Information Management under NARS. <http://egranth.ac.in/?q=Home>

20. E-PKSAR, E-Publishing and Knowledge System in Agricultural Research. <http://www.icar.org.in/node/381>

21. ROAR, Registry of Open Access Repository. <http://roar.eprints.org/>

22. Central Marine Fisheries Research Institute (CMFRI) <http://www.cmfri.org.in/>

23. Indian Institute of Spices Research (IISR) <http://www.spices.res.in/>

24. Indian Institute of Horticultural Research (IIHR) <http://www.iihr.res.in/>

25. OpenMeD@NIC, an open access archive for Medical and Allied Sciences established by National Informatics Centre, India <http://openmed.nic.in/>

26. Opendepot.org, for those without a local repository, including unaffiliated researchers, the OpenDepot is a place of deposit, available for others to harvest is being managed by EDINA National Data Centre (based at the University of Edinburgh, UK) <http://opendepot.org/>

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