DOCTORAL DISSERTATIONS ACCEPTED BY ICAR - INDIAN VETERINARY RESEARCH INSTITUTE DURING 1987 - 2019: A BIBLIOMETRIC STUDY

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ABSTRACT

The present paper analysed 957 Ph.D. dissertations accepted by ICAR-Indian Veterinary Research Institute, Izatnagar (Uttar Pradesh) during 1987-2019 which were indexed in Krishikosh, a digital repository of ICAR, New Delhi. The study found that male scholars produced 786 dissertations constituting more than three-fourth (82.1 %) of all Ph.D. dissertations and female scholars produced 171 (17.9 %) dissertations in different sub-disciplines of veterinary sciences. Chronological growth of data indicates that the pattern of theses accepted followed an inconsistent trend during the study period. Highest number (269) theses were accepted in the three year block of 2014-2016, constituting about 28 % of the total accepted theses. Most of the theses were awarded under the supervision of male supervisors. Of the 957 theses, 889 (92.9 %) students were supervised by male supervisors and the remaining 7.1 % theses were submitted under the supervision of female supervisors. Of the 18 prolific supervisors who supervised 10 or more scholars, 13 were male and five were female supervisors. Regarding the sub-disciplines of theses accepted, highest number (72) theses were accepted in the sub-discipline of animal nutrition followed by animal biotechnology and veterinary pathology with 65 dissertations.

Keywords: Krishikosh, Veterinary, Veterinary Science, Animal Sciences, Research Productivity, Research Assessment, Research Mapping, Indian Veterinary Research Institute, Indian Council of Agricultural Research, Theses, Dissertations, Doctoral theses, Doctoral dissertations, Ph.D. dissertations, Bibliometrics, Scientometrics, India.

1. Introduction

Research is considered as the foundation for any future endeavour or investigation in any field of knowledge. Academic and research institutions play a major role in shaping the scholars in their key areas. Globally all governments are investing heavily in research and development facilities as these provides access to wider range of resources. Dissertations or theses produced by different universities or research institutions are an integral part of the research process and a vehicle to transmit the results of research.

Doctoral dissertations besides the publication in scholarly journals are considered as parameters to assess the performance of the university or research laboratory in the field of investigation. The quality of research of a thesis or dissertation varies by country or university or programme. In order to be awarded a Ph.D., a scholar must be able to demonstrate mastery over a given subject. A good thesis is specific and focused which provide the readers with a map to guide him/her through the work presented in the thesis. It avoids vague language and anticipates and refutes the counter-arguments.

1.1. Veterinary Science in India

India has vast livestock resources which includes animal husbandry, dairy and fisheries. The livestock sector plays a vital role in national economy and in the socio-economic development of the country. Its role is very important in the rural economy by supplementing family incomes and generating gainful employment in the rural sector, particularly among the landless labourers, small and marginal farmers and women. "The field of **veterinary medicine or veterinary science plays an important role for the Indian economy** as livestock sector contributes 4.1% to the GDP and 25.6% to total GDP of agriculture" Singh (2020).

Veterinary research includes research on prevention, control, diagnosis, and treatment of diseases of animals and their care and welfare. It also deals with animal rearing, husbandry, breeding, and research on nutrition as well as product development. The outstanding advance in veterinary science in India was made with the establishment of the Indian Veterinary Research Institute (IVRI), a deemed to be university. "Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs) including veterinary, animal and fisheries science universities, spread over different agro-ecological zones of India, have played a key role in transforming livestock production scenario of the country through sustained animal health research, teaching and extension services backed by competent human resource generated from these institutions" Rana and Kumar (2017).

1.2. ICAR - Indian Veterinary Research Institute

Indian Veterinary Research Institute (IVRI) was established as Imperial Bacteriological Laboratory in 1889 at Pune (Maharastra) and later shifted to Mukteswar in 1893. Izatnagar, Uttar Pradesh (UP) campus was established in 1913 for large-scale production of serum and vaccines. The institute has been expanded to the present size with present headquarters and campuses at Mukteswar, Bengaluru, and regional stations at Palampur, Kolkata and Pune. The institute is one of the premier research institutions dedicated to livestock research and development in India. The research conducted at the institute have facilitated development of new biologicals used for diagnosis, prevention, cure and control of many devastating animal & poultry diseases and increased production of milk, meat, eggs and other animal products. At present the institute provides quality education at Master and Doctoral levels in more than 20 sub-disciplines of veterinary and animal sciences, livestock products technology, basic sciences and extension education. The institute was conferred the status of deemed to be university in the year 1983. The institute has linkages with several national agencies like Department of Science & Technology (DST), Department of Biotechnology (DBT), Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Defence Research and Development Organization (DRDO) and Ministry of Environment and Forest and many more. The institute also has collaborative linkages with several international agencies. The research in the institute is mainly conducted in the areas of animal health, animal production, livestock product technology, and basic and social sciences (http://www.ivri.nic.in/about/default.aspx, Official Website of IVRI, accessed on 8 October 2021).

2. Review of Literature

In the past several studies has been reported in literature dealing with bibliometric studies of theses accepted at different levels (courses) by different academic institutions in different disciplines. It is found from a comprehensive literature search that bibliometric studies of dissertations particularly at doctoral level in veterinary science are very few. Therefore in this review, only selected bibliometric studies on dissertations on veterinary science as well as agricultural field only are included and a few others are given in the reference part. Bibliometrics of veterinary science are given first in this review and those of agriculture latter.

Both PhD and MVSc. Theses in Veterinary Science in the College of Veterinary and Animal Sciences of Kerala Agricultural University has been analyzed through bibliometrics techniques by Hima Mohan (2004). A recent study by Weerasinghe (2022) analyzed 6754 citations in 361 UG dissertations in veterinary science submitted to the University of Peradaniya, Sri Lanka. Another recent study done by Sife and Kipanyula (2022), even though not on doctoral dissertations is worth mentioning here. This study is a scientometric analysis on the research productivity of veterinary research scholars at the Sokoine University of Agriculture, Tanzania. Bibliometric analysis of undergraduate theses in the faculty of veterinary medicine of San Marcos National University, Peru (2001-2006) has been studied by Felipe and Josmel (2008).Oliviera (1984) did analysis of citations in the post-graduate veterinary dissertations.

The first author of this paper along with different co-authors did a few bibliometric studies in dissertations. Garg and Saini (2015) made a bibliometric assessment of 1,763 postgraduate and Ph.D. dissertations accepted by Indira Gandhi Agricultural University, Raipur (Chhattisgarh). Another joint study by Garg and Pal (2019) analyzed 476 Ph.D. theses accepted by Indian Agricultural Research Institute (IARI) in different disciplines of agricultural science and technology during 2011-2016. Bansal and Garg (2021) analyzed 5,703 theses accepted by 54 Indian State Agricultural Universities in the year 2018.

Haque and Khan (2020) examined the doctoral theses awarded in the faculty of agriculture at Bangladesh agricultural university during 1974-2014. In a bibliometric study Krishna (2011) examined 68 Ph.D. theses accepted by Rajasthan Agricultural University during 1996-2000.

The review of literature indicates that no bibliometric study has been reported dealing with the PhD theses/dissertations accepted by ICAR-IVRI. The present study is an attempt in that direction, which examines the number of dissertations accepted by ICAR-IVRI during the 33 years period of 1987-2019 with the objectives mentioned below.

3. Objectives of the Study

Following are the objectives of the study:

- To examine the chronological growth of theses accepted by ICAR-IVRI during the study period of 1987-2019 (33 years) in block of three years each;

- To examine the productivity of male and female scholars during the study period of 1987-2019 consisting five blocks of 1987-1999 (13 years) and 2000-2019 (20 years) consisting of four blocks each of five years using Transformative Activity Index (TAI);

- To identify the gender of the supervisors and to identify most prolific male and female supervisors;

- To identify different sub-disciplines of veterinary sciences in which the dissertations were accepted during the study period of 1987-2019.

4. Data Source and Methodology

The source of data for the present study is Krishikosh, a digital repository of ICAR. It is a centrally managed portal at ICAR-Indian Agricultural Research Institute (ICAR-IARI), New Delhi. The details of Krishikosh are available at (*http://krishikosh.egranth.ac.in*). At present 103 SAUs and ICAR institutes are registered in Krishikosh. The data source for the present study was the records of Ph.D. theses accepted by ICAR-IVRI during 1987-2019. Each record of Ph.D. theses accepted by ICAR-IVRI and available in *Krishikosh* was examined to identify the name of the scholar, his/her gender, name of the supervisor and his/her gender, and the sub-discipline of each thesis as mentioned in the records. In all, 957 Ph.D. dissertations were accepted during the period of 33 years period from 1987 to 2019 by the institute under study. All the data elements like name, gender of the scholars as well as the supervisors and the sub-discipline of the theses were entered into MS-Excel data sheet for analysis of data. The name of the

supervisors who supervised the students was standardized as there were variations in the name of supervisors. Also gender of the scholars and supervisors was ascertained by using Face Book or Linked in where ever there was a doubt in the gender. From the names of the supervisors the prolific supervisors who guided more number of scholars in comparison to other supervisors were identified. The period of 1987-2019 (33 years) has been divided into five blocks. These five blocks are 1987-1999 (13 years) and 2000-2019 (20 years) divided into four blocks each of five years. Authors have used Transformative Activity Index (TAI) suggested by Guan and Ma (2004) and used by Garg, Singh and Rana (2021) to examine the relative productivity of male and female scholars. Data so obtained was analysed to meet the objectives mentioned above. Authors wanted to include Ph.D. dissertations accepted up to 2021, but the records after 2019 were not available in *Krishikosh*. Hence the study is limited to data from 1987-2019.

5. Analysis of Data and Interpretation

In the following paragraphs we present the results and interpretation of data as per the objectives mentioned above.

5.1. Chronological Distribution of Theses

Table -1 depicts the chronological distribution of theses accepted by ICAR-IVRI during 33 years period of 1987 to 2019 in 11 blocks of three years each by male and female scholars. During the study period of 33 years, 957 Ph.D. dissertations were accepted in different sub-disciplines of veterinary sciences. Thus, the average number of theses accepted per block of three years each was 87. Of the 11 blocks of three years each, the number of theses accepted was more than the average number of theses in last three blocks of 2011-2013, 2014-2016 and 2017-2019 and in the three years block of 2002-2004, the number of theses accepted was 82, close to the average number of theses accepted. In the three blocks of 2011-2013, 2014-2016 and 2017-2019, the number of theses accepted in each block was significantly higher than the average number of theses per block. The total number of theses submitted during these three blocks was 705, constituting about three fourth (73.7%) of total theses accepted. Highest number (269) theses were accepted in the three year block of 2014-2016, constituting more than one-fourth (28.1%) of the total accepted theses.

Table 1
Distribution of Theses Accepted in Blocks of Three Years and Gender

Year	Male	Female	Total
1987-1989	2	0	2
1990-1992	3	0	3
1993-1995	6	2	8
1996-1998	7	0	7
1999-2001	29	6	35
2002-2004	77	7	84
2005-2007	32	5	37
2008-2010	38	4	42
2011-2013	152	19	171
2014-2016	225	44	269
2017-2019	178	97	265
Total	786	171	957
Average of theses submitted in block of three years each = 957/11 = 87			

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5.2. Productivity of Male and Female Scholars

Of the total 957 theses, 786 (82 %) theses accepted were submitted by male scholars and the remaining 18 % were submitted by female scholars. Since the absolute output of theses accepted varied with the type of gender and period, authors have used Transformative Activity Index (TAI) suggested by Guan and Ma (2004) to examine the relative change in the number of theses accepted during the study period. For this, the period of study has been divided into five blocks as depicted in Table 2. The first block is 13 years because as reflected in Table 1 no theses was produced by women scholars in three blocks and zero output can't be used to calculate TAI. Remaining period of 2000-2019 has been divided into four blocks each of five years. The main advantage of using TAI is that it normalizes data horizontally as well as vertically, while the percentage can normalize data either vertically or horizontally.

The methodology to calculate TAI has been modified according to the requirement of the data.

Mathematically TAI = $\{(C_i/C_o)/(W_i/W_o)\}*100$, where C_i denotes the number of theses in the ith block for male and female scholars respectively, C_o is the total number of theses during the ith block,

W_i the total number of theses of a particular gender for all blocks and

W_o is the total number of theses accepted by ICAR - IVRI during the entire study period.

The calculation of TAI has been illustrated below for ease of understanding by the readers for the block of 1987-1999 for male and female scholars.

TAI for 1987-1999 for male scholars,

C_i = 18, C_o = 20, W_i = 786 and W_o = 957.

Therefore,

TAI = $\{(18/20)/(786/957)\}*100$ = $\{(0.9)/(0.82)\}*100$ = $1.097*100$ = 109.7 = 110 (Rounded off to the nearest whole number)

Similarly for female scholars C_i = 2, C_o = 20, W_i = 171 and W_o = 957.

Therefore,

TAI = $\{(2/20)/(171/957)\}*100$ = $\{(0.1)/(0.1786)\}*100$ = $0.5599*100$ = 55.99 = 56 (Rounded off to the nearest whole number).

Values of TAI for male and female theses accepted can be calculated like this for other blocks. Based on the values of TAI given in the Table 2, it is observed that the proportion of theses produced by male scholars remains almost same during the first four blocks, but declined in the last block of 2015-2019 and reached at the lowest level at 87. On the contrary, the proportion of theses produced by female scholars increased from 56 in 1987-1999 to 162 in 2015-2019. Thus, the share of theses produced by female scholars has increased considerably in later period. The finding is similar to the findings of Garg, Singh and Rana (2021) for Ph.D. theses accepted by AMU during 1954-2018 in the discipline of zoology.

Table 2
Distribution of Theses Accepted in Block Periods by Gender

Year	Male (TAI)	Female (TAI)	Total
1987-1999	18 (110)	2 (56)	20
2000-2004	98 (113)	8 (42)	106
2005-2009	107 (112)	9 (43)	116
2010-2014	272 (109)	33 (61)	305
2015-2019	291 (87)	119 (162)	410
Total	786	171	957

5.3. Distribution of Supervisors

Data depicted in table 3 indicates that during the period of study 957 theses were accepted under the guidance of 277 supervisors. Of these, 264 were male supervisors and only 13 were female supervisors. The results (table 3) indicates that of the 957 theses, 889 (92.9%) theses were supervised by male supervisors and the remaining 68 (7.1%) theses were submitted under the supervision of female supervisors. This indicates that male supervisors supervised significantly high number of scholars as compared to female supervisors. However, male supervisors

supervised (889/264) = 3.4 scholars per supervisor, while women supervisors supervised (68/13) = 5.2 scholars per supervisor. Also during the entire study period students supervised per supervisor by female supervisors was more than their male counter parts. This indicates that female supervisors supervised more students per supervisor unlike the dissertations accepted by IARI, where male supervisors supervised more students per supervisor than female supervisors as reported by Garg and Pal (2019) in their bibliometric study of Ph.D. theses accepted in agricultural sciences by ICAR-IARI.

Table 3
Distribution of Supervisor by Gender During Different Blocks

Year	Theses accepted under the male and female supervisors						Total
	Male Supervisor	Students guided	Students guided per	Female Supervisor	Students guided	Students guided per supervisor	
1987-1999	17	20	1.2	0	0	0	20
2000-2004	73	102	1.4	3	4	1.4	106
2005-2009	75	111	1.5	3	5	1.7	116
2010-2014	111	279	2.5	6	26	4.3	305
2015-2019	159	377	2.4	11	33	3.0	410
Total	264	889	3.4	13	68	5.2	957

5.4. Distribution of supervisors by number of students guided

As mentioned above, 277 supervisors guided 957 researcher scholars. Thus, number of scholars supervised by each supervisor was approximately 3.5 scholars. Data on the number of students

supervised by a supervisor is presented in table 4. It indicates that 108 (39 %) supervisors guided only one student. Remaining 169 (61 %) supervised two or more students. Of these, 56 supervisors guided six or more scholars and produced slightly more than half (51.1%) of the dissertations.

Table 4

Distribution of Supervisors and Number of Students Guided

Sl.No.	Details	No. of Supervisors	Total
1.	Number of supervisors guiding 1 student each	108*1	108
2.	Number of supervisors guiding 2 students each	43*2	86
3.	Number of supervisors guiding 3 students each	27*3	81
4.	Number of supervisors guiding 4 students each	22*4	88
5.	Number of supervisors guiding 5 students each	21*5	105
6.	Number of supervisors guiding 6 or more students each	56	489
	Total	**277**	**957**

5.5. Most Prolific Supervisors

Table 5 lists 18 supervisors who have guided 10 or more scholars in the different discipline of veterinary sciences. The maximum number of scholars (17) was supervised by Professor Mendiratta, S.K. who is the principal scientist and Head of Division of Livestock Products Technology of IVRI. This is followed by Professor Satish Kumar, Dinesh Kumar, Mondal, D.B., and Sharma, A.K. each supervising 14 scholars. The most prolific supervisors supervised 184 (19 %) scholars. Of the most prolific supervisors listed in table 5, five supervisors were female who guided 42 students in all. Among these, Sharma G. Taru supervised 12 students.

Table 5

Most Prolific Supervisors

Sl.No.	Name of Guide	Number of Students Guided	Gender
1	Mendiratta, S. K.	17	M
2	Kumar, Satish	14	M
3	Kumar, Dinesh	14	M
4	Mondal D. B.	14	M
5	Sharma, A. K.	14	M
6	Dimri, Umesh	13	M
7	Chander, Mahesh	12	M
8	Sharma, G. Taru	12	F
9	Agarwal, R.K.	11	M
10	Dey Sohini	11	F
11	Singh, B.P.	11	M
12	Tiwari, Rupasi	11	F
13	Gupta, P.K.	10	M
14	Joshi, Paritosh	10	M
15	Kataria, Meena	10	F
16	Kumar, Sanjeev	10	M
17	Tewari A.K.	10	M
18	Tripathi Hema	10	F
	Total	**184**	

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5.6. Distribution of Ph.D. Theses Accepted by Sub-disciplines

According to the information available on the website of the institute, the research programmes of the institute are pursued mainly in the area of animal health. The mandated areas of research activities of the institute are animal health, animal genetic resources, livestock products technology and basic and social sciences.

Animal Health: The divisions/centres related to animal health research are bacteriology and mycology, biological products, animal diseases research and diagnosis including epidemiology, pharmacology and toxicology, standardization of biological products, animal biotechnology including immunology, veterinary medicine, veterinary parasitology, veterinary pathology, veterinary public health, veterinary surgery and veterinary virology.

Animal Production: The divisions under animal production group are animal genetics, animal nutrition, animal reproduction, physiology and climatology of temperate animal husbandry.

Livestock Products Technology (LPT): The division of LPT plays a unique role in the development of meat industry in the country. The LPT division has a major emphasis on post-graduate education for developing human resources besides undertaking research for value addition of meat in selected areas.

Basic and Social Sciences: The research divisions involved in this group are livestock economics, statistics and information technology, extension education and biochemistry.

Based on the above classification, highest number of theses was accepted in the area of animal health (568, 59.4 %) followed by animal production (202, 21.1 %). Thus, more than two-third (80.5 %) theses were submitted in these two sub-disciplines. Remaining 19.5 per cent theses were accepted in the area of basic and social sciences and livestock products and technology. Table 6 depicts the distribution of theses accepted in different sub-disciplines. A glance at table 6 indicates that highest number (72) theses accepted were in the sub-discipline of animal nutrition followed by number of theses in the sub-discipline of animal biotechnology and veterinary pathology each contributing 65 dissertations. The number of theses accepted in these two sub-disciplines constituted about 21 per cent of all theses accepted during 1987-2019. Other sub-disciplines where theses accepted were more than five per cent are veterinary extension and education (57), poultry science (56), veterinary pharmacology (55), veterinary medicine (55), veterinary virology (52), animal genetics and breeding (48), and veterinary parasitology (47). In these seven sub-disciplines, the share of theses accepted was about 38.7 % of all theses.

Table 6

Distribution of Theses by Sub-disciplines of Veterinary Sciences in IVRI

	Animal Health	
Sl.No.	Sub-disciplines of Animal Health	No. of Thesis Submitted (%)
1.	Animal Biotechnology	65 (6.8)
2.	Veterinary Pathology	65 (6.8)
3.	Poultry Science	56 (6.8)
4.	Veterinary Pharmacology	55 (5.7)
5.	Veterinary Medicine	55 (5.7)
6.	Veterinary Bacteriology	53 (5.5)
7.	Veterinary Virology	52 (5.4)
8.	Veterinary Parasitology	47 (4.9)
9.	Veterinary Surgery and Radiology	43 (4.5)
10.	Veterinary Public Health	39 (4.1)
11.	Veterinary Immunology	31 (3.2)
12.	Avian Disease	7 (0.7)
	Total	**568 (59.4%)**
	Animal Production	
	Sub-disciplines of Animal Production	
1.	Animal Nutrition	72
2.	Animal Genetics and Breeding	48
3.	Veterinary Gynecology and Obstetrics	47
4.	Animal and Veterinary Physiology	35
	Total	**202 (21.1%)**
	Basic and Social Sciences	
	Sub-disciplines of Basic and Social Sciences	
1.	Veterinary Extension Education	57
2.	Animal Biochemistry	45
3.	Biostatistics	4
4.	Livestock Economics	2
	Total	**108 (11.3%)**
	Livestock Products Technology	
	Sub-disciplines of Livestock Products Technology	
1.	Livestock Products Technology	37
2.	Livestock Production and Management	23
3.	Meat Hygiene and Health Hazards	1
	Total	61 (6.4%)
	Others	18 (1.9%)
	Grand Total	**957 (100%)**

6. Findings

- The present study analyzed 957 Ph.D. theses accepted at ICAR-IVRI during 33 years period of 1987-2019. The study indicates that Ph.D. theses accepted at the institute followed an inconsistent trend like the number of theses accepted in the discipline of chemistry of Aligarh Muslim University (AMU) as reported by Garg and Kumari (2018). Highest number (269) theses were accepted during the last three year block of 2014-2016.

- Of the total 957 theses accepted, 786 (82.1%) were by male scholars and 171 (17.9 %) by female scholars. In the last six blocks of 1999-2001 to 2014-2019 the number of theses submitted by female scholars has gone up but followed an inconsistent trend. Maximum numbes of theses accepted of male scholars was 225 in the three years block of 2014-2016, while the highest number of theses accepted (97) for female scholars was in the three years block of 2017-2019.

- Of the 277 supervisors who supervised 957 scholars, 264 were male supervisors and 13 were female supervisors. This indicates that most of the theses were awarded under the supervision of male supervisors. Data presented in table 3 also indicates that during the first 15 years of the existence of the institute no theses were awarded under the supervision of female supervisors. However, female supervisors supervised 5.2 students per supervisor and male supervised 3.4 scholars per supervisors.

- Only five female supervisors could find place among the 18 most prolific supervisors and remaining 13 were male supervisor. Five prolific female supervisors supervised 54 scholars in all.

- More than half (568, 59.4 %) theses were submitted in sub-discipline of animal health. Highest number (72) theses were accepted in the sub-discipline of animal nutrition followed by animal biotechnology with 65 theses.

7. Conclusion

A big gender gap with male students dominating their female counterparts has been reported in all the studies cited under review of literature as well as in the present study. All studies under review of literature found that the quantum of male supervisors was more than their female counterparts. The findings of the study may inspire female scholars at different ICAR institutes to pursue their PhD and the faculty members should also encourage more and more female scholars to do PhD.

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