PUBLICATION PRODUCTIVITY OF KERALA AGRICULTURAL UNIVERSITY, THRISSUR DURING 2008-2017: A SCIENTOMETRIC ANALYSIS

Thesis submitted to the
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DOCTOR OF PHILOSOPHY IN LIBRARY AND INFORMATION SCIENCE

by

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DECLARATION

I hereby declare that the thesis entitled "**PUBLICATION PRODUCTIVITY OF KERALA AGRICULTURAL UNIVERSITY, THRISSUR DURING 2008-2017: A SCIENTOMETRIC ANALYSIS**" is the authentic record of research work carried out by me, for my Doctoral Degree under the supervision and guidance of Dr.Vasudevan T.M., Professor, Department of Library and Information Science, University of Calicut, and that no part thereof has previously formed the basis for the award of any degree or diploma or any other similar titles or recognition.

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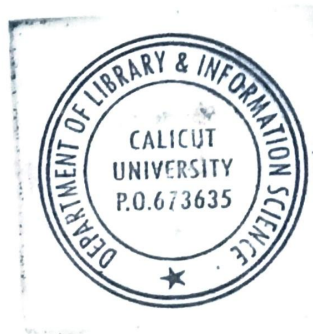**Dr.VASUDEVAN.T.M**
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CERTIFICATE

This is to certify that the thesis entitled "**PUBLICATION PRODUCTIVITY OF KERALA AGRICULTURAL UNIVERSITY, THRISSUR DURING 2008-2017: A SCIENTOMETRIC ANALYSIS**" submitted to the University of Calicut for the award of the **Degree of Doctor of Philosophy in Library and Information Science** is a record of original research work done independently by **Ajitha.A,** under my guidance and supervision and that it has not previously formed the basis to onward of any degree. diploma. fellowship. associateship.

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ABBREVIATIONS

AACR-II	-	Anglo American Cataloguing Rules II
AgriSA	-	South African Agricultural Industry Association
AICARP	-	All India Co-ordinated Agronomic Research Project
AICRPs	-	All India Co-ordinated Research Projectss
AIS	-	Accounting Information System
AMC	-	Agricultural Mechanic Course
AMPRS	-	Aromatic and Medicinal Plants Research Station
APA	-	American psychological Association
ASEAN	-	Association of Southeast Asians Nations
ATIC	-	Agricultural Technology Information Centre
BARC	-	Babha Atomic Research Centre
BS	-	Ball and Socket
CAI- Co	-	Authorship Index
CC	-	Collaborative Coefficient
CCSAAU	-	Chaudhary Charan Singh Haryana agricultural University
CD	-	Compact Disc
CeRA	-	Consortium for e- Resources in Agriculture
CESS	-	Centre for Earth Science Studies
CI	-	Collaborative Index
CMFRI	-	Cochin Marine Fisheries Research Institute
CIT	-	Coimbatore Institute of Technology
CSIC	-	Spanish National Research Council
CSIR	-	Council of Scientific and Industrial Research
CUSAT	-	Cochin University of Science and Technology

DAE	-	Department of Atomic Energy
DARE	-	Department of Agricultural Research and Education
DARE	-	Diploma in Agricultural & Rural Engineering
DASc	-	Diploma in Agricultural Science
DC	-	Degree of Collaboration,
DDC	-	Dewey Decimal Classification
DT	-	Doubling Time
FAO	-	Food and Agricultural Organisation
FID	-	International Federation for Information and Documentation
GJUST	-	Guru Jambeswar University of Science and Technology
IARC	-	International Agriculture Research Centers
IARI	-	Indian Agriculture research Institute
IAT	-	Institute of Agricultural Technology
ICAR	-	Indian Council of Agriculture Research
ICRISAT	-	International Crop Research Institute for the Semi-Arid Tropics
IF	-	Impact factor
IFSRS	-	Integrated Farming Systems Research Station
IGCAR	-	Indira Gandhi Centre for Atomic Research
IIG	-	Indian Institute of Geomagnetism
IIMK	-	Indian Institute of Management, Kozhikode
IIHR	-	Indian Institute of Horticulture
IIT	-	Indian Institute of Technology
INO	-	International National Organisation
ISAdatabase	-	Indian Science Abstract Database
ISI	-	Indian Statistical Institute
IVRI	-	Indian Veterinary Research Institute

JCR	-	journal citation Report
KAIC	-	Kerala Agro-Industries Corporation
KAU	-	Kerala Agricultural University
KCAET	-	Kelappaji College of Agricultural Engineering and Technology
KHDP	-	Kerala Horticulture Development Programme
KUFOS	-	Kerala University of Fisheries and Ocean Studies
KUMS	-	Kerman University of Medical Science
KVASU	-	Kerala Veterinary and Animal Science University
KVKs	-	Krishi Vigyan Kendras
NAAS	-	National Academy of Agriculture Science
NAEP	-	National Agricultural Extension Project
NAI	-	NASA Astrobiology Institute
NARP	-	National Agricultural Research Project
NCRI	-	National Cereal Research Institute
NDRI	-	National Diary Research institute
NHM	-	National Horticulture Mission
NRCPB	-	National Research Centre plant biotechnology
NSIT	-	Netaji Subash Institute of Technology
R&D	-	Research and Development
RARS	-	Regional Agriculture Research Stations
RGR	-	Relative Growth Rate
RKVY	-	Rashtriya Krishi Vikas Yojana
S&T	-	Science and Technology
SAUs	-	State Agriculture Universities
SCI	-	Science Citation Index
SHM	-	State Horticulture Mission
SJR	-	SCImago Journal Ranking
SPSS	-	Statistical Package for the Social Science

SSCI	-	Social Science Citation Index
SUA	-	Sokoine University of Agriculture
TANUVAS	-	Tamilnadu Veterinary and Animal Science University
UGC	-	University Grants Commission
USDA	-	United States Department of Agriculture
WoS	-	Web of Science

ABSTRACT

Measurement of research productivity of an institution plays a vital role in development as well as its science policy making. In this study, Publication productivity of Kerala Agricultural University, Thrissur is to found out growth and development during 2008-2017. The main objective of the study is to examine the publication trend of Kerala Agricultural University (KAU) during the study period. The Specific objectives of the study are1) To determine the year wise growth of publication of Kerala Agricultural University (KAU) during 2008-2017, 2) To examine the type of document preferred for publishing as well as the language preferred,3)To ascertain the authorship pattern of documents, collaboration pattern and other collaboration measures 4)To find out the most prolific authors of KAU,5)To identify the subject-wise and institutional wise productivity, 6)To identify the journals preferred for publishing and the detailed analysis of these journals and 7)To test the applicability of various bibliometric laws.

The hypothesis of the study are 1)The year–wise productivity of KAU research output shows the fluctuating trend, 2) Collaborative research dominates in KAU publications 3)Journals are most used channel of communication among KAU staff 4) KAU scientists prefer to publish in Indian Journals than foreign journals and 5). The KAU research productivity confirms to Scattering of publications according to the Bradford's Law.

The data for the study was collected from Annual reports of KAU, Institutional repository of KAU and agricultural databases. Total 2822 records were analysed. The stydy limited to last ten years ie;2008-2017.In 2010,KAU separated as Kerala Veternary and Animal Science University(KVASU) and Kerala University of Fisheries and Ocean Studies (KUFOS). The results

reveals that there is a fluctuating trend in the growth of publications, among the 21 type of documents identified, majority of the publications are journal articles. English is the predominant language used for the publications. Multiple authorship is predominant, in which degree of collaboration is 93.10%. Relative Growth Rate shows decreasing trend while Doubling Time shows increasing trend. The most prolific author during study period was Suseela P (74) from College of Agriculture Vellayani followed by Jose Mathew (63) and Jose Joseph (47). Trusted area of research observed was Biotechnology and Applied microbiology, Colleges of Agriculture tops among in-house institutions. The journal analysis showed that *Journal of Tropical Agriculture* ranked first, about $3/4^{th}$ of the journal articles are published in Indian journals. The highest NAAS rating journals selected for publishing was *Geoderma, Genome, Environmental Biology of Fishes, and Indian peadiatrics.These will helpful for researchers,students , faculties andauthorities of the institution.*

CHAPTER I

INTRODUCTION

1.1 Introduction

The invention of agriculture is one of the greatest revolution in human history. The availability of nutritional adequacy of food has been the driving force for human evolution and civilisation. People lived a nomadic life as hunters and gatherers following the migration of animals or moving during the seasonal changes in the weather prior to the domestication of plants and animals, some 12,000 years ago. The adoption of agriculture, and the domestication of plants and animals reduced the nomadic lifestyles among people. Human Communities began to grow. Eventually, as agriculture flourished and produced larger food surpluses, these communities grew into cities, that furthered the pursuit of government, art and technology for which human civilisation is known (Sagar, et.al. 2014). Attaining food security has been the major policy issue for the entire nation since independence. So agriculture is necessary. In India around 70% of the population earns its livelihood from Agriculture. It still provides livelihood to the people in our country. It fulfils the basic needs of human beings and animals. It is an important source of raw material for many agro based industries. India's geographical condition is unique for agriculture as it provides many favourable conditions. Apart from unique geographical conditions India has been consistently making innovative efforts by using science and technology to increase the production. Our first Prime Minister, Pandit Jawaharlal Nehru, immediately after independence had accorded the highest importance to agriculture by stating that "Everything can wait but not agriculture". Prime Minister Lal Bahadur Shastri had also accorded high importance to

agriculturists by equating them with defence personnel, through the slogans like 'Jai Jawan, Jai Kisan'. Recognising the contribution of   science for the all-round progress of our nation, Prime Minister Atal Bihari Vajpayee further pronounced the slogan as 'Jai Jawan, Jai Kisan and Jai Vigyan'. He also gave a call to double the food production in the next one decade. Owing to the vision of all our great leaders, India could achieve the required success in agriculture.   (http://publications.drdo.gov.in/ojs   /index.php/djlit/article/ viewFile/ 5022/4053 v.in)

Agriculture field faces many challenges. The major ones are stagnation in prediction of crops, high cost of farm inputs, soil exhaustion, depletion of fresh ground water, adverse impact of global climatic change, impact of globalization providing food security and farmers suicide. This could be overcome by the research.

In India, the Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India formerly known as Imperial Council of Agricultural Research. It was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860 in pursuance   of   the   report   of   the   Royal   Commission   on Agriculture(http://www.researchgate.net/publication/328245384). Agriculture research in India was entrusted to the Indian Council of Agricultural Research (ICAR) in 1966. At that time, three national institutes, the IARI, the NDRI and the IVRI and some of them institutes were functionally brought under ICAR. The ICAR sahas played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development, that has enabled the country to increase the production of food grains by 4 times, horticultural crops by 6 times, fish by 9 times (marine 5 times and inland 17 times), milk 6 times and

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eggs 27 times since 1950-51, thus making a visible impact on the national food and nutritional security. It has played a major role in promoting excellence in higher education in agriculture. The ICAR has its headquarters at New Delhi. The Council is the apex body for coordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 99 ICAR institutes and 53 agricultural universities spread across the country (http://www. researchgate.net/publication/328245384). India is one of the largest national agricultural systems in the world. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.

Evaluation of research output of an organisation is important. It is to identify research trends in different areas of knowledge, to formulate an effective need based acquisition policy within the limited budgetary provisions and that too without being detrimental to the research interest of the parent organisation, to study past and present publication trends and there by forecast future publishing trend of any subject. The technique used for the evaluation of research output is called Bibliometrics. In science, it is called Scientometrics. Hence the present study emphasises on evaluation of scientific output of KAU for the last decades.

1.2 Agriculture research

Agricultural research plays vital role in the nation's food security. Agriculture is basis for all. It provides food, shelter, job, etc. for human being. As such agriculture is able to explore key issues for society as sustainability of production, health, nutrition, adaptation to and mitigation of climate change, energy, etc.

Many organisations and institutions are supporting agriculture research

in national and international level. Food and Agriculture Organisation (FAO), International Fund for Agriculture Development, International Association of Agriculture Information Specialist and AgriSA provides financial support in international level.While Indian Council of Agriculture Research (ICAR), Department of Agricultural Research and Education, Ministry of agriculture (DARE), United States Department of Agriculture (USDA) are national level. Besides state agriculture universities in each state contribute maximum output to the R&D in agriculture field (http://www.oecd.org/agriculture/ crp/42581681.pdf).

1.3 Agriculture research in India

Agriculture plays a dominant role in the Indian economy and as a subject has held a special fascination to us, because we feel that agriculture is a source of perpetual creation on which civilization depends (Srivastava& Srivastava, 1993). It was in the beginning of this century that the Government of India recognized the need for the establishment of a sound system of scientific investigations in connection with agriculture. As part of it, the Imperial Department of Agriculture was established in Calcutta in 1881 followed by the state department of agriculture in Bombay, Madras, Shillong, Allahabad and Nagpur between 1883 and 1895(Kumar, 2008). The Council of Agriculture Research was established in 1929 as a registered society. A number of central commodity committees dealing with research in respect of particular crops were set up between 1921 and 1962 as semi-autonomous bodies and were located in the main growing regions of crops concerned. Further the Government of India also established under their direct administrative control a number of research institutes such as Central Rice Research Institute, Cuttak in 1946, the Forest Research Institute and colleges, Dehradun in 1906, the National Diary Research Institute, Karnal in 1922, the Central Potato Research Institute, Shimla 1949 etc.(Surendra Mohan,

1978).Under the aegis of the Indian Council of Agriculture Research, 34 research institutes are functioning in different geographical location of the country. In addition to the research institutes, 4 project directorates and 54 all India coordinated research projects and national agriculture research projects are functioning under ICAR.

1.4 Agriculture education and research in India

The establishment of agriculture universities is one of the most significant landmarks in the history of agriculture education and research in India. The university education commission (1949) headed by Dr.S. Radhakrishnan examined the entire pattern of higher education in India, recognized the need for linking education with production programmes and recommended the establishment of "Rural universities". This turned out to be a far reaching recommendation for it represented the germ of the idea that later led to the establishment of agriculture universities. The joint Indo-American teams on agriculture research and education (1954-55 and 1959-60) recommended the setting up of agricultural universities on the pattern of land grant colleges of the United States of America. Accordingly, the first agriculture university came into existence at Pantnagar (Nainital) in Uttar Pradesh in 1960 and now there are 23 agriculture universities established in almost all the states in India with one more university for horticulture and forestry established in Himachal Pradesh. Two more agriculture universities one at Dharward in Karnataka and other at Raipur in Madhya Pradesh have also been just announced. Around 75 agricultural colleges, 24 veterinary colleges and about 20 home science, food science and technology, fisheries and agricultural engineering colleges apart from state government departments of agriculture, Horticulture,

Animal husbandry and Diary have been actively participating in the National Agriculture Programme. In addition corporate bodies dealing with

rural development like All India Institute of Rural Development, National Diary Development Board, National Institute of Rural Management etc. contribute to the development of agriculture. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) functioning at Hyderabad is an Institute of international level in agriculture. There are various other research institutes like coffee, tea, silk, coir and rubber boards, Central Food Technology Research Institute, Central Leather Technology Research Institute etc. functioning in the area of agriculture research. In addition, the country has huge co-operates of the Government of India like Fertilizer Corporation of India, Food Corporation of India, and National Seed Corporation etc. Industries of Pesticides, Food, Beverage and Fertilizer are also added to the agriculture complex of India.

The national agriculture research system of India has necessary Infrastructure and well equipped labs, libraries, manpower, etc. and has the largest scientific manpower. Also it is estimated that the country today has over 60,000 scientists under various government and non-government organizations engaged in active research, excluding technical, administrative and supporting personnel. The scientific manpower management, staff, scientists and teachers engaged in research, education and extension work in agricultural sector has been estimated to about 31,000.

Including all 28 state agricultural universities comprising of 172 agricultural colleges and 4 deemed universities under ICAR annually enroll about 16,500 students at various level courses under human resource development programme (Kumar,2008). These are strengthen the agriculture research in India.

1.5 Indian Council of Agricultural Research (ICAR)

The Indian Council of Agricultural Research (ICAR) is an autonomous body responsible for co-ordinating agricultural education and research in India. It reports to the Department of Agricultural Research and Education, Ministry of Agriculture. The Union Minister of Agriculture serves as its president. It is the largest network of agricultural research and education institutes in the world. Headquarter is situated in New Delhi (Seema parmar,2018).

The Committee to Advise on Renovation and Rejuvenation of Higher Education (Yashpal Committee, 2009) has recommended setting up of a constitutional body the National Commission for Higher Education and Research which would be a unified supreme body to regulate all branches of higher education including agricultural education. Presently, regulation of agricultural education is the mandate of ICAR, Veterinary Council of India (Veterinary sub-discipline) and Indian Council of Forestry Research and Education (Forestry sub-discipline). The UPA government has included Yashpal Committee recommendations in its '100 days agenda'.

1.5.1 Milestones

- As of July, 2006 it has developed a vaccine against flu. The vaccine was developed at the High Security Animal Disease Laboratory, Bhopal, the only facility in the country to conduct tests for the H5N1 variant of bird flu. ICAR entrusted it with the task of developing a vaccine after the Avian Influenza outbreak in February. The ICAR was provided with Rs. 8 crore for the purpose.

- 2009: In December 2009, it announced that it was considering a policy to provide open access to its research.

- 2010: In March 2010, ICAR made its two flagship journals (Indian Journal of Agricultural Sciences and Indian Journal of Animal Sciences) as Open Access Journals.

- 2013: On 13 September 2013, it announced the Open Access Policy and committed for making all the public funded scholarly research outputs openly available via open access repositories.

- ICAR scientists were the first in the world to sequence the pigeon pea

- Genome. It was a purely indigenous effort by 31 scientists led by Nagendra Kumar Singh of NRCPB. The first draft of the sequence was published in *J. Plant Biochem. Biotechnol.*

1.5.2 ICAR institutions

As of September 2009 ICAR has following institutions,

- Four Deemed Universities

- 45 ICAR Institutions

- Six National Bureaux

- 25 Project Directorates

- 18 National Research Centres

- 138 Substations of ICAR Institutes

- 61 AICRPs (All India Coordinated Research Projects)

- 10 Other Projects

- 17 Network Projects

- Eight Zonal Project Directorates

- 633 Krishi Vigyan Kendras (KVKs)

- 45 State Agricultural Universities (SAUs)

- 2 Central Agricultural University and

- 4 Central Universities having faculty of agriculture

1.5.3 ICAR Merits & Awards

- ✓ Choudhary Devi Lal Outstanding All-India Coordinated Research Project Award

- ✓ Rafi Ahmed Kidwai Award

- ✓ Fakhruddin Ali Ahmed Award for Tribal Areas

- ✓ Hari Om Ashram Trust Award

- ✓ Jawaharlal Nehru Award for outstanding doctoral thesis research

- ✓ Vasantrao Naik Award

- ✓ Lal Bahadur Shastri Young Scientist Award

- ✓ Bharat Ratna Dr C Subramaniam Outstanding Teacher Award

- ✓ Punjab Rao Deshmukh Woman Agricultural Scientist Award

- ✓ Chaudhary Charan Singh Award for Excellence in Journalism in Agricultural Research and Development

- ✓ N.G. Ranga Farmer Award for Diversified Agriculture

- ✓ Jagjivan Ram Kisan Puruskar

- ✓ Swamy Sahajanand Saraswati Extension Scientist/ Worker Award

- ✓ ICAR Award for Outstanding Multidisciplinary Team Research in Agriculture and Allied Sciences

- ✓ National Krishi Vigyan Kendra Award

- ✓ Dr. Rajendra Prasad Puruskar for Technical Books in Hindi in the field of Agriculture and Allied Sciences

- ✓ Udyan Pandit Award for excellence in fruit growing

1.6 Agriculture Research in Kerala

The history of agricultural education in Kerala can be traced back to the year 1896 when a scheme was evolved in the erstwhile Travancore State to train a few young men in scientific agriculture at the Demonstration Farm, Karamana, Thiruvananthapuram, presently, the Cropping Systems Research Centre under Kerala Agricultural University. Agriculture was introduced as an optional subject in the middle school classes in the state in 1922 when an Agricultural Middle School was started at Aluva, Ernakulum District. The popularity and usefulness of this school led to the starting of similar institutions at Kottarakkara and Konni in 1928 and 1931 respectively (http://www.kau.in/basic-page/about Kerala agriculture university).

Agriculture was later introduced as an optional subject for Intermediate Course in 1953. In 1955, the erstwhile Government of Travancore-Cochin started the Agricultural College and Research Institute at Vellayani, Thiruvananthapuram and the College of Veterinary and Animal Sciences at Mannuthy, Trissur for imparting higher education in agricultural and veterinary sciences, respectively. These institutions were brought under the direct administrative control of the Department of Agriculture and the Department of Animal Husbandry, respectively. With the formation of Kerala State in 1956, these two colleges were affiliated to the University of Kerala.

The post-graduate programmes leading to M.Sc. (Ag), M.V.Sc. and Ph.D. degrees were started in 1961, 1962 and 1965 respectively.

On the recommendation of the Second National Education Commission (1964-66) headed by Dr. D.S. Kothari, then the Chairman of the University Grants Commission, one Agricultural University in each State was established. The State Agricultural Universities (SAUs) were established in India as an integral part of the National Agricultural Research System to give the much needed impetus to Agriculture Education and Research in the Country. As a result the Kerala Agricultural University (KAU) was established on 24th February 1971 by virtue of the Act 33 of 1971 and started functioning on 1st February 1972. The Kerala Agricultural University is the 15th in the series of the SAUs.

In accordance with the provisions of KAU Act of 1971, the Agricultural College and Research Institute at Vellayani, and the College of Veterinary and Animal Sciences, Mannuthy, were brought under the Kerala Agricultural University. In addition, twenty one agricultural and animal husbandry research stations were also transferred to the KAU for taking up research and extension programmes on various crops, animals, birds, etc. (*http://www.kau.in/basic-pageaboutkeralaagriculture_ university*).

Kerala Agro Industries Corporation (KAIC) is a joint venture of the Government of India and the Government of Kerala and promotes mechanisation and modern technology in Agriculture through setting up of agro industries, infrastructure development, value addition, waste management, and so on(http://www.keralaagro.com).

1.7 Kerala Agriculture University, Mannuthy, Thrissur

Kerala Agricultural University (KAU) is the primary and the principal instrumentality of the Kerala state in providing human resources, skills and

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technology, required for the sustainable development of Agriculture. It's defined, broadly encompassing all production activities based on land and water, including crop production (Agriculture), forestry and fisheries through conducting, interfacing and integrating education, research and extension in these spheres of economic endeavour. It is situated in Vellanikkara, Thrissur, Kerala(http://www.en.wikipedia.org).

Deemed to have come into existence on February 24th 1971 by the Act 33 of 1971 of the Kerala State Legislature, entitled 'The Agricultural University Act, 1971', the Kerala Agricultural University (KAU) became operational since February 1st 1972 when then existing two educational and 21 research institutions administered by the Departments of Agriculture and Animal Husbandry of the Government of Kerala, were brought under one umbrella for facilitating the sustainable and accelerated development of agriculture in the state(http://www.kau.edu.in).

During 2011, Kerala Agricultural University was trifurcated into Kerala Veterinary and Animal Sciences University (KVASU), Kerala University of Fisheries and Ocean Studies (KUFOS) and Kerala Agricultural University (KAU).

Now the University has six colleges (three Agriculture, one Agricultural Engineering, one Forestry, one Co-operation Banking & Management), 6 RARSs, 7 KVKs, 15 Research Stations and 16 Research and Extension Units under the faculties of Agriculture, Agricultural Engineering and Forestry. In addition, one Academy on Climate Change Adaptation and one Institute of Agricultural Technology offering M.Sc. (Integrated) Climate Change Adaptation and Diploma in Agricultural Sciences respectively are also functions in Kerala Agricultural University.

Figure 1.1

Entrance-Kerala Agriculture University, Mannuthy, Thrissur.

1.8 Metric studies: A brief description

1.8.1 Bibliometrics

Bibliometrics has gained considerable significance in recent years because of its practical application in the evolution of library operations and services as a statistical technique. It helps in formulating need based development policy and provides object data to inform managers to take timely decisions.

Bibliometrics is relatively a new tool in the emerging research front in its own right and in information science. Still it is now being vigorously persuaded and it has been found that one-fourth of all articles published in the library and information science periodicals are on bibliometrics and other related topics.

Allan Prichard first coined the term 'Bibliometrics' in 1969. It refer to "the application of mathematical and statistical methods to books and other media of written communication and of the nature of course of a discipline". This is an umbrella term which is used for many studies where quantitative methods are used to investigate the scientific communication process by measuring and analysing various aspects of written documents. But the first recorded study of bibliometric topic was in 1917 by Cole and Eales, being a so-called. Statistical analysis of literature of history of comparative anatomy papers by counting the number of publications country wise from 1543 to 1860. In 1923 Hulme used the term statistical bibliography and later it was used by many others. Gross and Gross in 1927 used for citation studies, the term" statistical bibliography" used by Henkle in 1938. Gosnell in his dissertation in 1943 and later in his article of 1944. Later 'Fusseler' in 1948 and 1949, Raising in 1962, Berker in 1966 and Prichard in 1968 and 1969 have used the term statistical bibliography in their works. The historical development of the term 'statistical bibliography' has been traced by writing in a footnote. As the term was very clumsy, not very descriptive and prone to confusion with statistics itself or bibliographies on statistics' ,Prichard have suggested the word 'Bibliometrics' in 1969 in preference to statistical bibliography. This term 'Bibliometrics' is analogous to Ranganathan's 'Librametrics' Russian concept 'Scientometrics', FID's 'Informetrics' and also to some other well established sub disciplines like 'Econometrics', 'Psychometrics' 'Sociometrics' Biometrics', etc. where mathematical and statistical calculations have been applied systematically to study and solve the problem in their respective fields.

De Solla Price and Garfield have referred to this   kind of user study as 'Citation analysis where Garfield recognised the importance of citation analysis as a tool in journal evaluation.

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During 1920's and 1930's, some significant contributions were made to this discipline by Lotka (1926), Bradford (1934) and Zipf (1935). They separately proposed three empirical rules having mathematical relations. These three fundamental laws laid the foundation of bibliometrics with mathematical base.

Lotka's Law is based on the measuring of productivity of authors on the basis of contributors of scientific papers to their number of contributions. Bradford law is a statistical expression derived on the basis of studies on scattering of articles on a subject in various periodicals. Bradford's law helped in the selection of documents in the collection development. Zipf's law is based on the relation between the rank of a word and the frequency of its appearance in a long text. Working on the statistics of vocabularies, he formulated the law by taking the statistical technique of ranking word frequency, beginning with the most productive. At the time of their first publications, none of them had any rational explanations and even today it is far from having a complete understanding of all implications of these laws for which the need for some empirical research, statistical application and mathematical modelling have been felt necessary from time to time(Jena,2012).

1.8.1.1 Laws of Bibliometrics

The fundamental laws of Bibliometrics are:

1. Lotka's law of scientific productivity

2. Bradford's law of scattering of articles

3. Zipf's law of word occurrence

1.8.1.2 Lotka's Law

In 1926 Alfred J. Lotka proposed his inverse law correlating contributors of scientific papers to their number of contributions. His law provided fundamental theoretical base for bibliometric studies involving authorships. Lotka's Law describes the frequency of publication by authors in a given field.

> *It states that " . . . the number (of authors) making contributions is about $1/n^2$ of those making one; and the proportion of all contributors, that make a single contribution, is about 60 percent" (Lotka 1926, cited in Potter 1988).*

1.8.1.3 Bradford's Law

Samuel Clement Bradford developed this law in 10934. According to the Bradford's law, the journals are arranged on the order of decreasing productivity on a given subject. They are divided into nucleus of journals/ periodicals more particularly devoted to the Agricultural research and several groups or zones containing the same number of articles at the nucleus where the number of periodicals in the nucleus, and the succeeding zones will b as 1: n: n2 For describing the scattering phenomena, the following mathematical formula expressed as

F(x) = a + b log X

where

F(x) is the cumulative number of references as contained in first 'x' most productive journals. 'a' and 'b' are constants.

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1.8.1.4 Zipf's Law

George Kingsley Zipf (1935) developed and enhanced an empirical law governing a relation between the rank and the frequency of its appearance in a long text.

The Law states that in a relatively lengthy text, if you "list the words occurring within that text in order of decreasing frequency, the rank of a word on that list multiplied by its frequency will equal a constant''.

If 'r' is a rank of a word 'f' is the frequency, then Zipf's law is stated as follows;

$$r \square 1/f \qquad \text{or}$$

$$rf = c...............$$

Where 'c' is constant

Zipf illustrated his law with an analysis of James Joyce's Ulysses. "He showed that the tenth most frequent word occurred 2,653 times, the hundredth most frequent word occurred 265 times, the two hundredth word occurred 133 times, and so on. Zipf stated in a *text in order of decreasing frequency, the rank of a word on that list multiplied by its frequency will equal a constant.*

1.8.2 Scientometrics

In 1969 Nalimov coined the Russian word 'naukometriya' which means scientometrics. The term 'Scientometrics' was used to mean the application of quantitative methods to the history of science, but it is now generally used as a generic term for a variety of research approaches within

the study of science that a quantifiable aspects of science can be utilized to assess the characteristics of science. The term scientometrics was made popular by the journal "*Scientometric*s'' by T Braunin in the year 1977. It was originally published in Hungary and currently publishing from Amsterdam.

1.8.3 Informetrics

The term **Informetrics** coined by **Otto Necke** in 1979. It looks at both informal or the spoken communication as well as recorded and information needs. It aims to define and measurement of information and types and characteristics of retrieval performance measure.

1.8.4 Webometrics

The term was coined by **Almind** and **Ingwerson** in 1997. It is the quantitative analysis of web related phenomena.

Areas of study are:

1) Webpage content analysis

2) Web link structure analysis

3) Web user analysis and

4) Web terminology analysis

1.8.5 Altmetrics

Altmetrics was proposed in 2010. It is the alternative method of measuring the resources through social networking cites. It demonstrate one aspect of the changing landscape of scholarly and academic production dialogue an0d use. It illustrates the changing method of both bibliometrics and scientometrics. The study collects data from Tweets, blog mentions, Facebook, Presentations, news articles, Shared citations and Data uploads (Yasmin, 2015).
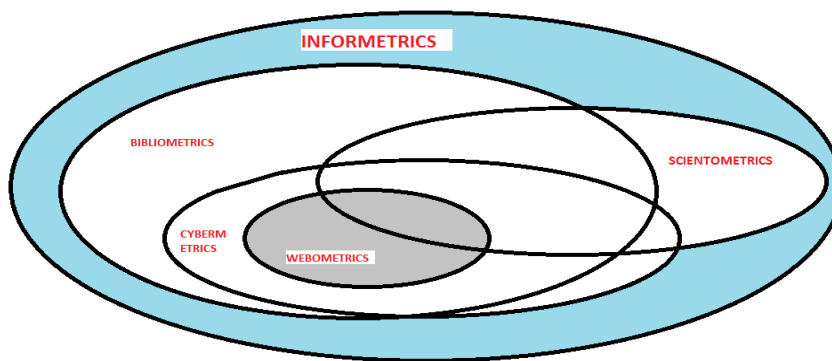
Figure 1.2

Inter-relationship between different metrics

1.9 Scientometrics: An overview

The term 'scientometrics' was introduced and came into prominence with the journal named 'Scientometrics' by T.Braunin in 1977,originally published in Hungary and currently publishing from Amsterdam. Scientometrics is part of the sociology of science and has application to scientific policy making. It involves quantitative studies of scientific activities including publication thus overlaps bibliometrics to some extent. Scientometrics is a branch of science of science.

Nallimove and Mulchenko defined scientometrics as a subfield which applies quantitative methods to the study of science as an information process. Hailteun treats 'scientometrics' as a scientific discipline which perform reproducible measurement of scientific activity and reveals its objective quantitative regularities. According to wiki dictionary, 'scientometrics' is the scientific measurement of the work of scientists, especially by way of analysing their publications and the citations within them.

1. The analytical aspect which deals with the general laws of the development of science as a knowledge systems and a specific social institutions.

2. The normative aspect deals with the development of practical recommendations for raising research efficiency.

The principle aim of Scientometrics is to determine the state and prospect of a subject and its further development. Several scientometric indicators are used for this purpose and one of the most significant indicators is the number of publications its change over time is usually considered as a measure of research topically in a given field. This indicators become a standard tools of evaluation and analysis in research. Management of science years to way to measure scientific information, which may be used for the control of scientific development in two ways, strategic and practical policy making. The practical way includes search of information to users. As far as the strategic use of information is concerned, it implies the monitoring of scientific development and the analysis of changing structure of science. Since the beginning of the 1970's, this kind of research actively aimed at getting structural picture of the state of the science and is gaining popularity.

Scientometrics and its methods can be divided into the following structural entities:

- **Dynamical Scientometrics**: Deals with the construction of comprehensive models of growth of the scientific knowledge, the age of the scientific information, the development of the citation processes, etc.

- **Structural Scientometrics:** Concerned mainly with the problem of "mapping of the cognitive structure of scientific knowledge", based on methods such as co-citation, bibliographic coupling or co-word analysis.

- **Evaluative Scientometrics:** Dealing with the assessment in the sphere of scientific research, and for the purposes of the science policy.

- **Prognostic Scientometrics:** Pertaining to drawing visions about the development of the science processes in the future.

Scientometric techniques are immensely useful for decision makers and researchers working in a technical domain, understanding the state of their area of interest are of the highest importance. Scientometric techniques can provide information regarding past and current research from a variety of channels, providing both a difficult challenge as well as a rich source of possibilities, while on the other; they provide a rich source of data with which a well-informed and comprehensive research strategy may be formed. (Alvi, 2015)

1.9.1 Tools for scientometric analysis

Science Citation Index (SCI)

Science Citation Index is a citation index originally produced by the Institute for Scientific information (ISI) and created by Eugene Garfield. It was officially launched in 1964, it is now owned by Thomson Reuters. The larger version (SCI Expanded) covers more than 6,500 notable and significant journals across 150 disciplines, from 1900 to the present.

The index is made available online through different platforms such as Web of Science and SCI search. (There are also CD and printed editions covering a smaller, number of journals). This database allows a researcher to identify which later articles have cited the articles of any particular author, or have been sited most frequently. Thomson Reuters also markets several subsets of this database, termed special citation indexes, such as Neuroscience Citation Index and Chemistry Citation Index.

Chemistry Citation Index

Chemistry Citation Index was first introduced by Eugene Garfield, a

chemist, his original search examples were based on experience as a chemist. In 1992 an electronic and print form of the index was derived from a core of 330 chemistry journals, within which all areas were covered. Additional information is provided from article selected from 4000 other journals. All chemistry sub disciplines were covered. Organic, Inorganic, analytical, physical chemistry, polymer, computational, organometallic, materials chemistry and electrochemistry. By 2002 the core journals increased to 500 and related article coverage increased to 80000 other journals. One 1980 study reported the overall citation indexing benefits for chemistry examining the use of citations as a tool for the study of the sociology of chemistry and illustrating the use of citation data to observe chemistry subfield over time.

Social Science Citation Index (SSCI)

Social Science Citation Index is an interdisciplinary citation index, product of Thomson Reuter's health care and science division. It was developed by Institute for Scientific Information (ISI) from the Science Citation Index. This citation database covers some 2474 of the world's leading journal of social science across more than fifty disciplines. It is made available online through the web of science service. This database product provides information to identify the articles cited most frequently and by what publisher and author.

Web of science

Web of Science (WoS, previously known as web of knowledge) is an online subscription based scientific citation indexing service maintained by Thomson Reuters that provides a comprehensive citation research. It gives access to multiple databases that reference cross disciplinary research.

Expanding the coverage of WoS in November 2009 Thomson Reutor introduced century of social sciences, this service contains files which trace

social science research back to the beginning of the 20th century, and WoS now has indexing coverage of the web of science encompasses over 50,000 scholarly books,12,000 journals and 1,60,000 conference proceedings. The selection is made on the basis of impact evaluations and comprise open access journal, spanning multiple academic disciplines. The coverage include sciences, social sciences arts and humanities and goes across disciplines. However, web of science does not index all journals and its coverage in some fields is less complete than in others.

Scopus

Scopus is a bibliographic database, containing abstracts and citations for academic journal articles. It covers nearly 22,000 titles from over 5000 publishers of which 20,000 are peer reviewed journals in the scientific, technical, and medical and social science (including arts and humanities). It is owned by Elsevier and is available online by subscription searches in Scopus also incorporate searches of patent databases.

Scopus subject coverage spans 27 area of disciplines update daily. Geographical publishers across a wide range of countries. Scopus include articles, books, business article and press release, conference report, editorial, erratum, letter, note, report, review and short survey.

Google scholar

Google Scholar is a freely accessible web search engine that indexes the full text or metadata of scholarly literature across an array of publishing formats and disciplines. Released in beta in November 2004, the Google Scholar index includes most peer-reviewed online academic journals and books, conference papers, theses and dissertations, preprints, abstracts, technical reports, and other scholarly literature, including court opinions and patents.

Scholar has gained a range of features over time. In 2006, a citation importing feature was implemented supporting bibliography managers (such as Ref Works, Ref Man, EndNote, and Bib TeX). In 2007, Acharya announced that Google Scholar had started a program to digitize and host journal articles in agreement with their publishers, an effort separate from Google Books, whose scans of older journals do not include the metadata required for identifying specific articles in specific issues. In 2011, Google removed Scholar from the toolbars on its search pages, making it both less easily accessible and less discoverable for users not already aware of its existence. Around this period, sites with similar features such as CiteSeer, Scirus, and Microsoft Windows Live Academic search were developed. All three of these are now defunct.

A major enhancement was rolled out in 2012, with the possibility for individual scholars to create personal "Scholar Citations profiles", public author profiles that are editable by authors themselves. Individuals, logging on through a Google account with a bona fide address usually linked to an academic institution, can now create their own page giving their fields of interest and citations. Google Scholar automatically calculates and displays the individual's total citation count, h-index, and i10-index. According to Google, "three quarters of Scholar search results pages show links to the authors' public profiles" as of August 2014.

A feature introduced in November 2013 allows logged-in users to save search results into the "Google Scholar library", a personal collection which the user can search separately and organize by tags. A metrics feature now supports viewing the impact of academic journals, and whole fields of science, via the "metrics" button. This reveals the top journals in a field of interest, and the articles generating these journal's impact can also be accessed.

Journal Citation Report

Journal Citation Reports (**JCR**) is an annual publication by Clarivate Analytics (previously the Intellectual Property and Science business of Thomson Reuters). It has been integrated with the Web of Science and is accessed from the Web of Science-Core Collections. It provides information about academic journals in the sciences and social sciences, including impact factors. The *JCR* was originally published as a part of *Science Citation Index*. Currently, the *JCR*, as a distinct service, is based on citations compiled from the *Science Citation Index Expanded* and the *Social Science Citation Index.*

There are separate editions for the sciences and the social sciences; the 2013 science edition includes 8,411 journals, and the 2012 social science edition contains 3,016 titles. The issue for each year is published the following year, after the citations for the year have been published and the information processed.

The publication is available online (*JCR on the Web*), or in CD format (*JCR on CD-ROM*); it was originally published in print, with the detailed tables on microfiche.

1.9.2 Software packages for scientometric studies

Sitkis

In the initial stages of research project, identifying the most relevant authors and publications in the particular field of study is fundamental. Sitkis a bibliometrics tool aids the research process by facilitating the selection and treatment of high quality scientific information. It is developed by Hentry. We outline the specification of the program, describing its operation and identifying its main uses and limitations.It works on Java and MS Access. It analyses 50000 articles at a time.

Pajek

Pajek (Slovene word for spider) is a program, for windows (32 bit), for analysis of large networks. It is freely available for non-commercial use, and its home page http://vlado.fmf.uni-ij.si/pub/networks/pajek.Large networks can be found in many different areas usually they are produced automatically, using computers, from different data sources that are already available in computer readable form.

The main goals in the design of Pajek are:

- To support abstraction by(recursive) factorisation of a large network into several smaller networks that can be treated further using more sophisticated methods

- To provide the user with some powerful visualisation tools

- To implement a selection of an efficient algorithms for analysis of large networks.

Data structure

Currently Pajek uses six data structure to implement the algoritham

1. Network-main object (Vertices and lines)

2 .Permutation-Reordering of verticles

3. Vector-values of verticles

4. Cluster-subset of verticles (one class from partition)

5. Partition-Tells for each vertex to which cluster the vertex belongs.

6. hierarchy-hierarchically ordered clusters and verticles

The power of pajek is based on several transformations which support

different transitions among these data structure. Besides its own input formats, pajek support all other formats like UCINET DL, GED, geniologies, can be read either as one graph or p-graph; and some molecular formats BS(Ball and socket), MAC(mac molecule) and MOL (MOL MOLfile)

Publish or Perish

"**Publish or perish**" is a phrase coined to describe the pressure in academia to rapidly and continually publish academic work to sustain or further one's career.

Frequent publication is one of the few methods at scholars' disposal to demonstrate academic talent. Successful publications bring attention to scholars and their sponsoring institutions, which can facilitate continued funding and an individual's progress through a chosen field. In popular academic perception, scholars who publish infrequently, or who focus on activities that do not result in publications, such as instructing undergraduates, may lose ground in competition for available tenure-track positions. The pressure to publish has been cited as a cause of poor work being submitted to academic journals. The value of published work is often determined by the prestige of the academic journal. Journals can be measured by their impact factor (IF), which is the average number of citations to articles published in a particular journal.

Orgin

The earliest known use of the term in an academic context was in a 1927 journal article. The phrase appeared in a non-academic context in the 1932 book, *Archibald Cary Coolidge: Life and Letters,* by Harold Jefferson Coolidge. In 1938, the phrase appeared in a college-related publication. According to Eugene Garfield, the expression first appeared in an academic

context in Logan Wilson's book, "The Academic Man: A Study in the Sociology of a Profession", published in 1942.

Advantages

Research-oriented universities may attempt to manage the unhealthy aspects of the publish or perish practices, but their administrators often argue that some pressure to produce cutting-edge research is necessary to motivate scholars early in their careers to focus on research advancement, and learn to balance its achievement with the other responsibilities of the professorial role. The call to abolish tenure is very much a minority opinion in such settings.

HistCite

HistCite is a software package used for bibliometric analysis and information visualization. It was developed by Eugene Garfield, the founder of the Institute for Scientific Information and the inventor of important information retrieval tools such as *Current Contents* and the *Science Citation Index*

The main purpose of the software is to make it easier for individuals to perform bibliometric analysis and visualization tasks. Bibliometric analysis is the use of the bibliographic information (titles, authors, dates, author addresses, references, etc.) that describe published items to measure and otherwise study various aspects of a specific field of scholarly endeavour.

Some typical questions asked by bibliometricians that can be answered by HistCite analysis are:

1. How much literature has been published in this field? When and in which countries has it been published? which countries are the major contributors to this field? which are the languages most frequently used by the items published in this field?

2.   Which journals cover the literature of the field? Which are the most important?

3.   Who are the key authors in this field? which institutions do these authors represent?

4.   Which articles are the most important?

5.   How have the various contributors to the field influenced each other?

The answers to such questions are valuable to researchers, librarians, and administrators.

Information visualization is the transformation of non-numerical data into a graphic format. Visualization helps various researchers and scholars understand large collections of information. Although there are numerous uses for information visualization, HistCite performs one specific application: it converts bibliographies into diagrams called historiographs.

Application

A wide variety of professionals who need to analyse the published literature use HistCite for analysis.

Operation

In order to perform its functions, histcite must import a bibliography from another source. Once   the bibliography is imported, basic point and click commands initiate the various analysis and visualisation. HistCite is currently setup to import bibliographies created by searches of the web of science database offered by Thomson Reutors scientific bibliographies from other sources can be manually entered into histcite. The bibliography user feeds to histcite represents the literature of the subject area as it is defined by that users unique perspective. Thus the analysis and visualisation produced by

Histcite from that bibliography are one–of-a kind. Histcite operates on windows computers with internet explorer. (https://en.wikipedia.org/wiki/Histcite)

Bibexcel

- Bibexcel is a great tool for bibliometric and citation analysis. Developed by Olle Persson from Umea University, Sweden to assist a user in analyzing bibliographic data. It is possible to do most types of bibliometric analysis, and bibexcel allows easy interaction with other software like Pajek, excel, SPSS, etc. The program offers the user high degree of flexibility in both data management and analysis and this flexibility is one of the real strength of the programs.

- Bibexcel produces several types of files; in fact every procedure will give the user a new file. However the OUT-file is always created first and it is this file that is the starting point for the analysis you want to do in bibexcel.

Citespace

Citespace is a freely available java application, to generate and analyse networks of co-cited references based on bibliographic records retrieved from the web of science. The input is a collection of scientific publications representative for a specific topic. In this tool thematic patterns and emerging trends are computationally detected and visually represented.

Applications

1. The mathematical-statistical techniques has made possible the process of quantifying the number of publication and the number of people participating in the social system of science or R&D.

2.   Quantification of the intellectual products of scientists or   researchers

3.   Ability to map literature of a discipline intelligibility at different level

4.   An ability to model dynamic aspects of literature mathematically with good-to-excellent fits.

1.10 Relevance of the study

Research and development (R&D) institutions contribute to socio-economic development of the state by producing high quality research outputs in various fields. They are published in various forms. The quantitative analysis of research publication by applying some statistical methods, generally termed as bibliometrics. In science it is called as "scientometrics". Scientometric studies plays vital role in chronological evaluation of growth rate of publication, publishing trend, focused areas of research and specialised journals in each field. This will helpful for budgetary control, promoting staffs, and thus enhance the research productivity of an R&D institution.

Kerala Agriculture University is a major Research and development institution providing research and education in agriculture field in Kerala. It is started in 1971, it's headquarter is situated in Mannuthy, Thissur. It is well poised to meet the challenges ahead that transforms agriculture sector into the engine of growth of Kerala's economy by providing the human resources, skills and technology for the sustainable development of state's Agriculture, all economic activities put to the production of biomass based land and water including crop production (agriculture), animal husbandry, forestry and fishery. For attaining these, it is important to conduct researches in these fields (www.kau.edu.in). These are lead to the present study "publication productivity of Kerala Agricultural University, Thrissur During 2008-2017:A scientometric analysis".

1.11 Statement of the problem

The most fundamental social process of science is the communication and exchange of research findings. It is mainly through the journals, conference proceedings and other sources. The articles /research papers published commonly termed as research productivity. Research productivity of R & D institution is very important in all field of knowledge. State like Kerala, agriculture is the backbone of the state economy. The Kerala Agricultural University provides research and education in this field. Measurement of research productivity of an institution is very significant. So the present study is entitled as **"Publication productivity of Kerala Agricultural University, Thrissur during 2008-2017: A scientometric analysis".**

1.12 Definition of the Key terms

- **publication productivity**

Publication

Research has been defined in a number of ways

The Merriam –Webster online dictionary defines "publication" in more details as "The act or the process of producing a book, magazine etc., and making it available to the public.

A broad definition of "publication" is given by Collins Dictionary is "The publication of a book or the magazine is the act of printing it and sending it to shops to be sold."

Cambridge dictionary defined as "Publication" is the act of making information or stories available to people in a printed or electronic form.

Productivity

Cambridge learner's dictionary defines "productivity" means the rate at which goods is produced.

In the present study '**publication productivity**' means research papers/articles produced by faculty, researchers or the scientists of Kerala Agriculture University.

- **Kerala Agricultural University**

Kerala Agricultural University (KAU) is the primary and the principal instrumentality of the Kerala state in providing human resources, skills and technology, required for the sustainable development of Agriculture, it broadly encompasses all production activities based on land and water, including crop production (Agriculture), forestry and fisheries through conducting, interfacing and integrating education, research and extension in these spheres of economic endeavour. It is situated in Vellanikkara, Trissur, Kerala.

- **Scientometric analysis**

Scientometrics is the study of measuring and analysing science technology and innovation. Major research issues include the measurement of impact, reference sets of articles to investigate the impact of journals and institutes, understanding of scientific citations, mapping scientific fields and the production of indicators for use in policy and management contexts.

1.13 Objectives of the study

The main objective of the study is to ascertain the publication productivity of Kerala Agricultural University during the period 2008-2017. The specific objectives of the study are following.

1. To determine the year wise growth of publication of Kerala Agricultural University (KAU) during 2008-2017.

2. To examine the type of document preferred for publishing as well as the language preferred.

3. To ascertain the authorship pattern of documents, collaboration pattern and other collaboration measures.

4. To find out the most prolific authors of KAU

5. To identify the subject-wise and institutional wise productivity.

6. To identify the journals preferred for publishing and the detailed analysis of these journals.

7. To test the applicability of various bibliometric laws.

1.14 Hypotheses of the Study

The following are the hypotheses formulated for this study:

H1:The year–wise productivity of KAU research output shows the fluctuating trend.

H2: Collaborative research dominates in KAU publications.

H3: Journals are most used channel of communication among KAU staff.

H4: KAU scientists prefer to publish in Indian Journals than foreign journals.

1.15 Methodology of the study

Agriculture research outputs are published in various print and electronic media. For the purpose of study, several possible sources like institutional website, institutional repositories, consortia, science databases, annual reports, etc. are used. A well-structured data sheet containing details

likes author(s), title, year, name of author, number of author, etc. would be used for data collection.

The variables used for the study are research productivity, year-wise distribution of publication, subject-wise distribution of publication, author collaboration, impact factor, prolific author, journal article analysis and institutional collaboration.

1.16 Scope and limitations of the study

Various research has been carried out in the field of Agriculture for attaining sustainable development of food in the state. The growth of the scientific research is measured using statistical techniques. The information from the study is helpful for future development in the field.

The present study covers latest ten years (2008-2017), research products like projects, theses, dissertations, articles and other publications in various departments of Kerala Agriculture University and research stations are included. The veterinary and animal sciences, forestry and fisheries are separated from KAU on 2010 onwards. Research productivity of these three universities measured up to 2010 only.

1.17 Organisation of the thesis

The whole study is organised into six chapters in these as follows. The appendix and select bibliography are attached at the end of the thesis.

Chapter I-In this chapter include introduction, agriculture research, agriculture research in India and Kerala, Kerala Agricultural University, Bibliometrics in general, Scientometics-its origin, tools and software used for analysis, Need and significance of the study, objectives, hypotheses, methodology, scope and limitation, chapterization and conclusion.

Chapter II-The related studies are reviewed and arranged under the following headings;

1. Institutional productivity-agriculture

2. Institutional productivity-other subjects

3. Bibliometrics-Other discipline

Chapter III- It describes an overview of Kerala Agriculture University; genesis, research and development

Chapter IV- It consists of research design and describe its objectives. It also explain the methods adopted and took well with relevant technique.

Chapter V - Includes analysis and interpretation of results. The results are presented in tables and graphs in order to understand simplified manner.

Chapter VI - Summarises findings of present study, suggestions and recommendations and scope for future research are included.

1.18 Style manual used

In this study the researcher used guidelines in the APA (American Psychological Association) 6th edition for preparing references and bibliography albeit with minor variations in the in-text citations. In order to assist readability, the researcher has limited explicit mentioning of the names of authors up to the first three during in-text citations. However, in the references and select bibliography, the names of authors are provided using the style manual.

1.19 Conclusion

Food security is the major problem all over the world; in order to overcome this agriculture research is necessary. Research outputs in

agriculture field are published for public to make them aware of the cultivation, most yielding crops with resistivity, techniques in agriculture etc. this act as a motivation for farmers and many supporting programmes also increase the productivity in the field. So the present study focuses on one of the prestigious institution in Kerala-Kerala Agriculture University that supports each and every field of agriculture to lead to a sustainable development of the state.

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CHAPTER II
REVIEW OF LITERATURE

2.1. Introduction

Studies on related problems are useful for indicating the type of difficulties that may be encountered in the present study as also the possible analytical shortcomings. At time such studies may also suggest useful and even new lines of approach to the present problem. (Kothari, 2004, p.28)

For this purpose investigator searched academic journals, conference proceedings, government reports, books, book chapter, etc. must be reviewed for the present problem is not carried out yet and give a path to forward. The studies related to the present problem reviewed are arranged as in following heading.

➤ Institutional publication productivity-Agriculture

➤ Institutional publication productivity-other disciplines

➤ Bibliometrics-other disciplines

2.1.1 Institutional publication productivity-Agriculture

R&D institutions are most important one to the socio-economic development of a state to the nation as well as to the world. Hence its scientific analysis of literature produced by them gives performance of researchers. In various fields it highlights most contributing, prolific author, major area of research, etc.

According to Garfield and Welljams-Dorof, the value of using citation based institutional readings as S&T indicators is "obvious" university administrators and corporate manager can compare their peers and

competitors. Government and private funding sources can monitor return on their S&T investment. And policy makers can identify relative strengths and weakness in strategically important S&T sectors." (Negi, 2005,p.274)

There various scientometric studies related to agriculture literature done in earlier, like literature analysis, growth of publication, authorship collaboration, comparative studies, mapping of agriculture literature, journal analysis, institutional productivity, etc. this will help to know the latest trend of research and development in agriculture field. This can help investigator to present study.

Siwach (2020) analysed wheat research output in India during 1996-2015. The parameters of the study were year wise output, most prolific authors, document types, top journals, top institutions, international collaborations, funding agencies, citation profile and top cited papers. The data was extracted from Scopus database. The study found out that with 8.52% of the global research output on wheat, India stands at third position in the world, the researchers collaborate with 91 countries. IARI is the top institution, H S Dhaliwal is the top author. CSIR is the most funding agency. Most preferred journals are *Indian Journal of Agriculture Science and Indian Journal of Agronomy.* The paper by J.Peng et.al. Published in *Nature* was the top cited paper about wheat research during the study period.

Rathinasabapathi and Kopperundevi (2020) undertook a study of 1799 papers published by members of faculty and researches of the Tamil Nadu Veterinary and Animal Science University, Chennai during 1999 to 2018. The parameters of the study were year wise growth, most prolific authors, journals used for communication, most preferred journals and the number of citations received during the period. The research showed that most of the publications are journal articles, which are published mostly in Indian journal. However foreign journal publications got more citations than Indian journals. The most

productive author of TANUVAS was B.Murali Manohar.

Kasa et.al. (2019) examined authorship pattern of faculty members in university based agricultural research institute in Nigeria. The data collected for the period 2009-2018. The results showed that majority of the publications are multiple authored, in which highest number of author per paper was those papers with four on collaboration two third of a paper showed internal collaboration and the least was intra-institutional collaboration. The country wise collaboration highest observed in Africa and the least South America.

Deepthi and Tadasad (2019) observed collaborative research in university of agricultural Science, Dharwad. For the purpose of study, data retrieved from google Scholar and CABI abstract for the year 2017. The result obtained was majority of the publication were joint authored. It also noted that collaboration within the same departments in more predominant among collaborated publications and only a few are international collaboration publications. This study suggested that the collaboration with national and International institution is necessary to improve the academic productivity.

Sapna Verma and Singh (2019) studied food security research publications during 2000 to 2018. It was found that majority of the publication are journal articles, *Current science* is the most preferred journal in which the maximum number of publication appeared in the field. Most prolific author was Singh R. whereas varshney R.K has highest citation. Food technologist in India mostly collaborated with USA followed by UK.

Parabhoi and Sabu (2019) analysed publication of Himachal Pradesh University during 1972-2015. The parameters of the study were type of publication, authority trends, collaboration pattern, most prolific author and journals. The data were collected from scopus data base. The results showed that most number of publication are journal articles. The growth of

publication observed steady growth during the period of study the interuniversity collaboration was renewed over the year. The major area of research was science in which majority of the publications are from Physics and Astronomy with 758 publication (25.04%)

Scientific productivity of ICAR-Indian Institute of Horticulture, Bangalore (ICAR-IIHR) is analyzed by Suresh and Thanuskodi Shanmugam (2019). The data was retrieved from web of science database. The study limited to 30 years (1989 to 2018). The study found out that growth of literature follows the exponential growth pattern, journal articles are the most published form of literature. Most preferred journals are *Journal of Agricultural Home Science* followed by *Current Science*. United States and Horticulture experiment station are top collaborating country and Institution. The highly productive subject areas are Agriculture and plant science.

Yury Dranev, Maxim kotsemir and Boris Syomin (2018) studied the diversity of research publications related to agricultural productivity and possible implications for STI policy. The data collected from Scopus database. The study emphasised research publication diversity of 75 countries using panel regression model and used agriculture productivity as a dependent variable .It revealed that agricultural productivity largely influences economic performance of the countries. And also shows that R&D funding, if carefully balanced with the diversification of agriculture science, could improve research performance and eventually productivity in an agriculture sector.

Siwach and Parmar (2018) has attempted to study the research contributions of CCS Haryana Agricultural University (CCSAAU). The parameters of the study was year wise growth pattern, major subject categories, national and international collaboration, most preferred journal, most prolific authors, keywords, authorship pattern, citation pattern and highly cited papers of CCSAAU. The study showed that a total of 2649 paper

were published during 2001-2015. It received 15282 citations. Almost 50% of the publications are scattered over 10 journals and it has collaborated with many institutions at national and international level.

Parabhoi et. al (2017) studied the research outputs of Dr.Yarwant Singh Parmar University of Horticulture and Forestry, during 2006-2015. The variable of the study were year wise growth of articles, types of publications authorship pattern, degree of collaboration, average number of citation per articles, most preferable journal, subject wise distribution and author productivity. The data retrieved from scopus database. The study found that majority of the publication are journal articles. In which 88.21% are published articles, the major area of research was agricultural and biological science. The most preferred journal was *Indian journal of agricultural science* and most prolific author was "Sharma N." Sharma N also got 1st rank with received of H-Index 8, G-index 10 and M –Index 0.666667. The highly cited paper found was "synthesis of ZNA nano particles and study of their antibacterial and antifungal properties."

Yasmin (2016) studied research productivity of Central Marine Fisheries Research Institute. The parameters of the study were year-wise distribution, authorship pattern, and degree of collaboration, ranking of authors and ranking of journals. E-prints @CMFRI are annual reports that were the source for collecting data. The study revealed that fluctuation in the growth of publication during the period. Relative growth rate showed a decreasing trend while doubling time showed an increasing trend. Major research contribution are from socio-economic evaluation and technology, but deresal fisheries division is the least productive area. The study also analysed ranking of authors by applying Lotka's law and analysing of journals by applying Bradford's law.

Can Besimoglu (2016) examined research trends of agricultural

faculties in Turkey and the world during 1996-2011.The data was collected from web of the science and analysed using bib excel and Gephi. The study found that agricultural policies determined by Turkish councils, Institutions and scholars had effects on the researches carried out on the agriculture. Publications growth in each subject is gradually increased. While there is a significant percentage of publication on biochemistry, molecular biology, genetics and heredity, microbiology and cell biology. In agriculture faculties in other countries, the percentage of the publication is much lower in Turkey. The subject agricultural plant and food science shows decreasing trend.

Biometric analysis of cereal crop research see through scopus database curing 1965-2010 is studied by Tripathi and Garg (2016). The result revealed that most number of papers published on rice followed by wheat. Universities and the institution under the sponsorship of ICAR were most productive institution, most preferred journal for publishing was *Indian Journal of Agricultural Science* followed by *Indian Journal of Agronomy*. Indian Agricultural Research Institute ((IARI), New Delhi topped among the prolific institution followed by Punjab Agricultural University, Ludhiana. The most focused area of research was Genetic and plant breeding followed by agronomic aspects. Multiple authorship in dominated among the publication. Most of the prolific authors were affiliated to Indian agricultural research institute.

Sarala (2016) studied the faculty productivity in Kerala Agricultural University. The parameters of the study were year wise growth, authorship pattern, document types, journal analysis and factors affecting research productivity. The questionnaire and datasheet is used as a data collection tool. The major finding was year-wise growth is skewed, multiple authorship is predominant. The most prolific authors were identified as the teachers who carrying highest position. The majority of the faculties prefer Indian journal

Safe and Kripanyula (2016) conducted mapping of veterinary research at Sokoine University of Agriculture, Tanzania. The data for the study was collected from publish or perish software. A total of 2392 publications were recorded for all veterinary scientists, giving an average of 74.75 publications per year. The relative growth rate and doubling time are 2.10 and 0.36 respectively. The collaborative authorship is predominant with over one third of these being jointly contributed by 6 or more authors. The degree of collaboration was 0.96.The veterinary scholars at SUA published their research findings in 241 different journals during the period of study.

Pastor and Zaera (2015) analysed higher education research productivity of European countries .The data was collected from SCOPUS database. The study reflected quantitative and qualitative aspect of research outputs in higher education limited to the period 1996-2010 for the countries of European Union, UK, Germany, France, Italy and Netherlands are most produced countries While, its relative growth is moderate. However results showed that intensive growth in both quantitative and qualitative aspect of research output of European Union.

Paul et.al. (2015) analyzed "research productivity of agricultural scientist in selected low and high performing institutions in India. The study revealed that there is an ample scope of enhancing research productivity among the scientists as the majority (63%) of scientists had low to very low level of productivity. In the low performing institute, only 20% of the scientists had high to very high level of productivity. The another results obtained was the crucial need for resistivity the present system of pioneer advancement for principle scientists as the result of a t-test failed to produce a significant value of productivity difference between the principal scientists and senior scientists. Balanced involvement of the scientists from the low performing institute in research teaching authorities, organisation

development intervention in regular intervals for ensuring of pre-research and creative organizational environment and association of sufficient fund for individual research project may be suggested among the necessary measurements of harnessing optimum research productivity of scientists".

Bagalkoti and Hosamany (2015) examined mapping of scientific article on agriculture research in India during 1999-2013. The study aimed to find out growth of agriculture research, doubling time, domain wise distribution of publication and citation, International collaboration, institutional productivity or collaboration, preferred journal for collaboration and most cited papers in the field of Indian agriculture. The data was retrieved from the web of science. The study revealed that most of the publications are in the form of articles. The rate of growth of publications decreased and the doubling time increased. However the overall growth of agriculture literature in India is increased. Most of research are collaborated as national as well as international level. Major contribution is in the field of plant science with 2017 papers, Council of Scientific and Industrial Research (CSIR) have the highest H –index 53with top individual productivity.

Payumo and Sutton (2015) evaluated a collaboration of ASEAN in plant biotechnology using bibliometric techniques, the investigator studied publication count author count compound annual growth rate, type of publication, top producers citation count, citation per publication and collaboration rate. The data was collected database using various key words. The study reveals that scientific output among ASEAN countries increased during 2004-2013.Influence and collaboration also increased. Thailand produced the most publications of the ASEAN member states while Singapore had the highest influence. Domestic and international collaboration is high while national collaboration is very low. The study highlight the need of more relevant studies to understand plant biotechnology co-operation and knowledge flows between ASEAN countries

Gupta, Saxena and Visakhi (2014) examined the contribution of twenty agriculture universities during the period 2007-2011. The data for the study was collected using Scopus database (http://www.scopus.com/search). Separate search strategy was developed for each university for analysing its total output, citation impact, international collaboration and subject wise output. The study revealed that total output increased during the period of study. IARI Delhi is the most productive institution. Out of the 20 universities collaborating with 83 other countries. The largest share of papers with USA followed by UK. The study mainly focused inter-filed and inter-university comparison.

Tripathi, and Garg (2014) examined Indian Crop Science research during 2008-2010. The population of the study was publicationsof crop science during study period retrieved from scopus, CAB and ISA database. The major findings of the study were highest number of paper was published on rice and wheat crop, Agriculture Universities and Institutions under the ICAR were most productive institutions. Most of the papers were published in Indian journal with low impact factor. The most preferred journals were Environment and Ecology, Indian Journal of Agriculture Science and Research on Crop. The major area of research is genetics and plant breeding followed by soil climate and environmental aspect. Nearly 3/4th of the publication were co-authored publication.

Lawal. et.al. (2014) surveyed the knowledge sharing of academic staff in Nigerian University of Agriculture. For the purpose of the study randomly selected 232 responds and collected data through questionnaire method. The result revealed that majority of the staff were aware about knowledge sharing. Major sharing media was journals followed by electronic meeting. Large influence of sharing of knowledge among academic staff in Nigeria is highlighted in the study.

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Tandon et.al. (2013) examined trend in publication, authorship pattern, availability, and accessibility of articles during 2008-2010 from the Indian agriculture research institute (IARI), India. The data revealed during 2008-2010 that total 1833 publication are joint authored and that the most preformed journal for publication by researchers is the Indian journal of agriculture science which in an open access journal. The publication from IARI are available to subscribers of the consortium for e-resources in agriculture (CERA), public availability to IARI publication is very less. Suggestion made in this study areas to make their research output more accessible and available to a wider audience, IARI researcher in should deposit their work in IARI's open access repository Eprints@ IARI. However, making such a deposit require an Open Access Policy.

Okiki (2013) reported "research productivity of teaching faculty members in Nigerian federal Universities. The results revealed that research productivity is high in journal publications, technical reports, conference papers, working papers and occupational papers. Also the research productivity higher in North East, South West and North Central Nigeria".

Sife, Bernard and Eanest (2013) examined publication productivity of forest researches in Sokoine University of Agriculture (SUA). The study focused growth pattern, authorship collaboration, most prolific author and the journals in which most number of researches published. The data were collected using Publish or Perish software. The most number of publications observed in the year 2008, followed by the year 2007. Multiple authorship is predominant and degree of collaboration was 0.88. It highlighted that many factors influence research productivity of SUA.

Borthakur and sing (2012) studied agriculture research in India in colonial and post- colonial era. This study gives detailed picture of agriculture development from colonial era to present. It describes growth of agriculture

colleges, universities and other institutes and also gave the role of each five year plan in agriculture research. The study revealed that the agriculture colleges and universities were in zenith stage of progress in colonial era. Limitation of the study is that it gave only overview of history of Indian agriculture research not gave about the growth or the trend.

Vithal (2012) analysed the impact of information use on publication productivity of faculty member of agricultural science. The data was collected by questionnaire. The result revealed that there is a positive correlation between publication productivity and dependency on information sources and services. The study suggest that take necessary steps for the improving the information sources and services and also provide information literacy program to faculty members to increase their publication productivity.

Vithal (2012) surveyed publication pattern of faculty member of Agricultural Science in Andra Pradesh. The population of the study was 235 faculty members working in Acharya N.G. Ranga Agricultural University.A.P. To collect the data questionnaire were employed. The result revealed that there is a positive correlation between publication productivity and gender, age, designation, educational qualifications, experience and workload of faculty members.

Hedjazi, and Behraven (2011) studied the factors influencing research productivity of agriculture faculty members in Iran. The study found out the relation between demographic individual and institutional variable. The data regarding demographic and research productivity were extracted from faculty member profile. Questionnaire was also used for collecting information concerning to institutional and individual variables. The method applied for the analysis are mean score, standard deviation, and correlation and regression analysis. The study explored variables having a meaningful relationship with the faculty members. It seems to be primarily associated with demographic and institutional variable rather than with individual variables.

Balasubramanian and Ravan (2011) analysed "scientific output in the area of agriculture in the last 66 years. The objective of the study wee to offer an overview of research trends in agriculture publications and to evaluation the quality of the research. The result indicate that the global agriculture research is presently showing increasing trend. Regarding country wise distribution of publication in agriculture research USA, tops and among the journals the most preferred is *Agriculture Ecosystem and Environment* which publishes 53 papers. Among the researchers proof URIND has the highest number of articles. Among the contribution, National Science Foundation has made the highest. All the findings indicate an agricultural effects various field high priority is being bestowed upon agricultural used research flouring".

Nabout, Bini and Diniz –Filho (2010) examined trends of global literature of fiddler crabs , genus Uca. The data were collected from Web of Science for the period 1991-2009. The results indicated that there is no increasing in the number of publications during the study period. The most number of articles published in the journal 'Journal of Experimental Marine Biology and Ecology. USA is the top ranking country in literature related to Uca. It was reflected the correlation between per capita income and number of publication per country. Besides, the species U.pugilator was the species most singularly referenced in the papers considered. The subjects most found about Uca was population biology followed by behavioral and psychological characteristics.

Sarkechel and Raychoudhary (2010) publication pattern of Bidhan Chandra Krishi Viswavidyalaya to agricultural research. The data was retrieved from CAB abstracts for the period 1993-2007. A total of 286 paper were analyzed the results obtained were the institution produces good number of publications in each year. Majority of the publications were in journals of

Indian origin. The collaboration research is predominant. The most preferred journal is e environment and ecology.

Krishna and Kumar (2004) made an attempt to study authorizing patterns of doctoral thesis submitted to Rajastan Agricultural University, Bikanir during 1996 to 2000. It focused subject wise analyze, authorizing pattern and trend of the publication.

Dizon and Sadorra (1995) analyzed publication pattern by the staff of an International Research Centre, Manila for the period 1978 to 1993. The variables of the study were year wise growth of publication, document type, number of pages and authority pattern. The study highlighted majority of the publication are journal literatures. Publication productivity depends largely on the individual features such as position /salary, education and age.

Radhakrishna Rama et. al (1994) perception of agriculture and extension faculty in India. The data were obtained from 1993 Directory of Teacher Education in Agriculture. The respondents ranged in age from 28-64 years. Majority of then held doctoral degree, 90% were professors and nearly 10% were resource for ranging of faculty productivity 5 point Lickert scale is used. Correlation is a tested with nature of position year of experience at present institution, involvement in graduate student research and experience as a research project director / codirector. Suggestion made in there study was faculty be provided with opportunities for advising undergraduate students and serving on graduate committees and be given training to help them develop expertise in writing.

Maclean and Carmela Janagap(1993) analysed publications of 22 International Agriculture Research Centers (IARCS), including 16 constructive group on Group on International Agriculture Research (CGIAR) Centers for the year 1990. Total 1694 items analyzed majority are primary

literature (referreed) followed by reports and monographs, proceedings Paper, book chapters, and popular literature. There is a similarity in publication of IARC with FAO. Average annual productivity of scientists of IARC, was 1.38 items per scientist. There was no correlation between scientific productivity and number of scientists in a center. However was significant positive correlation between scientific productivity and center budget, indicating higher efficiency in the large centers. Not only the Literature assessment of an organization but also individual scientists' assessment would strengthen the institutional output.

Akinboro (1990) analyzed research productivity of National Cereal Research Institute (NCRI), Nigeria. A list of the journal reprints showed that about 3/4th are published in international publication, while 1/4[th]is in local Nigerian Journal. Majority of the articles published the crops regarding of Cowpea and Maize but least about Soyabean. By discipline greatest numbers of articles are published in agronomy.

Jauch and Glueuk, (1975) evaluated research performance of university profession. The main aim of study was to compare systematically the multiple measures of research output, both objectively and subjectively, in order to identify those which are effective for evolution of research profession. The population of the study were 86 science profession of University of Missouri perusing funded research in 23 departments were considered. The study correlated with the effectiveness of research performance can be measured by the number of publication in respectable journal and also used weighting the publications with a journal quality index.

2.1.2 Institutional publication productivity-other disciplines

Nowenya (2020) investigated participation of International National Organisation (INO) Zimbabive. The main aim of the study was to examine

authorship pattern in international and national level. A visualization of the location of INOs in author research network reported a small number of authors occupying prominent spices in the networks for agriculture and health.

The publication productivity of faculty members of Indian Institute of Management, Kozhikode (IIMK) was studied by Sathikumari Amma (2019). The major objective of the study was to identify the quantitative distribution of articles over the years. Other variables used are Authorship pattern, degree of collaboration, prolific authors, productive journals and the application of Lotka's law. The study covers journal articles for the period 2000-2015 collected from annual report of IIMK. It is found that there is a gradual increase of publications. Around one third of the articles are double authored, three by fifth of the publications are collaborative papers, and the prolific author is Dr.Khulbhushan Balooni and *Economic and Political Weekly* as the highly productive journal.

Publication trend of Tripura University during the period 2007-2018 is examined by Bhattacharjee (2019). The data for the study were collected from web of science. The study focused publication growth rate, authorship pattern, collaborative coefficient, relative growth rate, doubling time, degree of collaboration, institutional collaboration, and productivity of journals, subject categories and top cited papers. Total 554 publications of the scholars of Tripura University were published during study period.

Hugar (2019) analysed publication productivity of Goa University during 2008-2017. The study focuses publication pattern and collaboration trend. Total 1218 publications analysed, 497 international collaborated articles with an increasing growth rate during study period. '*Current science*' is the most preferred journal and Chemistry is the most published subject area. The relative growth rate is decreased gradually. Study reflected funding

is important to improve the scholarly publication and its collaboration with more number of authors, universities and R & D centres are helpful for getting international funding for faculty members of Goa University.

Kumar (2019) analysed publication output of guru Jambeswar University of science and technology(GJUST) during 1999-2018.The parameters of the study was growth of research output, publication types, subject wise distribution of publications, collaborative institutions, most preferred journal, prolific author, citation distribution and top cited papers. The data were retrieved from scopus database and the analysis revealed that steady growth of publications during the study period, the average citation per paper is 13.67. The major area of research were pharmacology, toxicology and pharmaceutics. The most preferred journal and prolific author was *AIP conference proceedings* and Ashish Aggarwal respectively. The highest h-index noted was (42) V.k. Garg and also average citation per paper (46.17) as well.

Gnana prasad (2019) studied research productivity of faculty members of Bishop Haber College Thiruchirappilli. The study analysed data from 1998-2018. The data retrieved from scopus database. The growth of publication, citation rate, collaboration pattern, compound annual growth rate, institutional and country wise collaboration are studied.

Lihitkar and Bankar (2019) studied scientific publications of Shivaji University, Kolhapur (1989-2018). The parameters of the study was author productivity pattern, types of documents individual author productivity and citation analysis. The data collected from web of science. The findings showed that highest productive year was 2017, Material science was the leading subject. Multiple authorship is predominant. The top h-index ranking author is Dr.C.D. Lokhande. Shivaji University scientists collaborates with South Korea, Taiwan and Germany.

Griesel Zaccaq-Gonzalez (2018) conducted bibliometric study on scientific output of Latin American countries. The objective of the study was to characterise the scientific output and specialisation of the most productive Latin American countries with focus on international collaboration and impact. The data was collected from SciMago institutions rankings portal for the period 2003-2013. The study revealed that most productive topic are public health, infectious disease, surgery, neurology, cardiology and cardiovascular medicine. The most prolific countries are Brazil, Mexico and Argentina. International collaboration with Peru, Puer to Ricco and Argentina. This will helpful for design pragmatic policies, to encourage research in key fields in order to respond better to the health needs of a given population.

Shettar and Angadi (2018) analysed publication productivity and impact of research in NITK, Surathkal during 2001-2017. The data were obtained from Scopus database. Total 4038 articles published in 978 leading national and international journals were the population of the study. The average number of publications published per year was 237.53 and the average number of citations per year was 1183.65. A great majority (98.9%) of the publications are multiple authored. The prolific author was Isloor, A.M. who topped the list with 218 publications and the core journals preferred by the scholars of NITK are *Acta Cristallographica Section E Structure Reports* online, followed by *International Journal of Earth Science and Engineering*.

Sab, Kannappanavar and Riyaz (2018) examined scholarly output of Tumkur University during 2011-2016. The Pattern of communication of authors and scattering of their research output in different journals were focused. The study observed that the gradual growth of publications during the study period. Most of the publications were multiple authored. Most preferred journal, subject and collaboration institutions are *Spectrochimica Acta Part A Molecular and Biomolicular Spectroscopy*, Material science and

M.S. Ramayya Institute of Technology respectively. This concluded with publication output of a faculty members has a major role in ranking of university.

Kumar et.al. (2017) evaluated research output of Kurushethra University during 2006-15. The parameters of the study were its growth, citation quality share of collaborative papers, subject wise-department wise distribution, and contribution to most productive journals and characteristics of highly cited publications. The results revealed that the average growth rate of was13.25% and citation per paper was 4.85. Large share of publications are from Physics and Astronomy followed by Engineering. The suggestion made in this study was to enlarge research output to rise its quality and impact to compete with top universities in India and abroad.

Aggarwal Kaur (2017) studied quantitative measuring of research output of science universities of Punjab. The study focused on in-depth analysis of research contributions of the universities of Punjab that appeared in the Scopus during the period 1991-2014. The parameters of the study were year wise growth, authorship pattern, collaboration pattern and citation pattern. The results showed that most universities in Punjab, Punjab University ranks first in growth of research output. Collaborative authorship is dominant.

Aggarwal (2017) evaluated the impact of UGC programmes on enhanced research productivity of Department of Chemistry, Guru Nanak Dev University, and Amritsar. The objective of the study was to analyse the trend of publications; year wise, domain wise, authorship pattern, impact factor, citation and h-index. The data were collected from Scopus database. The results showed that growth of publication shows the linear growth. The majority of papers published as collaboration with three authors. The faculty has published more in collaboration with foreign origin. The quality of

publication showed remarkable increase. *Chemical Society Reviews* shows high impact journal in the field.

Rejith and Devarajan (2016) analysed research productivity and publishing habits of the scientists of Indian Institute of Geomagnetism (IIG) during the period 2010-2015. The parameters of the study were year wise distribution of publications, authorship pattern, and degree of collaboration, publication productivity and most preferred journal. Data was collected from annual report and was analysed using Microsoft excel. The result of the study explored that the growth of publication is linear. Degree of collaboration is high in journals, Proceedings or the technical reports. But there in only a moderate level collaboration between IIG scientists and External scientists.

Masoud et al., (2016) conducted a study on the scientific production of medical universities in the west of Iran. The study analysed scientometric indicators such as number of publication, number of citations, nationalisation index, internationalisation index, H-index, average number of citation per paper and growth index. The data was collected from Scopus database. The study revealed that Iran University of medical science had the highest international collaboration, and Ioresten University showed smaller collaboration with other universities. The investigator's limited to five universities in Iran compared the scientific productivity of these universities. Suggestion made in the study was to achieve better performance in this field and that the Universities must stabilize their budgeting and investment policies in research.

Chaudhary and Chaudhary (2016) analysed research output of Netaji Subash Institute of Technology, Delhi. The parameters of the study was subject wise growth, share of publication in department wise and the citations received by the publications during the period of study. The study was limited to 1996-2015. The data was retrieved from Scopus using affiliation search.

The study revealed that Engineering is the dominant area of research while Psychology is least. The publication growth is linear. The growth of publication in Delhi is increased during the study period. Most contributed divisions of NSIT is electronics and communication engineering, computer engineering division with information technology division, instrumentation and control engineering division and mathematics department. MPAE division received most number of citation during period of study.

Kumar, Dora and Desai (2015) analysed publication productivity of Gujarat University, Ahmadabad during 2004-2013. The data for the study was collected from Scopus database. It is noted most prolific authors, authorship pattern and trends, most preferred journal, the prolific author and citation analysis. The journal "*Actapoloniaepharmaceutica-drug research*" is the most preferred journal and V.K. Jain got the highest average citations per paper.

Taskin, Zebra and Aydinoglu, arsev (2015) investigated NASA Astrobiology Institute (NAI) funded research that was published between 2008 and 2012 using bibliometric techniques. For the purpose of study variables used were inventory of publications co- authored through NAI funding and investigated journal preferences, International and institutional collaboration and citation behaviour of the researcher to reach a better understanding of interdisciplinary and collaborative astrobiology research funded by the NAI. Tool of the study was NAI Annual report. Thomson Reuter's web of science was also used as a data tool, SPSS and MS-excel were used for statistical calculations. The bibliometric software such as Vosviewer and Citespace were used for social network analysis. The study highlighted that the NAI researchers prefer publishing in high impact multi-disciplinary journals. Astronomy and Astrophysics are the most preferred categories to publish with other researchers outside their organisation and there are prominent scholars in the other subject categories.

Reddy, Muraleedhara and Ragavan (2015) analysed the productivity of the faculties of Bangalore University. The Data were collected from web of science, Google scholar, Lista and other websites. The study highlighted Chemistry and Physics department of Bangalore University produces more number of publications than other basic science departments. Most productive author, to best journal, authorship pattern are studied.

Omar,(2015) studied publications in science and technology by faculty members in universities of Jordan. The investigator analysed the aspects such as most productive author, core journal, place, time subject and country of origin of publications. The data were retrieved from the sources such as abstract of the funded research projects at the University of Jordan. University research publications, database of Arab periodicals, indexes and Jordan national bibliography. The study was limited to 11 years. The results showed that the Journal '*Dirasath*' published from the University of Jordan occupied in first position. Most of the faculties published their scientific output in journals published from Jordan. The most preferred language is English, however Arabic occupies the second position. Jord Ulrich's international periodical directory highlighted that faculties produced outputs in 25 Subject area while most of the contribution is in the area of science and technology. Journal R. Quasam occupied fist rank among faculties producing publication in the University of Jordan.

Jeyshankar (2015) examined the research productivity of scientists of Indira Gandhi Centre for Atomic Research (IGCAR) Kalpakkam during the period 1989-2013. The parameters of the study were relative growth rate and doubling time, degree of collaboration, and pattern of co-authorship. The data was retrieved from Scopus database. The study revealed that the growth of the article showed gradual increase, during 2013 most number of papers indexed in Scopus database. Doubling time shows fluctuating tendency. Multi

authorship is prominent in publishing a paper, degree of collaboration is 0.95. *'Journal of Nuclear Material'* is the most preferred journal. Most publications are in collaboration with IIT Chennai.

Sudhier (2015) conducted a study on publication productivity of physics researcher of Indian Institute of Science, Bangalore. The study clearly showed that 267 papers were published during the period 1999 to 2003. Most of the papers are contributed by male scholars, degree of collaboration of papers in physics is 0.94. Journals are the main communication channel among physics research scholars in IISc. USA ranked first in country wise distribution of journals of publication. The study revealed that physics scholars are highly selective in publishing their research result in specialised and high impact factor journals.

Dillon and Selamath (2015) analysed factors associated with scholarly publication by academic staff of a Malaysian Public University. It is described that influence of personal, environmental and behaviour factors of academic staff of UTM. It showed positive influence on publication productivity of targeted population.

Lee and Bozemen (2015) conducted a study on the impact of research collaboration on scientific productivity. The data for the study was collected via three stage i.e; research value mapping program curriculum vita of research scholar and collected data. They are updated with websites of university. The finding showed that the factors such as age, language and job satisfaction largely influence collaborative research productivity.

Gopikuttan & Aswathi Sathi Sa (2014) analysed publication productivity of faculties of University of Kerala during 2000-2012. The parameters of the study were year wise analysis, subject wise analysis, most productive authors and the most preferred journals. The study limited to

science faculty only. The results showed that Chemistry is the subject which produces more number of publications and multiple authorship is predominant. Indian journals are the most preferred journals to publish the articles. And also collaborative coefficient varies from subject to subject.

Noruzi and Abdekhoda (2014) examined publication productivity of Iraqui-Kurdistan University during 1970-2012. This study focuses publication growth, author collaboration, most preferred channel of communication subject and the citation received. The data retrieved from scopus database. The 459 papers analysed, major journals preferred are *Eastern Medine-Maneal Health Journal*, *Journal of Chinese Clinical Medical, Asian Journal of Chemistry, Haemoglobin and Journal of Applied Science Research*. Salahaddin University-Hawler, University of Sulaimani and University of Duhok were the most productive universities in this field. It is noted that citation of publications is very low, hence there is a need to improve the number of publications and its quality to increase impact of Iraqui-kurdistan University.

Nagarkar (2014) conducted a study on publications of the chemistry departments of the University of Pune. The parameters of the study were number of papers, number of citations received, and institutional collaboration, productivity of journals, subject categories and authorship pattern. The data for the study was collected from Web of Science database. The study limited for the period of 1999-2012. The software such as histcite, vosviewer, etc were used for analysing and visualising the data. The result showed that among the papers published in various areas of chemistry; physical chemistry dominated and showed exponential growth in publications. Most of the faculty members published their papers in international journals-index of chemistry is 43 during period of study. International collaboration resulted USA top ranked, while within the country

National Chemical Laboratory dominates. The study reflects multiple collaboration of authors.

Ghosh and Narayan (2014) examined research productivity of CSIIR-IICB during 2001-2010. The main objective of the study was to quantify the growth of publications from CSIR-IICB and to make the quantitative assessment of the status of research. Authorship pattern, trend of research, highly preferred journals, document type preferred, status of collaboration and citation pattern are the parameters of the study. The data for the study was collected from web of science database and annual reports of CSIR-IICB. The maximum publications are in the form of research papers and they are mostly communicated through foreign journals. The average citation is 13.26.

Savithry and Gopikuttan (2014) studied the research productivity of the Centre for Earth Science Studies (CESS), Trivandrum. The major objective of the study was to analyse the year wise distribution of papers of scientists of CESS. Along with the authorship pattern, degree of collaboration, most productive scientists, and geographical distribution of papers and to examine the applicability of Bradford law of scattering. Data obtained from the Scopus data base for the period of 1997 to 2011. Analysis showed that growth of publication is not steady and scientists works in collaboration. Most productive scientist is found to be Rajendran, C.P. *Current science* is the most preferred journal. A total of 182 papers are scattered in 78 journals and it does not fit in the Bradford distribution pattern.

Mandirasalam (2014) analysed research publication output of Coimbatore Institute of Technology (CIT) based on Scopus database. The major objective of study was to examine the year wise research productivity, type of publication, most productive author and authorship pattern, degree of collaboration, subject areas of publication and citation count of CIT publications. The data was collected from Scopus database (citation database)

using the keyword, "Coimbatore Institute of Technology". In the search option selecting the address category. The study revealed that out of 51 years 2013 is the most productive year, Murugan,N is the most productive author, Multi-authorship is predominant and Norway is the country   highly collaborated with CIT.

Bharadwaj (2014) made an attempt to make a scientometric assessment of dengue research during 2001-2012. The data for this study is obtained from scope multi-disciplinary databases and analysed from different angles. The study reveals that there were 9618 publications within the period under study. During the period 2001-12 annual growth rate was 13.4 percentage compared to 14.31 percentage in the period 2001-2006 and 12.48% in 2007-12 USA is found to be the leading country on dengue research. USA has contributed 24.88 % publications. Guzman Mariya was found to be the most productive author.

Gupta et al., (2014) conducted a study on Glaucoma research output in India during the 2002-2011. The data was collected from SCOPUS international database. The study focused on global publication output and citation impact, India's contribution on Glaucoma research by population, age group, research profile of most productive Indian institution in glaucoma research and research communication in high productive journals. Glucoma research showed an increasing trend, largest contribution coms from open angle Glucoma. The study revealed that population   awareness of the glaucoma disease is low and it was suggested that there is a need to develop eye care facility in every district.

Sagar et al.,(2014) conducted a study on research trends in radio isotopes : A scientometric analysis(1993-2012).The Parameters study includes growth of publications and citations, continent wise distribution of publications and citations, country wise publication efficiency index,

international collaboration index, domain wise distribution of publications and Citations ,specialisation index, highly productive institutes, quality of research identification of highly cited publication and highly preferred journal. The data for the study was retrieved in 1994. There were 4421 publications with number of citations during the period under study. USA produces most research outcomes than other countries. Important research are published in core journals.

Sheeja, Mathew and Jose (2014) analysed research output of CUSAT in the area of Physics, Optics and Astronomy. The main objective of the study was to identify the leading area of research, find out the preference of source titles for research communication and determine the authorship pattern among researchers. The data was collected from Web of science. The study revealed that majority of research publications are brought out in joint authorship. English was the most preferred language, scientific journals were the preferred channel of communication of researchers and there is a linear growth of literature in the areas of Physics, Optics and Astronomy.

Sevukan and Rao (2014) examined science research profile of Pondicherry University for the years 1999-2012. The overall objective of the study was to ascertain the trend of research publication productivity of science faculties in Pondicherry University including authorship pattern, country wise collaboration, type of document and the subject wise research concentration. The data obtained from ISI web of science which is available through UGC-infonet consortium at Pondicherry university library. The search was limited to science citation index expanded (SCI-Expanded) for 14 years 1999-2012. The search Strategy used for the study was Doc.type=All documents; Time span=1999-2012, institution or university=Pondicherry university. A steady growth in terms of productivity was observed, articles were ranked first in order as source of research publication. USA ranks first in

terms of collaborative research and Chemistry occupies first place in order sharing.

Rajendran, Elango and Manickraj (2016) analysed publication trend and citation impact of tribology research in India during the period 2001-2012, based on the Scopus database. India's global publication share, annual output and its citation impact of Indian contribution, partner countries, leading contribution, leading institutes and highly cited papers were analysed. In addition to these a cloud technique is used frequently using single words in titles. The study revealed that India ranks in the seventh position with a global publication share of 3.83% and an annual average growth rate is 25.58% during the period of study. Most of the studies are collaborative in nature. Although the share of international collaboration papers in India's contribution is greater than for material science and medicine. China is the leading country in the area of tribology research.

Sravan kumar (2013) studied the overall representations of the Department of Atomic Energy (DAE) India. Aim was to highlight the research output of the DAE institutes, year wise growth and progress of the documents, subject mapping, and the medium of publication, finding the most used document type and most prolific author in the field in terms of publication count. Data was collected from Scopus database were analysed and interpreted. Findings of the study were BARC evolves out as the /top ranked institute in India, Indian scientists prefer to publish their documents in the article form and English or foreign language output of physics or astronomy found to be larger than other subjects.

Matakovic, Batch and Novac (2013) studied trends and obstacles of scientific productivity in transition countries. The study includes all article indexed in web of science in 34 countries. Population of the study were literature from most economically and scientifically advanced countries of the

world. They found that USA produced most number of papers developing countries like India and China have smaller proportion, However Scandinavian countries and Switzerland had larger proportion. The study reveals an alternative methods to assess scientific productivity is the ratio of governmental expenses for research development and number of papers. The result showed that scientific productivity exhibits different patterns in central European countries companied to western Balkan countries and Russia. The growth of croation publications included in web of science increased during the period of study. Financial problems and language issues were the major obstacles in scientific productivity.

Schizophrenia research output of India is analysed by Gupta and Bala Adarsh(2013). The parameters including the growth, rank and global publications share, citation impact, share of international collaboration papers contribution of major collaborative partner countries, contribution of various subject fields, impact of most productive institutions and authors, media of communication and characteristic of high cited papers, the Scopus database has been used to retrieve the data for ten years for searching the key words Scizophrenian research the result of the study was among top most productive countries in schizophrenia research. India was ranked 15th.

Zahid Asharaph Wani, Mohamed Thahir Pandit and Nighat May (2013) examined the research productivity of Indian Institute of Technology. The data for the study was retrieved from Scopus database. The study period limited to 1964 to 2010 only. The study reflected overall research productivity of IIT, Delhi. The study analysed year-wise growth, subject wise growth, subject-wise citation, preferred journal and collaboration etc. The result showed that 2010 was the most productive year, hence the study observed exponential growth in research publications during the period of study. Subject wise analysis explores Engineering is the dominant subject field with

24.32% publications. *Energy Conservation and Management* is the most preferred journal for publications. The study suggested that there is a need to have a consistent approaches towards supporting and promoting research.

Connel and Rugman (2013)analysed the research productivity and impact of the finalists of the AIB best dissertation award, this study examined whether there is a relationship between winning the best dissertation award from inception in 1987 to 2009, with cited publications as a measure of productivity and impact are identified; the data was obtained from Google scholar. It is found that the overall average citations of the award is less than that of the non-winners and the large majority of years the non-winner has the average citation count higher than that of the winner.

Lakitan, Benymin, Hidayath dudia and Herlinda sidi (2012) observed scientific productivity and collaboration intensity of Indonesian universities and public R&D institutions. The study highlighted collaboration research help in increasing knowledge. Higher scientific quality contacts and connections for future works and generation of new ideas, budget for education have directly influenced in scientific productivity. In Indonesia scientific productivities of universities and R&D institution is very low. The progress like national strategic research focused on selected issues (RUSNAS) started for improving productivity of universities and R&D institutions in Indonesia. Most of research published in peer reviewed international journals indicated collaboration with foreign partners. In conclusion, collaborative research help to increase productivity in the field.

Anilkumar and Dora (2012) conducted a study on research productivity of IIM-Ahmadabad for the period 1999-2010. During this period 318 unique publications included from web of science and Scopus. The results showed that most of the publications are journal articles (243) and most prolific author was Shukla, K. R. with 21 papers followed by

Mavlankar, P. with 20 papers. Most cited journals by IIM-A faculties were *Journal of Marketing* with 66 citations, *Economic and Political Weekly* with 49 citations and *Management Science* with 47 citations.

Gonzalez-Albo et.al. (2012) conducted a study on Spanish National Research Council (CSIC) research productivity using bibliometric indicators. The data was retrieved from Web of science complimented with ICYT and ISOC database for the period 2004-2009. The study highlighted the geographical distribution is high in Madrid, CSIC's collaboration rate was high. Using activity index the study found that physics, agriculture or biology or environment biomedicine and chemistry output are higher than that average (overall national output) CSIC produces higher impact factor journals than other institutes or universities. Study concludes that when citation count increases, impact factor is high. Zafrunnisha(2012) examined the Bradford's zones and productivity of journals in psychology doctoral theses journal citations are obtained from Ulrich's international periodical directory and recorded on the reference cards. The data was fed into the computer using MS excel and SPSS. The study highlighted journal usage pattern in the subfield of psychology but does not satisfy the verbal formulation of the Bradford's law of scattering.

Slenker ,ElbertManato and agnus (2012) conducted an evaluation study of research productivity of Canadian ophthalmology research journals from 2001-2010.The data was collected from web of science as well as the Canadian journal of ophthalmology. Analysis was done based on the three categories, number of articles, number of citations and federal research funding received. The study reflects most output produced institutions, most number of citations produced more number of citations from articles, cost efficiency and weighing research volume faculty size in Canadian department of ophthalmological research.

Vinitha et al., (2010) portrayed Indian perspective of water resource management research to find out author productivity .The objectives of the study were to calculate year wise growth of publication, source of publication, format of publication, institution-wise distribution, country-wise output and subject-wise distribution of publications in water research management. The data was obtained from Web of science database. Maximum contribution in this field was in the year 2008. Maximum number of publications are shared in current science and water resource management. Indian institute of technology have most productive institution and India's contribution is maximum in those field compared to other countries.

Vijayakumar and Nagarajan (2009) examined research output of IIT, Kharagpur during the period from 1994 to 2004. The data was collected by using SCI database. Year-wise distribution showed increasing trend. Relative growth rate decreases but doubling time increased. Kharagpur IIT has the highest research output than other IIT's. Study reveals that Chemistry and Engineering are the pre dominant area of research among humanity and the faculty members.

Akankandelwa (2009) studied publication trend of university of Zambia during 2002-2007. Total 220 papers are downloaded from Thomson scientific database. It is found that 2006 was the most productive year with 63 publications, average number of publications per year was 36.7. Multiple author collaboration is predominant and the degree of collaboration is 0.95. Country wise collaboration is high, most collaborating countries are USA, England, Japan and Belgium. The study also highlighted a positive relation between author productivity and author collaboration.

Mallikarjun et.al. (2006) studied the publications of TATA institute of social science during 2001-2004. It is found that majority of publications are multiple authored, most prolific author was Shalini Bharath. The most

preferred journals were *Economic and Political Weekly, Indian Journal of Social work and Indian Journal of Labour Economics.*

Ronald and Vicky (2005) examined research productivity of Accounting of Information System (AIS) faculty members and also institutional productivity. For the study details of faculties were collected from accounting faculty directory, faculty members were collected from accounting literature index and also used individual journal indexes and questionnaire survey. The study reflected that the '*Accounting Review*' and the '*Journal of Accounting Research'* are ranked as top two journal in quality output of a research employing the highest in institutional productivity. The study output reflects contribution of research output in AIS research domain by institutional faculty members.

Gupta et.al. (1996) analysed author productivity pattern of Indian potato research for the period 1900-1980, and application of Lotka's law in different forms.

2.1.3 Bibliometrics-other disciplines

Chaman sab,Dharany kumar and Biradar(2018) analysed oceanographic literature growth in India during 2011-2015. The study based on web of science database. The results showed that linear growth observed in the growth of publications. The 2015 is the most productive year, most of the researchers prefer journal as the communication media, and average citation per paper was 2.32. National Institute of Oceanography, Goa is the top most organistion. *Indian journal of geo marine science* is the most preferred journals. India collaborate mostly with USA and the study suggests that possibilities are that India may emerge as a stronger nation in oceanography research.

Elango (2017) conducted a scientometric study on nature

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nanotechnology. The study aim to analyse year wise growth, document type, most productive authors, citation profile of authors, most productive institution and countries. Data were collected from Web of science core collection. Analysis is done by using Histcite, intcoll, exe, Scitool and citNetExplorer. The study concluded that 2017 is observed as the highest productive year, Simon Liu is the most prolific author and majority of the publication are journal articles.

Thomas and Baby (2016) conducted a user study about CeRA consortium among PG students and faculty of College of Vetenary And Animal Sciences Thrissur the study explored awareness, use pattern, purpose of use of CeRA consortium. It plays vital role in agriculture research. Majority of the students and faculty members' area were about CeRA consortium. Majority of the students were used for teaching learning and research activity. It reveals that CeRA consortium boosts research in agriculture providing large number of E-resources.

Suresh, Hema and Subrahmanyam(2015) analysed the Indian journal of horticulture for the period of 2010-2014. The objective of the study was to find out year-wise distribution, authorship pattern, and relative growth rate, doubling time, geographical distribution and collaboration research in the field of horticulture. The data was collected from Scopus database. The study showed that highest publication was in the year 2010 followed by 2011and a constant growth observed in 2012, 2013 and 2014. Authorship pattern shows that more than three authors is dominant. The highest degree of collaboration occurred during the years 2011and 2013, authorship pattern shows that more than three authors are dominant. Relative growth rate is 0.24 and hence doubling time is 2.158. India contributed many publications to this journal. The most collaborate institute is Indian Agriculture Research Institute.

Chandra (2015) examined the research output on plant pathology

research during the period 2008-2012.The study focused on the number of articles by year, authorship patterns, degree of collaboration, and contribution by institution, subject growth of literature in plant pathology research .The data was retrieved from CeRA database. The study explored that growth of publication in plant pathology increased. 2011 is the most productive year. Multiple authorship dominated. International collaboration shows University of California, USA contributed mostly. In Indian states Uttar Pradesh contribute most and Puduchery is the least. Geographical contributions showed that USA produced most number of publications. The study concluded that this is an important area of research and should be given more attention to those subject areas in order to benefit those who work in the field and obtain the maximum benefit from plants for mankind.

Bhaskaran and Bathrinarayanan (2015) depicted the Research performance of Anna university with respect to Scopus database during 1979 to 2014, analysis of publication, subject wise distribution of publication, the most preference format of publication, find out the most preferred format of publication, highest contributing author, key word coverage of articles institution wise collaboration and country wise collaboration were used as parameters of the study. The findings of the study revealed that, the year 2013 is the top in publications, top productive author is Ramaswamy, majority of the researcher communicated through journal articles .European journal of scientific research is prolific journal majority of work collaborated with Anna university as well as India.99.77% of research findings were communicated in English language.

Rajgoli and Narasi (2014) examined authorship pattern and collaboration in the field of Spacecraft technology. The parameters of the study were authorship pattern, degree of collaboration and application of Lotka's law. The data were collected from the print version of three journals

in the field of spacecraft technology for the period 2001-2011,the results obtained was Journal of spacecraft and rockets is the most preferred journal and James M Longuski is most prolific author in the spacecraft technology field. Also showed highest degree of collaboration in the publications.

Sife and Lwoga(2014)analysed research productivity and scholarly impact of academic librarians in Tanzania for the period of 30 years. The data were collected from Google scholar using publish or Perish. The study reveals that 2008 had the highest number of publications followed by 2010. Degree of collaboration was 0.57,ie.,single authorship and multiple authorship are almost same. Most prolific author was E.T. Lwoga followed by J. Nawe and F. W.Dulle. The most of the academic librarians prefer foreign journals however, the *University of Dar es Salaam library Journal* (a Tanzanian journal) is the most prolific journal. In conclusion, the selection of highly cited journals is help to improve the researcher's productivity and impact and collaboration strengthen the field of study.

Padma and Ramaswamy (2014) studied academic contribution of faculty of department of physical chemistry at the Madurai Kamaraj University as reflected in Google scholar. The objective of the study was to list the contribution of the faculties, authorship pattern, degree of collaboration, impact factor of the faculties, rank and list the journal wise, list of articles published and the number of citations and number of versions available for the articles. Data collected using Google scholar are put to MS excel spreadsheet and analysed using simple percentage method. The study reflects 2011 has the highest number of articles published multi author ship pattern is high, collaborative index is high in 2006 and Dr, R Ramaraj scored the highest in both with Indian and foreign author collaboration.

2.2 Conclusion

From the review of related literature, many studies conducted in various agricultural universities, related institutions, individual countries and

allied disciplines. Major result found out that agricultural research is increases in year by year, also increases the publications. The collaborative authorship is predominant in agriculture publications. Some studies also mention about factors such as individual factors, behavioural factors and organisational factors affects agricultural faculty productivity. Sarala K R studied faculty productivity of Kerala agricultural university during1993 to 2008. Hence the present study publication productivity of Kerala agricultural university during 2008 to 2017 is needed to strengthen the existing scientific productivity of agriculture in Kerala.

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CHAPTER 3

KERALA AGRICULTURAL UNIVERSITY MANNUTHY, THRISSUR: AN OVERVIEW

3.1 Introduction

It was towards the end of 19th century and beginning of 20th century. The foundation for agriculture education was laid in India with the establishment of six agricultural college at Lahore, Kanpur (1593), Nagpur (1906), Pune and Coimbatore (1907) and sabore(1908) and three veterinary colleges. One each at Bombay (1886), Madras (1903) and Calcutta. At the time of independence there were 17agricultural colleges and a 9 colleges of veterinary science. All these were administered by the state governments and had affiliation to general universities in their respective states.

In 1948, the first educational commission headed by Dr. S. Radhakrishnan recommended establishment of rural universities. In 1955 the first joint Indian American team on agriculture education headed by Dr. K.R. Damala endorsed the establishment of rural universities and recommended starting post graduate schools at IARI and IVRI. The second joint indo American team on agricultural education (1959-61) headed by Dr. M.S. Randawa recommended establishment of agricultural universities on land grant pattern of USA. Agricultural universities committee appointed by government of India in1960headed by Dr. Ralf W Cunnings from USA prepared blue print on guide lines for establishing agriculture universities in different states.

3.1.1. State agricultural universities

The first agriculture university was established in 1960 at Pantnagar followed by a series of such universities in different states year and year.

Several states are now being two or more SAU's owing to the pressure of regional requirements.

Features of state agriculture universities

1. State-wise responsibility of teaching research and extension

2. Integration of teaching research and extension functions

3. Uniform administration, research and extension

4. Colleges as constituent universe of university

5. Education based on credit system with continues education

6. Emphasis on programs related to problems of rural people

7. Special training programs for rural youth, adult men and women.

8. Quick communication of ne 77 w knowledge to students , extension workers farmers

9. Organisational and operational autonomy.

3.3 Kerala Agricultural University

Kerala Agricultural University (KAU) is the primary and the principal instrumentality of the Kerala state in providing human resources, and skills and technology, required for the sustainable development of its agriculture, defined broadly encompassing all production activities based on land and water, including crop production (agriculture) and forestry through conducting, interfacing and integrating education, research and extension in these spheres of economic endeavour. It is situated in Vellanikkara, Trissur, and Kerala (www.kau.edu.in). Deemed to have come into existence on February 24th 1971 by the Act 33 of 1971 of the Kerala State Legislature, entitled 'The Agricultural University Act, 1971', the Kerala Agricultural

University (KAU) became operational since February 1st 1972 when the then existing two educational and 21 research institutions administered by the Departments of Agriculture and Animal Husbandry of the Government of Kerala, were brought under one umbrella for facilitating the sustainable and accelerated development of agriculture in the State(http://www.kau.in /institution/kerala-agricultural-university-hq).

In 2011 Kerala Agricultural University divided into three. They are:

1. Kerala Agricultural University

2. Kerala Veterinary and Animal Sciences University (KVASU)

3. Kerala University of Fisheries and Ocean Studies (KUFOS)

3.3.1 Kerala veterinary and animal science university

The newly formed Kerala Veterinary and Animal Sciences University (KVASU) is located in the scenic hilly terrain of Pookot in Wayanad district, Kerala, India (http://www.kvasu.ac.in/about). KVASU has three constituent colleges which include: College of Veterinary and Animal Sciences, Mannuthy, Thrissur, College of Veterinary and Animal Sciences, Pookot, Wayanad and College of Dairy Science and Technology, Mannuthy. Moreover the university has research stations at Thumbermuzhi, Thiruvazhamkunnu and Mannuthy. Since this is a newly established university, improvement of infrastructure facilities is of paramount importance. Infrastructure facilities in the areas of education, research, extension, capacity building, IT connectivity, distance learning, Clinical 76services, diagnostic facilities, zoonoses, animal nutrition, biotechnology, ethno veterinary medicine, pathobiology, dairy technology and in other related sectors are most essential and are directly linked to rural development. (http://www.kvasu.ac.in/about)

3.3.2 Kerala University of Fisheries and Ocean Studies (KUFOS)

KUFOS is an autonomous public funded-institution established on 20th November 2010. KUFOS is the first fisheries university in the country. The headquarters of KUFOS with its enchanting blue building stands in harmony with the greenery at Panangad, 12 km away from Kochi city, along NH-47. It provides high quality instructional programmes in fisheries, ocean sciences and allied subjects. The University now has 75 acres in the headquarters at Panangad, 50 acres at Fisheries station, Puduveypu and 10 acres at Thiruvallom near Vizhinjam. With a view to producing technocrats of high calibre, we provide highly qualified faculty, full-fledged infrastructure facility and good linkages with reputed national and international institutes The academic excellence is intended to be attained by undertaking graduate and post graduate teaching and research programmes in emerging disciplines of fisheries science .With a view to meeting the requirement of state and national priorities, we are introducing specialized courses in the needy areas thereby creating professionals and experts. Results of research emerging from various disciplines leading to successful technologies need to be disseminated to the end-users at the grass root level. (https://www.kufos.ac.in/)

3.3.3Kerala Agricultural University(KAU)

KAU consists of 8 faculties, 6 RARs, 16 research stations, 7 KVKs and extension centres. They are detailed in following (www.kau.in/ institutions).

Table 3.1

KAU Institutions

Sl. No.	Faculties& Research stations	Year of establishment
	Faculties	
1.	College of Agriculture,Vellayani	1955
2.	Collge of Agriculture Padannakad	1994
3.	College of co-operation banking and Management	1981
4.	Academy of Climate change Education and Research	-
5	Kelappaji college of Agriculture Engineering and Technology,Tavanur	1963
6.	College of forestry Vellanikkara	1986
7.	College of Horticulture ,Vellanikkara	1972
8.	Institute of Agriculture Technolgy	
	Regional Agricultural Research Stations(RARS)	
1	RARS Ambalavayal	1983
2	RARS Pattambi	1930
3	RARS Pilicode	1972
4	RARS Kayamkulam	1937
5	RARS Kumarakam	1947
6	RARS Vellayani	1982
	Research Stations	
1.	Agricultural research station,Anakkayam	1963
2.	Agricultural research station Mannuthy	1957
3.	Agricultural research station Chalakkudy	1972
4.	Banana research station Kannara	1963
5.	*Cardomom research station pampadumpara*	1956
6.	*Cashew research station Madakkathara*	1973
7.	Pepper Research Station,Panniyur	1972
8.	Plant Propagation & Nursery Management Unit, Vellanikkara	-

9.	Agricultural Research station, Thiruvalla	1976
10.	Aromatic&Medicinal Plants Research Station Odakkali	1951
11.	Coconut Research Station, Balaramapuram	1948
12.	Farming Systems Research Station, Sadanandapuram	1986
13	Integrated Farming Systems Research Station, Karamana	1955
14	Pinapple Research Station, Vazhakkulam	1995
15	Rice Research Station,Monkompu	1940
16.	Rice Research Station,Vyttila	1958
	EXTENSION CENTERS	
	Krishi Vigyan Kendras (KVKs)	
1.	Krishi Vigyan Kendra Kollam	1994
2.	Krishi Vigyan Kendra Kottayam	2000
3.	Krishi Vigyan Kendra Thrissur	2004
4.	Krishi Vigyan Kendra Palakkad	1979
5.	Krishi Vigyan Kendra Malappuram	2003
6.	Krishi Vigyan Kendra Wayanad	1984
7.	Krishi Vigyan Kendra Kannur	1984
8.	Agricultural Technology Information Centre,Mannuthy	1993
9.	The Information and Sales Centre, mannuthy	1974
10.	Communication Centre, Mannuthy	1974

(source:website)

3.3.3College of Agriculture, Vellayani

The College of Agriculture, Vellayani was established in May, 1955 and continues as the Centre of undergraduate and Post Graduate education. Within few years the College got sufficiently strengthened to claim a parity with any other leading Agricultural Institution in India. Post graduate programmes, leading to M.Sc. (Ag.) and Ph.D. degrees were started in the college during 1962 and 1965 respectively. Simultaneous development of the

College farm provided field facilities for giving adequate work experience for the B.Sc. (Ag.) course and for conducting researches of M.Sc. (Ag.) and Ph.D. students.

When the Agricultural University was established in Kerala during 1972, the College of Agriculture, Vellayani had grown up adequately to form the major constituent of the University. With the inclusion of this institution in the Agricultural University, the agricultural education and research in the state underwent tremendous changes and development. The `trimester' system of teaching with `internal evaluation' was introduced in the University and it emerged as a novel ideal system in the field of agricultural education. Now the teaching is done under the related `semester system'. The College of Agriculture, Vellayani has now become the nerve centre of agricultural research and education in the Southern State.

Much stress is being given at the under graduate level to train the students in all the farm operations. They have to raise all the important crops of the State in small plots in the college farm under the `work experience' programme. In the final year of the course they are given intensive field training in the Krishi bhavans of the Department of Agriculture and in the research stations of the University where they get proper exposure to the practical problems in agriculture. Thus make the students fully competent to face field problems in their future official carrier.

3.3.4 College of Agriculture, Padannakkad

The College of Agriculture, Padannakad is situated in Kasaragod, the northern-most district of Kerala. The college was established in the year 1994, as the third agricultural college under the Faculty of Agriculture of the Kerala Agricultural University. Since then it has envisioned a wide range of improvement and development in academic, research and extension needs of

the Northern Zone of Kerala. At present there are 21 departments functioning in the College(http://www.kau.in/institution/college-agriculture-padannakkad)

- The college offers four year professional degree programme in Agriculture, B.Sc.Hon.(Ag.) Current intake capacity for undergraduate programme is 50. From 2011, Post Graduate Programmes in Agronomy, Soil Science and Agricultural Entomology was started.

- The college is located 9 km south of Kanhangad town and 1 km north of Nileshwar town on the side of National Highway - NH 17 in Kasaragod District. Padannakad is well connected by road as well as rail. The nearest railway station is Nileshwar. (http://www.kau.in/institution/ college-agriculture-padannakkad)

3.3.5 College of Co-Operation, Banking & Management, Vellanikkara

The College of Co-operation, Banking and Management is a constituent institution of the Kerala Agricultural University was established in the year 1981 in accordance with Section 5 of the KAU Act (Act 33 of 1977). The College is the brainchild of great visionaries who had foreseen the need for a multi-disciplinary innovative management institution to impart education and undertake research and extension in the field of agriculture and related institutional support sector by blending agricultural input supply chain, post-harvest activities and managerial talents for the benefit of the agricultural sector and rural development(http://www.kau.in/institution/college-horticulture-vellanikkara) .

The College was granted an independent status since April 1985. The College has grown many fold since its inception and has an excellent academic record with committed faculty. The College has been recognized as a resource centre by several national level institutions for hosting training

programmes, workshops, summer institutes, seminars and short courses. Presently the College is offering a four year professional management degree, B.Sc. (Hons.) C&B, post graduate programme, M.Sc. (C & B) with three specializations (Co-operative Management, Rural Marketing Management, Rural Banking and Finance Management), a doctoral programme in Rural Marketing Management, and a MBA in Agribusiness Management. The graduates and post-graduates of the College hold coveted managerial positions in leading banking, financial services, co-operative, agribusiness, retailing institutions and Universities in India and abroad.

3.3.6 Academy of Climate Change Education and Research, Vellanikkara

It is situated in Kerala Agriculture University campus.it offers Bsc.Msc integrated course in climate change adaptation.

3.3.7 Kelappaji College of Agricultural Engineering & Technology, Tavanur

The KCAET, Tavanur is the seat of the erstwhile Rural Institute established by the Government of India in the year 1963. This institute was taken over by the University in 1975 and renamed as Institute of Agricultural Technology (IAT). The IAT offered Diploma in Agrl. Science (DASC), Diploma in Agrl. & Rural Engineering (DARE) and Agrl. Mechanic Course (AMC). The Kerala Agricultural University established the Faculty of Agricultural Engineering & Technology in the year 1985 by upgrading the IAT and renamed it as "Kelappaji College of Agricultural Engineering & Technology".

3.3.8 College of Forestry, Vellanikkara

The Ministry of Agriculture, Government of India has identified the Kerala Agricultural University as one of the Institutions to start forestry

education programme and accordingly, the College of Forestry was established in this University in 1986. Since then, the College of Forestry was functioning as a constituent college of the Faculty of Agriculture till 2012. However, considering the importance of forestry education, a separate Faculty of Forestry was constituted in 2012. The College presently is under this faculty (www.kau.in/institution/college-horticulture-vellanikkara).

Developing manpower resources required for the state's forestry, agroforestry, non-wood forest products, wildlife sciences, wood science, and social forestry sectors, is the principal mandate of the college. To cater to this requirement, a four year B. Sc. (Forestry) degree programme was started in 1986 and a master's programme just preceded that. Until 2013, 284 B. Sc. (Forestry) and 99 M. Sc. (Forestry) candidates have graduated from this college. For undertaking teaching and research activities, five statutory departments viz., Silviculture and Agroforestry, Tree Physiology and Breeding, Forest Management and Utilization, Wood Science and Wildlife Science were also established. Ph. D. programmes were initiated in the year 2010.

The college, over the years, has made steady progress on the academic and research fronts and has emerged as one of the leading forestry colleges in India. It has won several national level recognitions. Examples include the many ICAR-junior research fellowships awarded to the students of this college and a total of 31 of our alumni have been inducted into the Indian Forest Service/Indian Administrative service. Several of our alumni also have been awarded prestigious international scholarships (e.g., Erasmus Mundus fellowship of the European Union). Our faculty also have been getting many national and international awards and recognitions. In view of its accomplishments in the field of forestry, the college is a prominent destination for students interested in pursuing studies on nature conservation

and natural resources management, not only from the state of Kerala, but also from the rest of India and other countries. The ICFRE accreditation team (2009) rated our college as one of the two best Forestry Colleges in the country (A** rating).

The college celebrated the silver jubilee of its founding in 2010-11. It is envisaged to transform the college into an international centre of excellence in tropical forest sciences in the ensuing years.

3.3.8 College of Horticulture, Vellanikkara

The College of Horticulture was established in 1972 with the main objective of starting graduate programme in Horticulture and strengthening research and extension activities in Horticultural crops. B.Sc. (Hort.) degree programme was started with an intake of 20 students during 1972.

The intake capacity was increased to 30 from 1976 and then to 40 from 1979. The B.Sc.(Ag.) programme was also introduced from 1977 with an intake of 50 students. The syllabi for the B.Sc. (Hort.) and B.Sc. (Ag.) programme were then integrated and the B.Sc. (Ag) programme alone was continued with the integrated syllabus. The intake capacity for the B.Sc. (Ag.) programme was subsequently raised to 75 and then to 90.

Post graduate programme was started in six disciplines from 1976 viz., M.Sc. (Hort.), M.Sc. (Ag.) in Agronomy, Agricultural Botany, Soil Science & Agrl. Chemistry, Agrl. Entomology and Plant Pathology. From 1979, Ph.D. programmes in the above disciplines were commenced. Subsequently, M.Sc. programmes were also started in Agrl. Economics, Agrl. Extension, Agrl. Meteorology, Agrl. Statistics and Home Science (Food Science and Nutrition).

Two post-graduate diploma courses of one year duration were conducted in Natural Rubber Production and Land Water Resources and Management from 1979 and 1980 respectively and subsequently discontinued.

Under the Manpower Development Scheme sponsored by the Coffee Board of India, the final year B.Sc. (Ag.) students were given special training in coffee cultivation and processing from 1984 to 1997.

A new diploma course of two-year duration in Natural Rubber Production was started in 1998 for the sponsored candidates from Tripura with the financial assistance of the Rubber Board, Kottayam.

The required Infrastructure for imparting practical training has been established. In addition to the Instructional Farm having an area of 95.35 ha, the different departments have established farms of their own in a total area of about 72.24 ha. Most of the tropical annual, perennial and plantation crops are grown in these farms. The undergraduates are given training in the cultivation of various annual crops, maintenance of perennial crops and processing of agricultural and horticultural produces through various work experience courses. In addition to the regular field trips to various places within the state as part of practical training, the students of the second and third year B.Sc. (Ag) classes are taken on study tour to places of agricultural importance all over South India and all over the country, respectively. During the eighth semester, the final year students are attached to Krishi Bhavans and Agricultural Research Stations of the state for specific periods as a part of their field Training Programme (RAWE).

The Associate Dean heads the college. The faculty consists of nearly 130 highly qualified teachers specialised in various branches of agricultural sciences.

The College activities were initially taken up in the Veterinary College Campus during 1972 at Mannuthy and later shifted to the KAU Main Campus, Vellanikkara in 1977. At present, the College functions in the academic blocks II and III while the academic block I is occupied with university administrative affairs. It has grown in many folds since its inception and has a very good academic record with excellent faculty. The faculty strives hard to attain excellence in teaching, research and extension in the field of Agriculture. It is one of the three Colleges of Agriculture, located centrally in Kerala(http://www.kau.in/institution/college-horticulture-vellanikkara).

3.3.10 Institute of Agriculture Technology & RARS, Pattambi

It offers diploma in agriculture sciences

3.3.11 Thrust areas of KAU

➢ **Onattukara Regional Agricultural Research Station, Kayamkulam**

- Onattukara Regional Agricultural Research Station, Kayamkulam is located in the Kayamkulam Municipality of Alappuzha District, one kilometer east of Kayamkulam town, on the northern side of Kayamkulam - Punalur road. The station was established in the year 1937 under the erstwhile University of Travancore. It was subsequently transferred to the Department of Agriculture in 1958 and continued to function under it till it became a part of the KAU on 07.02.72. I n April, 2000, this Station was upgraded to the status of RARS (Onattukara Region)(http://www.agritech.tnauac.in/expert-system/paddy).

- Lead functions are on rice in *Onattukara,* coconut, annual oil seeds and pulses. Verification functions are on vegetables in homesteads,

mushrooms etc. The Station is implementing the Comprehensive Coconut Care Programme

➢ **Regional Agricultural Research Station, Ambalavayal**

Regional Agricultural Research Station for High range zone is located at Ambalavayal Wayanad district. Ambalavayal is located about 25 km east of Kalpetta, the district headquarter. The station was established under Ex Service men Colonisation programme Wayanad, in 1946 by the then Madras Government. It became a part of Department of Agriculture, Government of Kerala in 1956 and was renamed as Central Horticultural Research Station in 1966. It was transferred to kerala Agricultural University in 1972 and elevated as Regional Agricultural Research Station for High Range Zone in 1983.

• The lead function of the station is to provide research support for agriculture in the High Range zone (Wayanad & Idukki districts and Nelliyampathy area of Palakkad district). Cardamom Research Station, Pampadumpara, Idukki district is a substation of RARS Ambalavayal. Research programmes on crop breeding and management aspects of pepper, ginger, rice, scented rice and cool season vegetables; studies on crop weather relationships, soil fertility management etc are undertaken. Research and infrastructure development programmes are funded by a number of agencies including Indian Council of Agricultural Research (ICAR), National Horticulture Mission (NHM), State Horticulture Mission (SHM), Rashtriya Krishi Vikas Yojana (RKVY), India Meteorological department (IMD) and Government of Kerala. At present there are eleven state funded research/development projects and fourteen programmes supported by other agencies.

➢ **Regional Agricultural Research Station, Kumarakom**

The Coconut Research Station, Kumarakom was established in the

year 1947 with the financial support of the Indian Central Coconut Committee in order to cater to the research needs of coconut in the reclaimed alluvial soils of Kuttanad. With the establishment of the Kerala Agricultural University in 1972, the Coconut Research Station became one of the constituent institutions of the University. In 1982 the station was upgraded to the status of a Regional Agricultural Research Station (RARS) under the National Agricultural Research Project (NARP) funded the IBRD/ICAR with the mandate for research on crops and cropping systems in the Special Zone of Problem Areas comprising `Kuttanad', `Pokkali' and `Kole' tracts.

- The RARS, Kumarakom is situated at 9° 3' latitude and 76° 3' longitude in the Kumarakom village of Kottayam district on the southern side of the Kavanar (river). It lies at an altitude of 0.6 m. below MSL. The nearest municipal town is Kottayam, just 15 km. South of Kumarakom (Kavanattinkara). The total geographical area of the farm attached to the RARS is 44.76 hectares. The soil of the farm is riverine allumvium, silty clay in texture. It is acidic in reaction with the pH ranging between 5 and 5.4. Kumarakom enjoys a humid tropical climate. The normal annual rainfall is 2469 mm, the bulk of which (55.4%) is received during the span of 3 months from June to August. A dry spell prevails during December to April. The mean maximum and minimum temperatures are 30.8° C and 25.3° C, respectively. The mean relative humidity is 86.7 per cent. The bulk of the land area (19.5 ha) is planted with coconut. Rice, at present occupies an area of 3.0 ha only which can, however, be increased to 5 ha. Coconut is grown on bunds reclaimed from the Vembanad Lake. The other important crops grown are, banana, vegetables, clove, nutmeg, cocoa, pepper and fodder grass. An area of about 150 ha is utilised for aquaculture of fish and prawns.

➢ **Regional Agricultural Research Station, Pattambi**

The Regional Agricultural Research Station, Pattambi is known for the research and contributions on rice. The station has a long history. Established as a Paddy Breeding station by the British in 1927, it has made tremendous contribution to the betterment of rice production sector in the state. The station was named as Agricultural Research Station in 1930 and became a part of Kerala state in 1956. It became the Central Rice Research Station in 1962. The first high yielding hybrid derivative variety of rice of South East Asia "*Annapurna* (Ptb-35)" was released for cultivation from the station in 1966**.** Kerala Agricultural University took over the Station with its formation in 1972. In 1981, under the National Agricultural Research Programme (NARP), the station was upgraded as Regional Agricultural Research Station for Central Zone comprising of Ernakulum, Trissur, Palakkad and Malappuram districts. The lead function of the station is to conduct research on rice, pulses, horticultural crops and rice based farming systems.

- The station has well laid out fields and support infrastructure for field experimentation, and laboratory studies. Research and Development activities through more than eight decades by dedicated scientists with support from field staff and skilled labourers have given rise to an array of technologies which complemented the green revolution. The research contributions are continued with useful outputs for the crop production sector in general and rice production sector in particular. The station has so far released 60 rice varieties (Ptb- 1 to Ptb-60), two varieties each in cowpea and vegetables. It has also developed production package for rice and other crops for realising higher productivity through optimum resource use. Knowledge dissemination through training programmes, field days, exhibitions, melas, etc. had been an integral part of the R&D programmes.

- Kerala Agricultural University had been offering a Diploma programme in Agriculture till 1986.The course was discontinued then due to administrative reasons. Realising the potential for an academic programme which will lead to a Diploma in Agriculture, the university decided to re instate the course. Demand for trained hands from public and private sector involved in agriculture and related activities, potential for entrepreneurship development and employability in various sectors outside the country also supported the decision. A large number of students are from the state are depending on facilities available outside the state to join similar programmes. An Institute of Agricultural Technology was established at RARS, Pattambi considering academic environment, intellectual and physical infrastructure. The Institute offers a two year Diploma in Agricultural Science (DASc).

- The Institute aims to provide opportunities to young aspirants interested in agriculture to acquire basic knowledge and practical experience in the field, develop entrepreneurial skills as well as employability through the Diploma programme in Agriculture.

➤ **Regional Agricultural Research Station, Pilicode**

Coconut research was started in India in 1916 in the erstwhile Madras State with the establishment of four research stations, one each at Kasaragod and Pilicode and two at Nileshwar. When the Indian Central Coconut Committee was established, the research station at Kasaragod was taken over by the Committee in 1947 and in 1970, it became the C.P.C.R.I under I.C.A.R. With the formation of Kerala State in 1956 the remaining three stations came under the Department of Agriculture, Govt. Kerala. In 1972 when the Kerala Agricultural University came into existence, one of the stations at Nileshwar (Nileshwar-II) and the station at Pilicode were

transferred to Kerala Agricultural University with headquarters at Pilicode. Under the N.A.R.P., these stations have been reorganised to form the Regional Agricultural Research Station for the northern region since Ist August 1980 onwards.

- The main objective of the station is to perform the State wide lead function for research on coconut and to serve as a commodity verification and testing centre for rice, pulses and oilseeds and to supervise and guide the work at Pepper.

➢ **Regional Agriculture Research Station, Vellayani**

- The Regional Agricultural Research Station for the Southern Zone has been functioning at Vellayani since February 1982. Apart from continuing the research activities under NARP Phase I and Phase II, the station implemented 30 externally aided research projects comprising of five AICRPs, five ICAR ad hoc schemes, eight STED projects, one CDS project, one KAU-RRII project, one NWDPRA project, one Food processing project funded by Ministry of Food Processing Industry, three DST projects, two DBT projects, two PPIC projects and one RSMM project.

- **Mandate of the Station**

- Lead functions are research under partially shaded conditions and export-oriented vegetables and cut flower production. The Centre has verification functions on rice, fruits, homestead farming, coconut, tuber crops, vegetabeles, farm machinery for garden lands, AICRPs on forage crops, nematodes, oil seeds and pesticide residues are functioning here.

3.3.12 Research Stations

- **Agricultural Research Station, Anakkayam**

    Agricultural Research Station was started in 1963. The station situated at Anakkayam village in Malappuram district has an area of 9.92ha of which 8 ha is under cashew and 0.5ha under coconut.

    Verification function is done in cashew and vegetables

- **Agricultural Research Station, Mannuthy**

    This station was started during the year 1957 as Rice Research Station, Mannuthy in the then Central Farm, Ollukkara. With the formation of the Kerala Agricultural University during 1972, the Rice Research Station, Mannuthy and the Agricultural Research Station, Mannuthy were taken over from the State Department of Agriculture and brought under the control of Agricultural University. In the year 1976, Rice Research Station and Agricultural Research Station were merged and this Research Station was named as Agricultural Research Station, Mannuthy with effect from 01.01.1988.

    Lead functions are on rice for kole land management system, and on coconut. Verification functions include vegetables and organic farming(http://www.agritech.tnauac.in/expert-system/paddy).

- **Agronomic Research Station,Chalakkudy**

    The Agronomic Research Station was established on February 14th, 1972 by the Department of Agriculture, Kerala. The KAU took over the station in 1973 for implementing the Co-ordinated project for research on water management sponsored by ICAR. The Scheme started functioning from July 1974.

The lead functions are water management for rice and rice-based cropping system and other annual crops. The verification functions include agro-techniques in rice and rice-based cropping system. The AICRP on water management is functioning at this centre from 1974

- A phasic stress irrigation schedule was evolved for summer rice (under limited supply of irrigation water) which can save substantial quantity of irrigation water without any reduction in yield.

Water requirement of rice was also estimated.

The centre developed economic and efficient water management practices for the following crops: cowpea, sweet potato, black gram, pineapple, groundnut, Elephant foot yam, sesame, coconut, banana, bitter gourd, cassava, ash gourd and ginger

- **Banana Research Station, Kannara**

The Banana Research Station at Marakkal was established during the year 1963 in an area of 17.3ha, as a centre of the Department of Agriculture to carry out research on banana and pineapple. In 1970, the station was brought under the All India Co-ordinated Fruit Improvement Project of the ICAR to carry out research on banana and pineapple. In 1972, when KAU was established, this station was taken over by it. In 1974, the venue of the Pineapple Research Centre was shifted to KAU Main campus, Vellanikkara in an area of 6.3 ha suited for pineapple cultivation.

Lead function is on banana and banana-based cropping systems and verification function in vegetables. The All India Fruit Improvement Project for Banana is functioning in this centre.

Accomplishments

- The Kannara Centre maintains 212 accessions of banana. Two banana hybrids - H1 and H2 were recommended for cultivation in Kerala. Five superior types from the germ plasm - Dudhsagar, Sugandhi, Mysore Ethan and Highgate were selected based on yield.

- Recommendations for the integrated management of banana pests including nematodes were evolved. Several recommendations on nutrition and inter-cropping in banana were also made from this centre.

- **Cardamom Research Station, Pampadumpara**

The Cardamom Research Station, Pampadumpara was established in the year 1956 under the State Department of Agriculture, Government of Kerala. It was later transferred to the KAU with effect from February, 1972. The station was selected as one of the co-ordinating centres for spices under the All India Coordinated Re-search Projects in 1972. The station is situated in the Pampadumpara village of Udumbanchola taluk in Idukki district. It is located on the eastern side of Kumily-Munnar road, 35kms away from Kumily and 71kms from Munnar in the Cardamom hills of the Western Ghats.

Mandate of the Station

The lead function is research on cardamom and verification functions is in pepper and tree spices. The station is one of the co-ordinating centres for spices under AICRP on spices

Accomplishments

- The station is maintaining a germplasm bank of 77 cultivated and 14 wild types of cardamom. A clonal selection of cardamom was released as PV-1 for cultivation. Two clones are under IET and CYT.

- Nursery practices of cardamom were standardised. Control measures for shoot fly, Katte disease, thrips, nematode infestation etc. were evolved and recommended.

- Proper control strategy for foot rot of black pepper in Idukki district has been evolved.

- **Cashew Research Station, Madakkathara**

The Cashew Research Station, Madakkathara under the Kerala Agricultural University was established on 01-05-1973. Presently this is one of the eight Centres of the All India Co-ordinated Cashew Improvement Project. The Cashew Research Station, Madakkathara is located in Madakkathara Village of Trichur taluk in Trichur district. The station is situated at a distance of 1.50km away from Mannuthy on the left side of Mannuthy -Chirakkakode road. The total area of the farm is 47ha (22.25ha planted with cashew and 1ha under building and roads). The lead function of the centre is research on cashew. The All India Co-ordinated Cashew Improvement Project is functioning at this centre from 1973.

Accomplishments

- Five cashew cultivars were released for cultivation from this centre. They are Madakkathara-1, Madakkathara-2, Kanaka, Dhanya and Priyanka.

- The techniques of epi-cotyl and `soft wood' grafting in cashew have been standardised. Layering medium for air layering has been standardised.

- Fertilizer schedule for cashew has been recommended.

Spraying schedules for the control of `tea mosquito', `stem borer' etc. in cashew were evolved and recommended.

- **Pepper Research Station, Panniyur.**

    Pepper Research Station, Panniyur, started in 1952 as part of a scheme to improve pepper cultivation, was uplifted to the status of a research station under the KAU in 1972. The station concentrates on crop improvement, crop management and crop protection aspects of black pepper. It is an important co-ordinating centre of the All India Co-ordinated Re-search Project on Spices of the ICAR. Besides research, nucleus planting materials of released varieties of black pepper, viz. Panniyur 1, Panniyur 2, Panniyur 3, Panniyur 4 and Panniyur 5 are also been distributed.

Mandate of the Station

    Lead function is research on pepper. AICRP on spices is functioning in this centre from 1972.

Accomplishments

- The floral biology of pepper plant was studied which revealed the hereditary parameters involved in deciding productivity a vine.

- The hybridisation technique in pepper has been standardised at this station and evolution of hybrid pepper stands testimony to the success of this method. The Centre has released five varieties of pepper so far, viz., Panniyur-1, Panniyur-2, Panniyur-3, Panniyur-4 and Panniyur-5 and all are well received by the farmers.

- A technique for large scale production of rooted pepper cuttings was developed for the first time. A technology for the production of bush pepper was also developed.

    A low cost technology for the rapid multiplication of pepper was developed

- **Plant Propagation & Nursery Management Unit, Vellanikkara**

- **Agricultural Research Station, Thiruvalla**

The Agricultural research station, Thiruvalla was established during year 1976 with the complete assistance from ICAR, under AICRP on sugarcane. The KAU strengthened the research efforts of this station during 1979 by providing more infrastructural facilities and man power. The research programmes in sugarcane were later strengthened research in vegetables was initiated by the funds provided by NARP phase II. At present the research is also supported by plan funds.The lead function is research on sugarcane and verification function on vegetables. The AICRP Centre on sugarcane is functioning here.

- **Aromatic & Medicinal Plants Research Station, Odakkali**

Kerala Agricultural University is perhaps the first among the Universities in India to have a research station exclusively for Aromatic and Medicinal Plants. The station was established on 15-3-1951 as "Lemongrass Breeding Station" under the Department of Industries of the erstwhile Travancore-Cochin Government. The centre was brought under the Department of Agriculture with effect from 1-8-1954 and was baptized as "Lemongrass Research Station". The main objective of the centre was to provide adequate research support for lemongrass cultivation in the state. Consequent to the formation of Kerala Agricultural University in 1972, the station became an integral part of the University's research network. Diversifying the research emphasis of the centre to cover all other tropical aromatic and medicinal plants, the station was renamed as Aromatic and Medicinal Plants Research Station (A.M.P.R.S.) in 1982. Ministry of Agriculture, Government of India has upgraded the phytochemical laboratory of the station as one of the Regional Analytical Laboratories for medicinal and aromatic plants in 1994.

- The station was established in 1951 as "Lemon grass Breeding Station" under the Department of Industries of the erstwhile Travancore-Cochin Government. The Centre was brought under the Department of Agriculture with effect from 1-8-1954 and renamed "Lemongrass Research Station". The main objective of the Centre was to provide adequate research support for lemongrass cultivation in the state. Consequent to the formation of the KAU in 1972, the station became an integral part of the University's research system. The station was named as Aromatic and Medicinal Plants Research Station (AMPRS) in 1982. This institution is recognised as lead centre for lemongrass research at national and international level. United Nations Industrial Development Organisation usually directs the entrepreneurs to this centre for advice regarding their research and development needs on lemongrass. A Regional Analytical Laboratory for medicinal and aromatic plants started functioning on 31.12.1993.

- Mandate

- The lead function of the centre is research on essential oil yielding plants and the verification function is on medicinal plants.

- Achievements

- The most significant contribution of the Centre was the release of the high yielding lemon grass variety OD - 19 (Suganthi), the only nationally accepted variety in East India lemongrass. Six lemon grass accessions superior to OD-19 have been identified. Superior palmarosa selection made at the station, ODP-2 is popular among farmers. Among the South Indian vetiver types, Nilambur selection, ODV-3, identified at this station is very popular. A high eugenol yielding cinnamon type has also been identified. Agrotechniques for lemon

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grass, palmarosa and vetiver were evolved and recommended. Agronomic practices for maximising rhizome yield in Kaemferia galanga (Kacholam) has been worked out. The process of distillation of lemon grass and other essential oil yielding plants was standardised. The phytochemical laboratory of the station is recognised as one of the Regional Analytical Laboratories for medicinal and aromatic plants.

- **Coconut Research Station, Balaramapuram**

The Coconut Research Station was established in 1948 at Pachalloor, near the College of Agriculture, Vellayani by the Department of Agriculture, Kerala as a scheme partly financed by the Indian Central Coconut Committee. Later during in 1963 - 64, the venue was shifted to a 14.13 ha. Plot of garden land at Kattachalkuzhy, 4.0 km south of Balaramapuram on the Vizhinjam - Balaramapuram road. The station was taken over by the Kerala Agricultural University in February 1972.

Agro - techniques for coconut and coconut-based farming system in red soils.

- **Farming Systems Research Station, Sadanandapuram**

The Farming Systems Research Station, Sadanandapuram was started in the year 1986 as NARP Special Station. In October 1993, the station was renamed as Farming Systems Research Station. It is located at Sadanandapuram, five kilometers to the South East of Kottarakkara taluk, Kollam district. The total area is 3.96 ha comprising of two plots separated by distance of 250 meters. Plot 1 known as Kshethrakunnu, has an area of 4.03 ha and plot II, known as Chandapurayidam has 4.93 ha

Lead functions are homestead farming, soil and water conservation and

management. Verification functions are on tuber crops, coconut, rice, horticulture, agroforestry and cashewnut. A Krishi Vigyan Kendra is also functioning here.

The Centre came up with several recommendations to improve the productivity of homestead farming system. The Centre maintains 144 Cheradi types of rice.

- The Centre standardised pots and potting mixture for bush pepper.

- **Integrated Farming Systems Research Station, Karamana**

The Integrated Farming Systems Research Station (IFSRS) is located at Nedumcaud, Karamana, and 3.0 km south east of Thiruvananthapuram Central railway and bus stations. The station has an area of 7.65 ha of which 7.25 ha is double cropped wet land and 0.4 ha garden land. The centre, formerly known as the Model Agronomic Research Station, was established in 1955. New schemes and projects were started from 1968 onwards under the All India Co-ordinated Agro-nomic Research Project (AICARP) of the ICAR. From October, 1983 onwards, the station was upgraded as the HQ of the AICARP in Kerala.

- Lead functions are rice-based cropping system and verification functions are agrotechniques (rice), integrated farming systems with rice/ fish/ poultry/ cattle. From 1986, a unit of All India Co-ordinated Agronomic project is functioning here.

- **Pineapple Research Station, Vazhakulam**

The Pineapple Research Station at Vazhakulam was established on 2nd January 1995 to give research and development support to pineapple farmers. Since then, this research institute of the Kerala Agricultural

University has been steadily growing and serving as a subvention to the pineapple growers of the state and the country as well.

The research institute had a humble beginning on 2.1.1995 as "Pineapple Research Station & Pest and disease Surveillance Unit" under Kerala Horticulture Development Programme (KHDP). For the construction of the office-cum-laboratory building of the station. It was delinked from KHDP and became a constituent research centre of Kerala Agricultural University under central zone on 1.7.1997 and shifted to its own new building on 27.6.1998.

The research centre is located (link is external) at Google Map Geocoordinates: 9.9435,76.6384 close to the pineapple market at Vazhakulam, 10 km east of Muvattupuzha on the Muvattupuzha - Thodupuzha road in Ernakulam District, Kerala, India. It is about 40 km from Cochin International Airport, Nedumbassery; 50 km from Aluva railway station and 80 km from the Cochin harbour.

Our mandate is to give research and development support to the pineapple growers, provide quality technology, products and services to the pineapple sector and undertake basic and applied research in pineapple and other fruit crops of Kerala.

Vision

Quality People, Infrastructure & work culture for Quality Technology, Products & Services.

Motto

Merit alone counts for Quality suitable for the purpose.

Mandate

Give research and development support to the pineapple and passion fruit growers. Provide quality technology, products and services to the fruit crops sector Undertake basic and applied research in pineapple and other fruit crops of Kerala

- **Rice Research Station, Moncompu**

The Rice Research Station, Monkompu is located at Monkompu, Thekkekkara of Champakaulam Panchayat in Kuttanad Taluk of Alappuzha District. The station was started in the year 1940(http://www.agritech.tnauac .in/expert-system/paddy).

The centre is exclusively to deal with research on rice in Kuttanad ecosystem. A unit of All India Co-ordinated Rice Improvement Programme is functioning here.

Accomplishments

- The centre was instrumental in solving several problems in deep water areas such as Kuttanad. The Centre has so far released 12 rice cultivars. These are Mo1, Mo2, Mo3, Bhadra, Asha, Pavizham, Karthika, Aruna, Makom, Remya, Kanakam and Ranjini and are well accepted by the farmers. Another seven pre-release cultures were proposed for release. They are Pavithra, Panchami, Remanika, Uma, Revathy, Karishma and krishnanjana.

- The centre has come up with viable management strategy against varinellu (wild rice) in rice by coating rice seeds with calcium peroxide. Recommendations on nitrogen management, herbicidal control of weeds, use of rock phosphates in acid soils, etc. are other contributions.

- An Integrated pest management strategy has been worked out for Brown Plant Hopper of rice. Control measures for brown spot and sheath blight of rice were also evolved.

- An indigenous cheap and efficient rat trap "the Moncompu trap" has been designed for trapping rats in rice fieldshttp://www.agritech.tnauac.in/expert-system/paddy).

- **Rice Research Station, Vyttila**

  The Rice Research Station, Vyttila is situated in a representative site in the centre of the pokkali tract. This station started functioning during the year 1958 in a leased land in Kunnara, and was shifted to the present site in 1963. The station was taken over by the KAU in 1974. Taking into account the importance of fish- prawn culture during the saline phase, a unit for fisheries research was established during the year 1976. At present the station has a total area of 8.91 ha of which 4.25 ha are wet land (http://www.agritech. tnauac.in/expert-system/paddy).

3.3.13 Extension Centres

- *Agricultural Technology Info rmation Centre, Mannuthy*

- *Central Training Institute,mannuthy*

- *The Information and Sales Centre (I&SC), Mannuthy*

It was established in 1993 as an independent unit under the Administrative control of the Directorate of Extension, Kerala Agricultural University. The objective of the Centre was to establish a single window system to make available information and resources of the KAU for farmers. Conceptual clarity and proper co-ordination between the production centres

and the I&SC transformed the I&SC into an effective single window facility for transfer of technology. This successful experiment gained National attention and prompted ICAR to develop a national project under NATP for dissemination of information and technology *viz. Agricultural Technology Information Centre (ATIC)*. In the year 2000, the I&SC was upgraded as ATIC under NATP Project funded by ICAR. With the official operation of the ATIC commencing in 2000, the KAU imbibed the full spirit and object of ATIC and began translating ICAR's vision into reality.

- *Communication Centre, Mannuthy*

- Established in 1986 under the World Bank assisted National Agricultural Extension Project (NAEP), CTI serves as the nodal point of KAU's HRD activity and is mandated with training administration, documentation, negotiation, liaison, exploring scope for national and international training programmes. The training programmes undertaken by the institute are generally classified into:

- Sponsored training - where the course fee is paid by the sponsoring agency

- Vocational training - where the course fee is paid by the individual candidates

- Stipendiary training - where a nominal stipend is paid to the trainees

- HRD/MDP programmes for KAU and other organizational employees

- In academic performance, the Kerala Agricultural University (KAU) has been adjudged the best in the nation for six consecutive years. KAU has the best qualified human resources with technical competency in over 200 subject matter areas. The Central Training Institute (CTI) functioning under the Directorate of Extension at

Mannuthy facilitates the transfer of this immense knowledge and experience to various categories of stakeholders.

- **Krishi Vigyan Kendras(KVKs)**

1. Krishi Vigyan Kendra, Kollam

2. Krishi Vigyan Kendra, Kottayam

3. Krishi Vigyan Kendra, Thrissur

4. Krishi Vigyan Kendra, Palakkad

5. Krishi Vigyan Kendra, Malappuram

6. Krishi Vigyan Kendra, Wayanad

7. Krishi Vigyan Kendra, Kannur

- *Krishi Vigyan Kendra, Kollam*

The Krishi Vigyan Kendra at Sadanandapuram, Kottarakkara under KAU functions as the linkage organization between the University and stakeholders in agriculture, most importantly the farmers, in Kollam district. Established in the year 1994 with the prime objective of transfer of technology coupled with evaluation and refinement of proven technologies to suit the site specific farming situation, KVK attempts to increase the net returns to farmers and also self-employment opportunities among farming communities.

Vision

Conducting on-farm testing to identify the location specificity of agricultural technologies under various farming systems.

- Organising frontline demonstrations to establish production potential of various crops and enterprises on the farmers' fields

- Organising need based training of farmers to update their knowledge and skills in modern agriculture technologies related to technology assessment, refinement and demonstration and training of extension personnel to orient them in the frontier areas of technology development.

- Creating awareness about improved technologies to larger masses through appropriate extension programmes.

- Production and supply of good quality seeds and planting materials, livestocks, poultry and fisheries breeds and products and various bio-products to the farming community.

- Work as resource knowledge centre of agricultural technology for supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district.

- *Krishi Vigyan Kendra, Kottayam*

- *Krishi Vigyan Kendra, Malappuram*

Krishi Vigyan Kendra Malappuram is district level Farm Science Centre established by the Kerala Agricultural University with the support of Indian Council of Agricultural Research (ICAR) for speedy transfer of technology to the farmer's fields. KVK Malappuram is situated in the Kelappaji College of Agricultural Engineering and Technology (KCAET), campus at Tavanur.

The aim of KVK is to reduce the time lag between generation of technology at the research institution and its transfer to the farmer's fields for

increasing production and productivity and income from the agriculture and allied sectors on a sustained basis. The KVK aims at technology assessment, refinement and frontline demonstration of the technology and its dissemination through training of farmers and extension personnel.

The mandates of KVK are Conduct "On - farm testing" for identifying technologies in terms of location specific sustainable land use system. Organise training to update the extension personnel with emerging advances in agricultural research on regular basis. Organise short and long term vocational training courses in agriculture and allied vocations for the farmers and rural youth with emphasis on "learning by doing" for higher production on farms and generating self-employment. Organise front line demonstrations on various crops to generate production data and feedback information.

3.4 Conclusion

Kerala's agriculture promoted by researches done by the Kerala agriculture university, Trissur. It is spread across in Kerala with 8 faculties and research stations, 6 regional agricultural research stations, 16 research stations for specific crops and its extension centres. The institution focused to give research and development support to the farmers, providing quality technology, products and services to the agriculture sector.

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CHAPTER IV
RESEARCH DESIGN

4.1. Introduction

Research is defined by W. S. Monroe as "a method of studying problems whose solutions are to be desired partially or wholly from facts. The facts dealt within research may be statements to questionnaires, experimental data of any short, and so forth". Francis Rummed defines "research is an endeavour to discover, develop opinions, historical facts those contained in records and reports, the result of tests, answer and verify knowledge. It is an intellectual process that has developed over hundreds of years, ever changing in purpose and form and always searching for truth.

Research design means the exact nature of the research work in a systematic manner. It involves the information about the research work in view of framework of study, availability of various data, observations, analysis, sampling, etc. research design includes the structure of the research work. It may help the researcher to organise his ideas in a particular form. The researcher must be in a position to acquire necessary information relating to the problem. The availability of skills is also necessary.

In fact research design is the conceptual structure within which research is conducted. Research design stands for advance planning of the methods to be adopted for collecting the relevant data and techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money. Shortly, it is the blueprint of the research.

In this chapter, discusses sample taken for the study, variables used, data collection tools and statistical tools and techniques used for the study.

This study focus on the trends in research output of Kerala Agricultural University in general and its communication in special.

4.2. Sample used for the study

Publications from Kerala Agricultural University staff is considered as sample taken for the study. There are 21 types of publications are included. These are journal articles, thesis, popular articles, book chapters, technical bulletins, books, conference proceedings, Dissertation, poster presentations, leaflets, booklets, newsletter, extension literature, technical report, abstract, handbooks, patent, monograph, paper presentation, review and brochure.

4.3 Variables used for the study

The variables used in the present study are year-wise growth of literature, source wise distribution, authorship pattern and author productivity, relative growth rate and doubling time, degree of collaboration, subject wise and institutional wise distribution, most preferred journals and the application of various bibliometric laws in publication of KAU research output.

The subject themes are classified based on the DDC 22nd edition. The study is exploratory nature by analysing the trend of research output of KAU. And its analytical nature strengthen the empirical validity through application of suitable statistical tools.

4.4 Techniques used for the data collection

The data were retrieved from annual reports of KAU, agriculture databases such as CAB abstract, Krishikosh and CeRA consortium. Total 2842 data were retrieved. This data were entered in well-structured datasheet prepared in M S Excel. The data sheet contains Year, type of document, name of journal, subject, name of author, number of authors and language (sample datasheet is given in appendix-I). After elimination of duplicated records,

total 2822 data were analysed using SPSS.

4.5 SPSS (Statistical Package for Social Science)

SPSS is a software package used for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary is stored in the datafile) are features of the spss (https://en.m.wikipedia.org).

4.6 Application of Scientometric tools and techniques

The researcher has used the different Scientometric tools and techniques. They are Relative Growth Rate (RGR), Doubling Time, Degree of Collaboration, Collaborative Coefficient (CC), Co-Authorship Index (CAI) and Collaborative Index.

4.6.1. Relative Growth Rate

The relative growth rate is the increase in the number of publications per unit of time (Mahapatra, 1986). The mean relative growth rate R(1-2) over a specified period of interval can be calculated using the following equation.

$$R(1\text{-}2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R (1-2)　　=　　Mean relative growth rate over the specified period interval;

W1　　=　　log w1 (Natural log of initial number of publications)

W2　　=　　log w2 (Natural log of initial number of publications)

T2-T1　　=　　the unit difference between the initial time and final time.

The relative growth rate for publications can be calculated separately.

Therefore,

R(a) = Relative growth rate per unit publication per unit of time (year)

4.6.2. Doubling Time

Doubling time means if the number of publication of a subject doubles during a given period. The relative growth rate and doubling time are directly related to each other. It can be calculated by the following formula:

Doubling time (Dt) = 0.693/R(a)

Therefore,

Doubling time for publications Dt(a) = 0.693 / R (a)

4.6.3. Degree of Collaboration

In order to identify the degree of collaboration, the researcher has adopted C. Subramanian's formula

$$\text{The formula is } C = \frac{Nm}{(Nm + Ns)}$$

Where,

C   =   Degree of collaboration in a discipline

Nm   =   Number of multiple authored papers

Ns   =   Number of the single authored papers.

4.6.4. Collaborative Coefficient (CC)

The pattern of co-authorship among different countries have been examined by making use of Collaborative Coefficient (CC) (Ajiferuke

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et.al.1988). Where

$$CC=1-[\sum(1/j)Fj/N]$$

J=1

Fj   =   the number of authored papers

N   =   total number of research published; and

K   =   the greatest number of authors per paper

According to Ajiferuke, CC tends to zero as single-authored papers dominate, and to 1-1/j as j-authored papers dominate. This implies that higher the value of CC, higher the probability of multi authored papers.

4.6.5. Co-Authorship Index (CAI)

CAI can be calculated as

$$CAI = \{(Nij/Nio)/(Noj/Noo)\}*100$$

Nij : Number of papers having j authors in block I

Nio : Total Output of Block I

Noj : Number of papers having j authors for all blocks;

Noo : Total number of papers for all authors and all blocks

J=1, 2, 3, > 4

CAI = 100 implies that co-authorship in a particular block for a particular types of authorship corresponds to the world average, CAI>100 reflects higher than average co-authorship effort and CAI<100lower than average co-authorship effort in a particular block for a particular type of authorship.

4.6.6. Collaborative Index (CI)

Collaborative index is the number of authors per paper. It can be obtained by

$$\text{Collaborative Index} = \frac{\text{Total number of authors}}{\text{Total number of articles,}}$$

where, CI = the number of authors per paper

4.7. Application of Basic Empirical Laws of Bibliometrics

The researcher has used the bibliometric laws such as Bradford's law of scattering of journals, Lotka's law of author productivity, Inverse square law of author productivity, Price's Square root law and Pareto principle (80/20 rule) .

4.7.1. Lotka's law of author's productivity

Lotka's law is one of the three major laws of bibliometrics that mainly explain the distribution of literature of various authors' productivity in a given field (Lotka, 1926). Lotka's law of author productivity is tested with the application of scientific productivity Chi-square model, and it is applied in relation to number of authors contributing to the number of publication. Potter 13 identified the Lotka's fraction $1/n^a$ -4.65 on the basis of Euler- Maclaurin formula of summation. This model is applied in the present study.

The sum was used as a deviser for 1/n-4.65 tom determine the proportion of the total number of authors expected to produce "n" paper (in the case of present study n=1, 2,3,4…………….10)The following formula was used to find the proportions.

$$S = \sum_{n=1}^{10} 1/n\,4.65$$

For present study S is the sum of Lotka's modified rations for the value a=4.65

The formula   An=1/n4.65 T/S (n=1,2,3,….10)

Where T is the total number of authors in the sampling and 'An' is the total number of expected authors producing 'n' papers. The Lotka's law also tested with the application of scientific productivity chi-square model in relation to a number of authors who contributed 'n' number of publication. It can be expressed by the equation an=a1/n2, n=1,2,3

In other words, for every 100 authors making one contribution each, there would be 25 others contributing two articles each ($100/2^2=25$) about 11 contributing three article each $100/3^3=11.1$ and so on, where 'an' is the numbers of authors contributing 'n' papers each; and al is the number of authors contributing each one paper

The chi-square can be computed as (F-p) 2/p.

F=observed number of authors with 'n' publications;

P=expected number of authors

4.7.1.1. Lotka's –inverse square law scientific author productivity

In 1926 Alfred J. Lotka "proposed on inverse square law relating the authors of scientific papers to the number of papers written by each author". Lotka's inverse Square Law scientific author productivity is tested with the application of scientific productivity least square method, and it is applied in relation to number of authors contributing to the number of publication.

Lotka's Law describes the frequency of publication by authors in a given field and states that "the number of authors making n contributions is about $1/n^2$ of those making one; and the proportion of all contributors who

make a single contribution is about 60 percent. This means that out of all the authors in a given field, 60 percent will have just one publication and 15 percent will have two publications (1/2² times.60), 7 percent of authors will have three publications (1/3² times.60) and so on" (Lotka,1926).

The general formula is

XY = C,

where X is the number of publications, Y is the relative frequency of authors with X publications, and n and C are constants, depending on the specific field. In brief, the author who publishes two articles accounts, on average, for 1/4 of the total number of publications. The authors who publish three articles account for about 1/9 of the total number of publications, and so on. Therefore, authors who publish one article account for 60% of all the publications. That is to say, authors who Publish n publications will be $1/n^2$ of the proportion of total publications.This formula is also called the Inverse Square Law (Tsay, 2003).

The 'n' value is calculated by this method using the following formula

$$N = \frac{N\Sigma xy - \Sigma x \Sigma y}{N\Sigma x2 - (\Sigma x)2}$$ \hfill (1)

Where,

N = Number of pairs of data

X = Logarithm of articles (x); and

Y = Logarithm of authors (y)

The value of constant 'c' is calculated using the following formula

Where,

P = Number of x items in table

N = Sum of contributors

N = Observed value

With x=1, 2, 3,……37

Here p = 37, n = value obtained using formula (1) and x =number of articles.

In this study also applies maximum likelihood (ML) method to test Lotka's law for the scientific research output of Kerala agricultural university. The best known fitting ML method currents available is a computers program called Lotka by Rousseau& Rousseau. It offers two columns for data input: Source and production. Once the data are properly entered, the program returns the "best fitting" values of β (Lotka exponent) and 'c' for the dataset.

4.7.2. Price's Square Root Law

Price's Square Root law, which states that "half (50%) of the literature on a subject will be contributed by the square root of total number of authors publishing in that area (Travis Nicholls paul 1988)."

In order to validate whether the distribution status of authors fulfil Prices square root law, the following calculation is carried out.

PSQ =√N

4.7.3. Pareto Principle (80 X 20 Rule)

Pareto Principle (80/20 Rule) states that, for many events, roughly 80%of the effects come from 20 percent of the causes. The original observation was in connection with income and wealth. Pareto noticed that 80 % of Italy's wealth was owned by 20 percent population. He then carried out surveys on a variety of other countries and found to his surprise that a

similar distribution applied.

4.7.4. Bradford's Law of scattering of journals

Bradford's law of scattering has been adopted to examine all the journal title contributing to a bibliography that focused on Agricultural research by the scientists. Samuel Clement Bradford developed this law in 1934. Bradford's Law serves as a general guideline to librarians in determining the number of core journals in any given field. It states that journals in a single field can be divided into three parts, each containing the same number of articles:

1. A first zone containing core of journals on the subject, relatively few in number that produces approximately one-third of all the articles.

2. A second zone, containing the same number of articles as the first, but a greater number of journals.

3. A third zone, containing the same number of articles as the second, but a still greater number of journals.

The mathematical relationship of the number of journals in the core to the first zone is a constant 'n' and to the second zone the relationship is 'n²'. Bradford expressed this relationship as '1: n: n²'.

1. Bradford formulated his law after studying a bibliography of geophysics, covering 326 journals in the second zone, containing the same number of articles as the first, but a greater number of journals.

2. A third zone, containing the same number of articles as the second, but a still greater number of journals.

The mathematical relationship of the number of journals in the core to the first zone is a constant 'n' and to the second zone the relationship is 'n²'.

Bradford expressed this relationship as '1: n: n²'. Bradford formulated his law after studying a bibliography of geophysics, covering 326 journals in the field. He discovered that 9 journals contained 429 articles, 59 contained 499 articles, and 258 contained 404 articles. So it took 9 journals to contribute one-third of the articles, 5 times 9, or 45, to produce the next third, and 5 times 5 times 9, or 225, to produce the last third.

As may be seen, Bradford's Law is not statistically accurate, strictly speaking. But it is still commonly used as a general rule of thumb (Potter, 1981).

4.8. Application of Other Statistical Tools

Further, the researcher has applied various statistical tools to analyse the empirical data, such as mean, coefficient variation, percentages and averages. The diagrammatic and graphical representations of the data are also made depending on the requirement of study.

4.9. Concepts and Measurement of Variable

- **Relative Growth Rate (RGR):** It denotes increase in the number of publications of Agriculture research output per unit to time.

- **Doubling Time for Publications (DT):** It denotes a number of publications of a subject Agriculture research double during a given period of time.

- **Degree of Collaboration (DC):** It explains that the percentage of single authored papers is less than that of multi authored papers in Agriculture research.

- **Collaborative Coefficient (CC):** The pattern of co-authorship among different countries have been examined by making use of Collaborative Coefficient.

- **Collaborative Index (CI):** Collaborative Index is the ratio of the total number of authors divided by the total number of published articles

- **Author Productivity:** Author productivity examines the prevailing trend in carrying out the research process of Agriculture in terms of the extent to which the research performance is concentrated by single authors.

- **Authorship Pattern:** It aims at analysing the percentage of single and multiple authors contributed Agriculture research output.

4.9. Conclusion

In this chapter, explained objectives, hypothesis, sample of the study, variables of the study, Data collection procedure, application of statistical tools and techniques and concept of measurement and variables in detail.

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CHAPTER V
ANALYSIS AND INTERPRETATIONS

5.1. Introduction

This chapter is to analysis and interpret the publication productivity of Kerala Agricultural University for the latest 10 years. For the purpose of the study, several sources like institutional website, annual reports, agricultural data bases, institutional repositories, consortia etc. are used. Total 2822 records were collected and it's analysed by using statistical tools such as MS excel and SPSS.

Main objective of study is to measure growth of publication and its trend during 2008 to 2017. This study specifically focuses year wise growth, type of document, language, authorship pattern collaboration pattern, most prolific author, subject wise analysis, institutional wise analysis, most prepared journal and applicability of bibliometic lose (Lotka's Law, Bradford Law, Pareto principle prices square root law).

Scientometric indexes such as co-authorship index, and collaborative index are determined. Also the applicability of Bradford's law of scattering of journals, Lotka's law of scientific productivity, Prices square root law and Parreto principle (80*20 rule) are tested. These are analysed and interpreted in this chapter.

5.2.   Year- wise growth of research output of KAU

The investigator collected 2822 Publications of Kerala Agricultural University during 2008 to 2017. Year wise distribution of publications are given in table 5.1.

Table 5.1

Year- wise growth of research output of KAU

Year	Frequency	Cumulative frequency	Percent	Cumulative percent
2008	500	500	17.7	17.7
2009	685	1185	24.3	42
2010	566	1751	20.1	62.1
2011	114	1865	4.0	66.1
2012	26	1891	.9	67
2013	100	1991	3.5	70.5
2014	58	2049	2.1	72.6
2015	325	2374	11.5	84.1
2016	261	2635	9.3	93.4
2017	187	2822	6.6	100.00
Total	**2822**		**100.0**	

It is found that the Kerala Agricultural Universality Community has produced 2822 documents during 2008 to 2017. There is an increase in percentage of documents upto 2010. It declined after 2010 and showed fluctuation trend. The main reason is that after 2010, the Kerala Veternary and Animal Science University and Kerala University of Fisheries and Ocean Sciences were newly formed and separated from KAU. The highest number of publication observed in the year 2009(685) and least is observed in 2012(26).

It revealed that Zig-zag growth of publications during the study period. This is corroborated with reports by Sarala (2016) in faculty productivity of the same institution during 1993-2008.

The graphical representation of the growth of publication is shown in Figure 5.1.
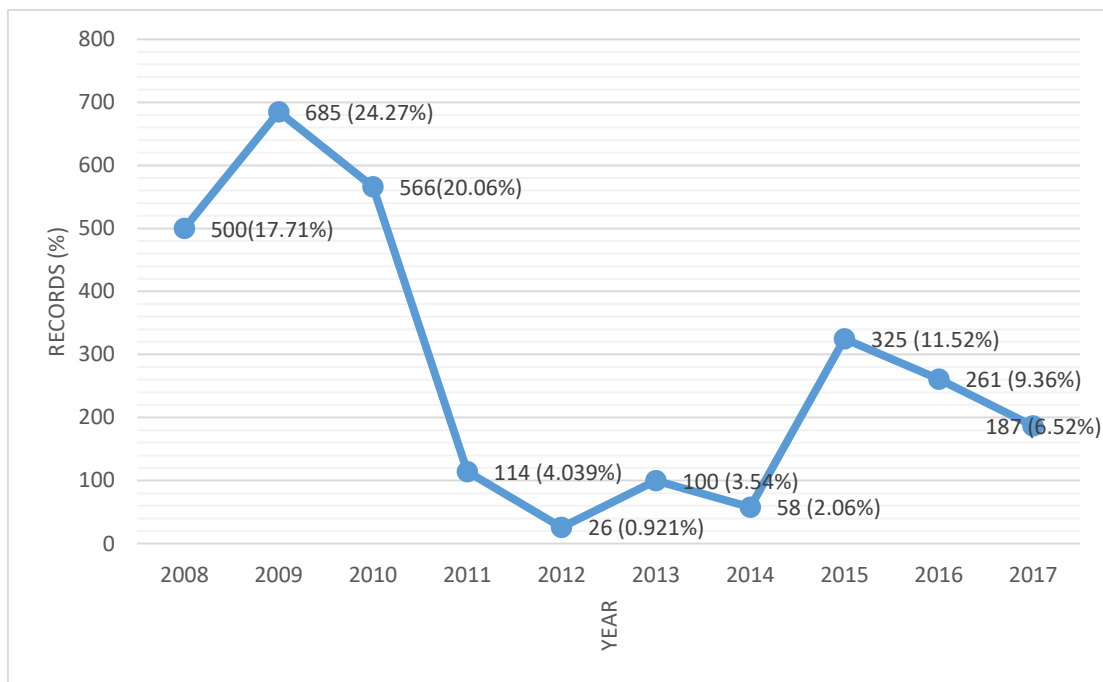
Figure 5.1

Year- wise growth of research output of KAU

5.3. Document wise distribution

The production of knowledge have decisive role in intellectual capital, lies at the heart of organisation or institutions. However, the value of any knowledge product hang on its effective dissemination to present and future audiences; without outreach the efforts of knowledge workers are waste. For this reason dissemination of knowledge is just as important as its production, more particularly is agriculture field.

The research output of KAU is disseminates through various kind of documents. There are 21 document types identified and they are journal articles; theses; popular articles; posters; conference proceedings; patents; book and book chapter; booklets; technical reports; abstracts; handbook; monograph; paper presentation; review and brochure. The document wise distribution is given in table 5.2.

Table 5.2

Document wise distribution

Sl. No.	Documents	Frequency	Cumulative frequency	Percent	Cumulative Percent
1	Journal articles	1666	1666	59	59.00
2	Thesis	422	2088	15.0	74.00
3	Popular Articles	298	2386	10.5	84.5
4	Book Chapters	121	2507	4.3	88.8
5	Technical Bulletins	76	2583	2.7	91.5
6	Books	70	2653	2.5	94
7	Conference Proceedings	63	2716	2.2	96.2
8	Dissertation	30	2746	1.1	97.3
9	Poster Presentations	19	2765	.7	98
10	Leaflets	15	2780	.5	98.5
11	Booklets	12	2792	.4	98.9
12	News Letter	11	2803	.4	99.3
13	Extension Literature	5	2808	.1	99.4
14	Technical Report	4	2812	.1	99.5
15	Abstracts	2	2814	0.1	99.6
16	Handbooks	2	2816	.1	99.7
17	Patent	2	2818	.1	99.8
18	Monograph	1	2819	.0	99.9
19	Paper Presentation	1	2820	.0	12.3
20	Review	1	2821	.0	25.3
21	Brochure	1	2822	.0	100.0
	Total	**2822**		**100.0**	

Maximum number of publications are in the form of scientific articles, 1666(59%) next to this were thesis, 422(15%).It is followed by popular articles 296 (10.5%); Book chapter 121(4.3%); technical bulletin 76(2.7%); books 70(2.5%); conference proceedings 63 (2.2%) and Dissertations 30(1.1%).

The documents such as poster presentations, 19(0.7%); Leaflets, 15 (0.5%); Booklet, 12(0.4%); newsletter 11(0.4%); extension literature, 5(0.3%) and technical report, 4(0.24%) are below one percent. Other documents, abstracts, handbooks patents, monograph, paper presentation review and brochure are negligible percent.

It is seemed from the analysis (table 5.2) that around 3/5th (59%) of the documents are published in the form journal articles. This is followed by research thesis (15%). One tenth (10.00%) of the documents are in lesser quantity (below 3%).

From the above, it is clear that scientific articles 1666(59%) are the major communication media. The same result is observed in study conducted by Sarala K R during 1998-2008.Also supported in studies by Parabhoi et.al(2017),Sapna verma and Singh(2019) and Suresh and Thanuskodi(2019). It is mostly due to the reason that publication of journal article is matter of prestige. As it helps in dissemination of knowledge at national/international level and makes the writer known to once and all to their peer in the field and also the seekers of knowledge. That is the primarily concern among the agricultural scientist for publishing their research in related journals particularly the journals of high impact.

5.4. Year wise distribution of documents

The year-wise distribution of documents is given in table 5.3.

Table 5.3

Year-wise distribution of documents

Characteristics	Year										Total
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Scientific articles	368	534	370	64	18	46	34	208	27	7	1666
Thesis	2	1	8	9	8	22	22	7	196	147	422
Popular Articles	52	71	100	22	0	10	2	30	2	1	298
Book Chapters	36	35	26	5	0	6	0	5	4	2	121
Technical Bulletins	18	20	12	1	0	15	0	5	0	0	76
Books	20	5	24	9	0	1	0	12	4	0	70
Conference Proceedings	0	0	0	0	0	0	0	52	11	0	63
Dissertation	0	0	0	0	0	0	0	0	0	30	30
Poster Presentations	0	1	1	0	0	0	0	0	17	0	19
Leaflets	1	6	8	0	0	0	0	0	0	0	15
Booklets	2	3	5	0	0	0	0	2	0	0	12
News Letter	0	8	3	0	0	0	0	0	0	0	11
Extension Literature	0	0	1	4	0	0	0	0	0	0	5
Technical Report	0	0	4	0	0	0	0	0	0	0	4
Abstracts	0	0	2	0	0	0	0	0	0	0	2
Handbooks	0	0	2	0	0	0	0	0	0	0	2
Patent	0	0	0	0	0	0	0	2	0	0	2
Monograph	1	0	0	0	0	0	0	0	0	0	1
Paper Presentation	0	0	0	0	0	0	0	1	0	0	1
Review	0	0	0	0	0	0	0	1	0	0	1
Brochure	0	1	0	0	0	0	0	0	0	0	1
Total	500	685	566	114	26	110	60	325	261	187	2822

It is found from the Table 5.3, in 2008 scientific papers got first position with 368 publications followed by popular articles 52, book chapters 38, books and technical bulletins 18 each. Scientific papers highest observed in 2009 with 532 publication followed by popular articles 73, bookchapters 35, technical bulletin 20, newsletters 8, leaflets 6 and others are very less.

In 2010,370 scientific papers observed followed by popular article 103. Book chapters 26, books 21, theses and leaflets 8 each, technical bulletins 12 and booklets 5, newsletters 3, technical report 4, abstract and handbooks are 2 each, extension literature and poster presentation are one each.

In 2011, scientific papers 60, followed by popular articles 22, books and theses 9 each, technical bulletins and book chapters 5 each and extension literature 4 respectively.

In 2012, publications are less compared to other years. Scientific papers 18, and thesis 8 only observed. In 2013, scientific papers 46 followed by technical bulletins 14, newspaper article 10, Book chapters 6, books and popular articles produced one each only.

In 2014, publication productivity is less compared to other year's. However, scientific papers 32, theses 22, and newspaper article and technical bulletins are 2 each. In 2015 ,scientific paper 205 followed by conference proceedings 52,popular article 30,booklets 12,theses 9,bookchapters and technical bulletins are 5 each and review and paper presentation are one each. In 2016, scientific papers 25, poster presentations 17, Theses 196, conference proceedings 11, booklets and book chapters 11 each and popular articles 4 only.

In 2017, scientific papers decreased i.e., 7 only. Thesis increased to 147 followed by dissertation 30, scientific papers 7, book chapters 2, and popular article 1

From the above results, it reveals that majority of the documents are published as scientific papers. Except in 2012 and 2015, Scientific papers shows decreasing trend. Highest number of papers produced in 2009(532) and least 2017(7).Highest number of popular article observed in 2010(105), highest number of thesis observed in the year 2016(196) followed by 147 in 2017.It shows increasing trend. Highest number of books observed in 2010(21) followed by 2008(10) and 2015(12) respectively. Book chapters

shows decreasing trend during the study period. The highest number of conference proceedings are observed in 2015(52) and presentation observed only in 2017(30).Most important observation is agricultural research output are reflected as print documents however at the end of the study period shows presentations which indicates influences of ICT in agriculture field.

5.5. Language wise distribution

Language plays an important role in research communication. It depends on type of user, place of publication, etc. Kerala Agricultural University publishes research outputs in English, Malayalam, Kannada and Hindi. They are tabulated in given in table 5.4.

Table 5.4

Language wise distribution

Year	Language				Total	Percent
	English	Malayalam	Kannada	Hindi	Total	Percent
2008	452	47	0	0	500	17.7
2009	641	44	0	0	685	24.3
2010	510	56	0	0	566	20.1
2011	99	15	0	0	114	4.0
2012	26	0	0	0	26	0.9
2013	70	30	0	0	100	3.5
2014	57	1	0	0	58	2.1
2015	301	22	1	1	325	11.5
2016	259	2	0	0	261	9.2
2017	187	0	0	0	187	6.6
Total	2602 (92.2%)	217 (7.7%)	2 (0.07%)	1 (0.03%	2822	100.0

The analysis (table 5.4) shows that lion' share (92.2%) of the documents published by the KAU staff are in English language. Rest around 8% are in other languages i.e. Indian languages. Among this 7.7% are in

Malayalam Language which is state language of the Kerala. Two papers (007%) are in Kannada and one paper in our national language Hindi (0.03%).

It could be identified from the analysis above, 2602(92.2%) papers published in English followed by 217(7.7%) papers in Malayalam. Only two papers (0.07%) are in Kannada and one paper (0.03%) in Hindi.

It is clear that KAU scientists prefer English language for their research communication. Second most preferred language is Malayalam, i.e., Malayalam is the state language of Kerala.

The graphical representation of language wise distribution is given in figure 5.2
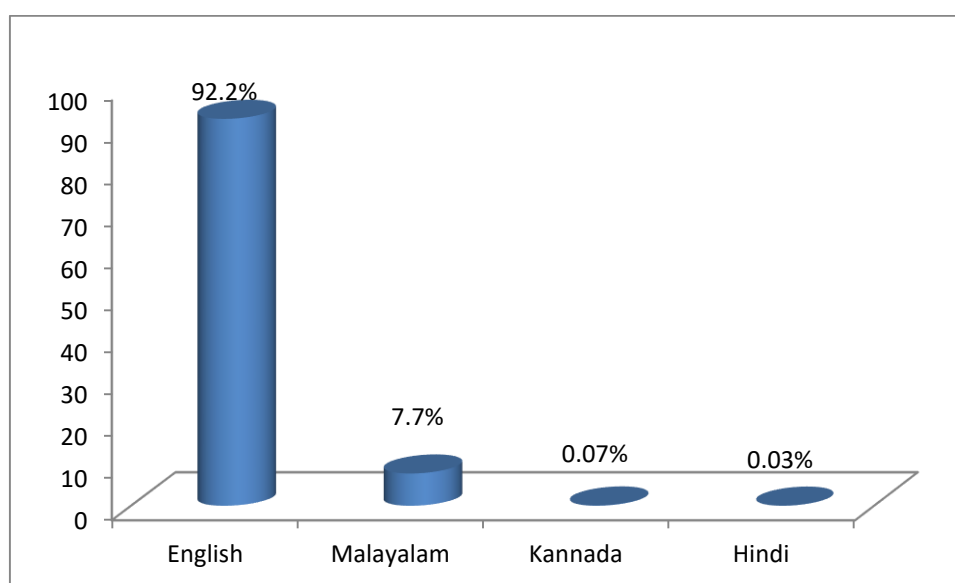
Figure 5.2

Language wise distribution of KAU research output

5.6. Journals preferred for publications

Journals are one of the primary source communications in scientific research. It reflects research outputs in print or online or both without time lag, cost effective and is easily accessible to the user. In the present study total

1666 scientific articles are scattered in 281 journals top 30 journals among them are presented in table 5.5

Table 5.5: Journal Preferred by the KAU Community

Sl. No.	Name of Journal	Number of Articles	Cumulative Number of articles	Percentage	Cumulative percentage	Rank
1	*Journal of Tropical Agriculture*	133	133	8.01	8.01	1
2	*Journal of Crop Improvement*	64	197	3.27	11.85	2
3	*Insect Environment*	50	247	2.74	14.59	3
4	*Spice India*	40	287	2.21	17.59	4
5	*Indian Journal of Marine Science*	38	325	2.11	19.87	5
6	*Trends In Biosciences*	36	361	2.11	22.03	6
7	*Indian Pediatrics*	30	391	1.69	23.83	7
8	*Pest Management in Horticultural Ecosystems*	25	416	1.48	25.31	8
9	*Indian Journal of Experimental Biology*	17	433	1.05	26.36	9
10	*Journal of Farm Science*	17	450	1.05	27.41	9
11	*Vegetable Science*	17	467	1.05	28.46	9
12	*Indian Forester*	17	484	1.05	29.51	9
13	*Indian Horticulture Journal*	16	500	0.95	30.45	10
14	*Agricultural Science Digest:*	16	516	0.95	31.39	10
15	*Bioinfolet*	16	532	0.95	32.33	10
16	*Indian Farmers Digest*	16	548	0.95	33.27	10
17	*Indian Journal of Agriculture Research*	16	564	0.95	34.21	10
18	*Intas Polivet*	16	580	0.95	35.15	10
19	*Journal of Mycology and Plant Pathology*	16	596	0.95	36.09	10
20	*Journal of Plantation Crops*	16	612	0.95	37.03	10
21	*Pesticide*					10

	Research Journal	16	628	0.95	37.97	
22	*Indian Veterinary Journal*	16	644	0.95	38.91	10
23	*Genome*	14	658	0.84	39.75	11
24	*Indian Journal of Arecanut, Spices and Medicinal Plants*	14	672	0.84	40.59	11
25	*Indian Journal of Plant Protection*	14	686	0.84	41.43	11
26	*Environment and Ecology*	14	700	0.84	42.27	11
27	*Oryza*	14	714	0.84	43.11	11
28	*The Cashew and Cocco Journal*	14	728	0.84	43.95	11
29	*Indian Journal of Agronomy*	12	740	0.74	44.69	12
30	*International Aqua Horticulture*	12	752	0.74	45.43	12

Total number of articles= 1666

The journals prepared for publication by the KAU community is given in table 5.5. It is found that *Journal of Tropical Agriculture* is the most preferred journal of imperial agriculture.It is a peer reviewed international journal that publishers scientific articles concerned with all aspects of crop science agro ecosystem and conservation and in particular, the applications of biological engineering, ecological and social knowledge to the management of agriculture crops in the topics including plantation and horticultural crops. The journal has been published since 1961- initially as the agricultural research journal of Kerala and renamed in 1993 to reflect the changing needs end relevance of the contents (http://jtropag.kau.in). The same result is noted by study done by Sarala KR(2016).

Next preferred journal is Journal of Crop Improvement with 64 articles. The *Journal of Crop Improvement* is as platform to evaluate and review the latest advancement in basic and applied aspect of crop improvement and production, including seed science and technology. It is abstracted and indexed in CABI, CSA, Ebcohort, Elsveir and other science

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databases.

The journal *Insect Environment* is preferred next with 2.74% of articles. It is a quarterly journal that publishers' publications related insect study, conservation and watching.

The fourth preferred journal is *Spice India* published by spices board located in Kerala. It is a monthly publication available both in English and Hindi.

Next in order is *The Indian Journal of Marine Science* published Niscair (National Institute of Science Communication and Information Resources) having 2.11% of articles. It is a multidisciplinary journal publishes full paper and short communications in the field's related marine science. It is started in 1992.

The sixth journal is the *Trends in Bioscience* with 2.11% of articles. It is published by Dheerpura society for advancement of science and rural development published in print and online format.

Rest of the journal are having a percentage of below 2% of articles.

5.7. Ranking of periodicals

Journals plays vital role in the dissemination of scholarly output. The scholars select high impact journals to publish the research output. Higher the impact factor quality of journal is high. Hence the scholar must choose high impact factor journals.

Table 5.6

Ranked list of periodicals

Sl. No.	Name of Journal	Number of Articles	Cumulative number of articles	Percent	Cumulative percent	Rank
1	*Journal of Tropical Agriculture*	133	133	8.01	8.01	1
2	*Journal of Crop Improvement*	64	197	3.84	11.85	2
3	*Insect Environment*	50	247	2.74	14.59	3
4	*Spice India*	40	287	3	17.59	4
5	*Indian Journal of Marine Science*	38	325	2.28	19.87	5
6	*Trends In Biosciences*	36	361	2.16	22.03	6
7	*Indian Pediatrics*	30	391	1.8	23.83	7
8	*Pest Management in Horticultural Ecosystems*	25	416	1.48	25.31	8
9	*Indian Journal of Experimental Biology*	17	433	1.05	26.36	9
10	*Journal of Farm Science*	17	450	1.05	27.41	9
11	*Vegetable Science*	17	467	1.05	28.46	9
12	*Indian Forester*	17	484	1.05	29.51	9
13	*Indian Horticulture Journal*	16	500	0.94	30.45	10
14	*Agricultural Science Digest*	16	516	0.94	31.39	10
15	*Bioinfolet*	16	532	0.94	32.33	10
16	*Indian Farmers Digest*	16	548	0.94	33.27	10
17	*Indian Journal of Agriculture Research*	16	564	0.94	34.21	10
18	*Intas Polivet*	16	580	0.94	35.15	10
19	*Journal of Mycology and Plant Pathology*	16	596	0.94	36.09	10
20	*Journal of Plantation Crops*	16	612	0.94	37.03	10
21	*Pesticide Research Journal*	16	628	0.94	37.97	10
22	*Indian Veterinary Journal*	16	644	0.94	38.91	10
23	*Genome*	14	658	0.84	39.75	11
24	*Indian Journal of Arecanut, Spices and Medicinal Plants*	14	672	0.84	40.59	11
25	*Indian Journal of Plant Protection*	14	686	0.84	41.43	11

26	*Environment and Ecology*	14	700	0.84	42.27	11
27	*Oryza*	14	714	0.84	43.11	11
28	*The Cashew and Cocco Journal*	14	728	0.84	43.95	11
29	*Indian Journal of Agronomy*	12	740	0.74	44.69	12
30	*International Aqua Horticulture*	12	752	0.74	45.43	12
31	*Journal of Agro Materiology*	12	764	0.74	46.17	12
32	*Journal of Progressive Agriculture*	12	776	0.74	46.91	12
33	*The Andhra Agriculture Journal*	12	788	0.74	47.65	12
34	*Asian Journal of Dairy and Food Research*	12	800	0.74	48.39	12
35	*Annals of Plant Physiology*	10	810	0.63	49.02	13
36	*Current Biotica: international journal of life science*	10	820	0.63	49.65	13
37	*Environmental Biological Fisheries*	10	830	0.63	50.28	13
38	*Geoderma*	10	840	0.63	50.91	13
39	*Himachal Journal of Agriculture Research*	10	850	0.63	51.54	13
40	*Indian Journal of Plant Protection*	10	860	0.63	52.17	13
41	*Indian Research Journal of Extension Education*	10	870	0.63	52.8	13
42	*Journal of Biological Control*	10	880	0.63	53.43	13
43	*Journal of Krishy Vigyan*	10	890	0.63	54.06	13
44	*Journal of Medical Aromatic Plant Science*	10	900	0.63	54.69	13
45	*Annals of Plant Protection Science*	9	909	**0.53**	55.22	14
46	*Applied Ecology and Environmental Research*	9	918	**0.53**	55.75	14
47	*Asian Journal of Home Science*	9	927	**0.53**	56.28	14
48	*The Intensive Agriculture*	9	936	**0.53**	56.81	14
49	*Indian Journal of*	9	945	0.53	57.34	14

	Animal Sciences					
50	*Indian Journal of Forestry*	9	954	0.53	57.87	14
51	*Plant Archives*	9	963	0.53	58.4	
52	*Indian Journal of Horticulture*	9	972	0.53	58.93	14
53	*Fishing Chimes*	9	979	0.53	59.46	14
54	*Applied Ecology and Environmental Research*	9	988	0.53	59.99	14
55	*Asian Journal of Home Science*	9	999	0.53	60.52	14
56	*The Intensive Agriculture*	9	1008	0.53	60.94	14
57	*24 journals (7 articles each)*	168	1176	10.08	71.25	14
58 59	*24 journals (5 articles each) 8 journals (4 articles each)*	120 32	1296 1328	7.2 1.92	78.45 80.37	14
60	*47 journals (3 articles each)*	141	1469	8.44	88.77	
61	*78 journals (2 articles each)*	156	1625	9.22	97.99	14
62	*41 journals (1 articles each)*	41	1666	2.11	100	14
	total journals 281	1666		100.00		

From the table 5.6 it is analysed that top eight journals contribute about 1/4th of the articles in agriculture. Next thirty journals contribute 1/4th of the article. Next forty journal contribute next 1/4th of the articles. Total 80 journals contribute about 3/4th of the total article.

The analysis in table 6 founded that agricultural science literature had a wide range, the total 1666 articles were scattered among 281 journals devoted to agricultural field. These journals acted as main channel of dissemination of information in agriculture.

Thus it is found that most of documents are published as articles in journals. However a rank list of 44 periodical with a minimum of 10 articles each covering 50% of the significant article.

5.8. Distribution of journals in the decreasing order of number of articles

Table 5.7

Distribution of journals in the decreasing order of number of articles

Rank No.	Number of journals	Number articles per journal	Number of articles	Cumulative number of articles	Cumulative percentage articles
1	1	133	133	133	8.01
2	1	64	64	197	11.85
3	1	50	50	247	14.59
4	1	40	40	287	17.59
5	1	38	38	325	19.87
6	1	36	36	361	22.03
7	1	30	30	391	23.83
8	1	25	25	416	25.31
9	4	17	68	484	29.5
10	10	16	160	644	38.91
11	6	14	84	728	43.95
12	6	12	72	800	48.3
13	10	10	100	900	54.69
14	12	9	108	1008	60.94
15	24	7	168	1176	70.91
16	24	5	120	1301	78.66
17	8	4	32	1333	80.42
18	47	3	141	1474	90.29
19	78	2	156	1620	98.32
20	41	1	41	1666	100

5.9 Indian and foreign journals

Analysis of the national (Indian) and international (foreign) journals distribution of publications are given in Table 5.8.

Table 5.8

Indian and foreign journals

Type of journal	Number journals	Number of Articles	Percent
Indian	215	1405	84.33
Foreign	66	261	14.67
Total	281	1666	100.00
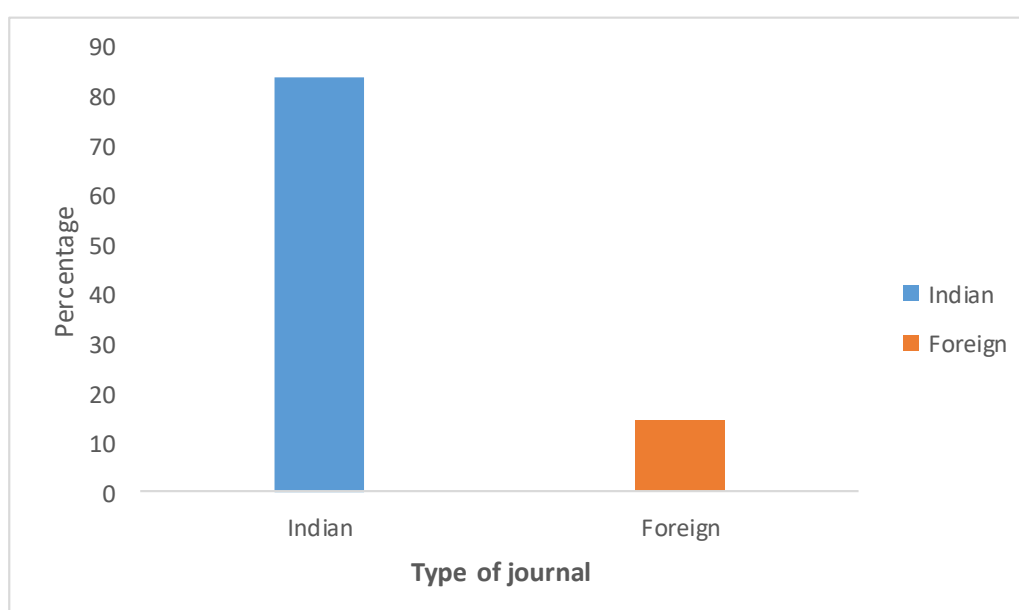
Fig. 5.3

Indian and foreign journals

From the analysis, about more than $3/4^{th}$(84.33%) of the publications are in Indian journals . A few publications (14.67%) are in foreign journals.It is revealed that KAU scientists prefer Indian journals than foerien journals.

5.10 Bradford's law of scattering

One of the important la of scientometrics, which describes scattering of journals in a subject it is known as Bradford's law.

A total of 281 journals containing 1666 articles collected from KAU. The publications are arranged in their descending order of productivity the journals are grouped in to three major zones as 22:58:201.

Table 5.9

Bradford's law of scattering: KAU publications.

Sl. No.	Number of journal	Cumulative number of journals	Log n	Number of articles per journal	Number of articles	Cumulative number of articles	Cumulative percentage of articles
1	1	1	0	133	133	133	8.01
2	1	2	0.301	64	64	197	11.85
3	1	3	0.477	50	50	247	14.59
4	1	4	0.602	40	40	287	17.59
5	1	5	0.699	38	38	325	19.87
6	1	6	0.778	36	36	361	22.03
7	1	7	0.845	30	30	391	23.83
8	1	8	0.903	25	25	416	25.31
9	4	12	1.079	17	68	484	29.5
10	10	22	1.342	16	160	644	38.91
11	6	28	1.447	14	84	728	43.95
12	6	34	1.531	12	72	800	48.3
13	10	44	1.643	10	100	900	54.69
14	12	56	1.748	9	108	1008	60.94
15	24	80	1.903	7	168	1176	70.91
16	23	103	2.012	5	115	1291	78.66
17	8	111	2.045	4	32	1323	80.42
18	47	158	2.198	3	141	1464	90.29
19	79	237	2.374	2	158	1622	98.32
20	44	281	2.448	1	44	1666	100

Table 5.10

Scattering over Bradford zones

Zones	Number .journals	Number of articles	Percent of Journal	Percent of articles
1st zone	22	644	7.82	38.65
2nd zone	58	532	20.64	33.97
3rd zone	201	490	71.54	29.48

The nuclear zone containing 22 journals with 644(38.65%) publications, second zone contains 58 journals with 532(33.97%) publications and 201 with 490(29.48%) publications.

5.11 Country-wise analysis of journals

As mentioned earlier, the 1666 scientific articles are scattered over 20 countries. It is seen that KAU scientist prefer to publish more in journals publishing from India. Country wise analysis of journals observed is given in table 5. 11.

Table 5.11

Country-wise analysis of journals

Sl. No	Country	Number of Journals	Number of articles	Cumulative number of articles	Percentage of Articles	Cumulative percent
1	India	214	1405	1405	84.33	84.33
2	USA	21	118	1523	7.08	91.41
3	UK	10	31	1554	1.86	93.27
4	Netherland	9	27	1581	1.62	94.89
5	Canada	4	14	1595	0.84	95.73
6	Switzerland	2	14	1609	0.84	96.57
7	Philippines	1	14	1623	0.84	97.41
8	Korea	1	7	1630	0.42	97.83
9	Iran	1	6	1636	0.36	98.19
10	London	1	5	1641	0.30	98.49
11	Poland	1	5	1646	0.30	98.79
12	Thailand	1	3	1649	0.18	98.97
13	Europe	1	3	1652	0.18	99.15
14	Italy	1	3	1655	0.18	99.33
15	Cheque Republic	1	2	1657	0.12	99.45
16	Germany	1	2	1659	0.12	99.57
17	Malasia	1	2	1661	0.12	99.69
18	Egypt	1	2	1663	0.12	99.81
19	Pakistan	1	2	1665	0.12	99.94
20	Scandinavian	1	1	1666	0.06	100
		271	1666		100	

From the analysis in (table 5.11), it is found that India with 1405 (84. 33%) articles ranked as top, followed by USA (7.08%) and UK (1.86%). A very few journals from other countries; Netherland (1.62%), Canada (0.84%), Switzerland (0.84%), Philippines (0.84%), korea (0.42%), Iran(36%) and London (0.3%). Other remaining countries have only very few journals published.

It is revealed that eighty percent of the total publications are from India.

5.12 Standards of journal

An academic or scholarly journal is a periodical publication in which scholarship relating to a particular academic discipline is published. Academic journals serve as permanent and transparent forums for the presentation, scrutiny, and discussion of research. They are usually peer-reviewed or refereed.[1] Content typically takes the form of articles presenting original research, review articles, and book reviews. The purpose of an academic journal, according to Henry Oldenburg (the first editor of *Philosophical Transactions of the Royal Society*), is to give researchers a venue to "impart their knowledge to one another, and contribute what they can to the Grand design of improving natural knowledge, and perfecting all Philosophical Arts, and Sciences."[2 (https://en.wikipedia. org/wiki/Academic_journal).For agriculture, National Academy of Agriculture Science (NAAS) rate the journals by NAAS rating. Other standards are JCR (Journal Citation Ranking) and SJR (SCimago journal ranking).The highest NAAS rating journals are listed in Table 5.12.

Table 5.12

Standards of journal

Sl.No.	Name of journal	NAAS SCORE	Origin of journal
1	*Geoderma*	10.34	NETHERLAND
2	*Genome*	8.15	CANADA
3	*Environmental Biology of Fishes*	7.23	INDIA
4	*Indian Paediatrics*	7.16	INDIA
5	*Indian Journal of Experimental Biology*	6.93	INDIA
6	*Journal of Agro Meteorology*	6.64	INDIA
7	*Pesticide Research Journal*	5.9	INDIA
8	*Journal of Mycology and Plant Pathology*	5.79	INDIA
9	*Journal of Plantation Crops*	5.54	INDIA
10	*Indian Journal of Agronomy*	5.46	INDIA
11	*Journal of Biological Control*	5.34	INDIA
12	*Indian Journal of Plant Protection*	5.07	INDIA
13	*Vegetable Science*	4.98	INDIA
14	*Indian Journal of Agriculture Research*	4.86	INDIA
15	*Indian Research Journal of Extension Education*	4.81	INDIA
16	*Intas Polivet*	4.79	INDIA
17	*Journal of Tropical Agriculture*	4.75	INDIA
18	*Journal of Medical Aromatic Plant Science*	4.49	USA
19	*Pest Management in Horticultural Ecosystems*	4.49	INDIA
20	*Oryza*	4.44	PHILIPPINES
21	*Journal of Farm Science*	4.42	INDIA
22	*Journal of Krishy Vigyan*	4.41	INDIA
23	*Agricultural Science Digest: A Research Journal of Agriculture ,Animal and Veterinary Science*	4.21	INDIA

24	Asian Journal of Dairy and Food Research	4.2	INDIA
25	Environment and Ecology	4.18	INDIA
26	The Andhra Agriculture Journal	4.14	INDIA
27	Trends In Biosciences	3.94	INDIA
28	Himachal Journal of Agriculture Research	3.91	INDIA
29	Current Biotica: international journal of life science	3.89	INDIA
30	Bioinfolet	3.75	INDIA
31	Annals of Plant Physiology	2.9	UK
32	Journal of Progressive Agriculture	2.89	INDIA
33	Indian Horticulture Journal	2.86	INDIA
34	Indian Journal of Arecanut, Spices and Medicinal Plants	1.55	INDIA
35	Indian Farmers Digest	-	INDIA
36	Indian Forester	-	INDIA
37	Indian Journal of Marine Science	-	INDIA
38	Indian Veterinary Journal	-	INDIA
39	Insect Environment	-	INDIA
40	International Aqua Horticulture	-	INDIA
41	Journal of Crop Improvement	-	INDIA
42	Spice India	-	INDIA
43	The Cashew and Cocco Journal	-	INDIA
44	Indian journal of plant protection	-	INDIA

5.13 Authorship pattern

Analysing authorship pattern of research output is the one of the aspect of a scientometric analysis. Collaborative research has been a characteristic feature of the modern science and there has been a consistent trend towards increased collaboration in all the branches of science. It has also been found

that the rate of increase in the collaborative authorship varies considerably with the subject concerned. In order to identify author productivity and authorship pattern, the researcher has attempted to analyse the following aspect of authorship pattern in the present study.

➤ Extent of authorship pattern.

➤ Co-authorship index

➤ Collaborative co-efficient

➤ Collaborative index

➤ Degree of collaboration

➤ Ranking of authors

➤ Author productivity based on Lotka's law.

The categories of authors used for analysis are one, two, three, four, five, six, seven, more than seven and anonymous. The results are presented in the table 5.13.

Table 5.13

Authorship pattern of KAU research output

No of Authors	Frequency	Percent
Anonymous	52	1.8
One	531	18.8
Two	**1070**	**37.9**
Three	551	19.5
Four	353	12.5
Five	145	5.1
Six	73	2.6
Seven	33	1.2
>7	14	0.5
Total	2822	100.0

Table 13 reveals that total 2822 publications analysed. 1070 (37.9%) publications are by two author and 551(19.5%) publications by three authors. 531(18.8%) publications by single author. Four author contribution is 353(12.5%), five author contribution is 145(5.1%), Six author contribution is 73(2.3%), 33(1.2%) by seven authors, and 14(0.6%) by more than seven authors. Anonymous documents are found to be 52(1.8%).

It is clear from the above analysis, about 80% of the documents are published by multiple authored and only 20% contribute single authorship. Hence the collaborative authorship is predominant especially two authorship with 1070(37.9%) publications respectively.

5.14 Authorship pattern vs. year

The authorship pattern of last 10 year (2008-17) is presented in table 5.14.

Table 5.14

Authorship pattern Vs Year

Year	*Zero	One	Two	Three	Four	Five	Six	Seven	More than eight	Total
2008	12	115	148	104	85	27	6	1	2	500
2009	9	144	173	182	105	38	22	11	1	685
2010	21	154	129	117	82	32	21	7	3	566
2011	1	39	40	24	4	4	1	0	1	114
2012	0	4	14	3	3	1	1	0	0	26
2013	1	16	46	12	14	5	1	3	2	100
2014	0	4	31	9	4	1	2	4	3	58
2015	8	52	99	83	48	23	9	3	0	325
2016	0	3	209	17	8	11	8	3	2	261
2017	0	0	181	0	0	3	2	1	0	187
Total	52	531	1070	551	353	145	73	33	14	2822

*Zero indicates Anonymous authors

From the table 14, clearly indicates measuring trend of single authorship in, 2008, 2009 and 2010 with 115,144 and 154 publications respectively.

In 2010 highest number of publications produced after it shows fluctuating trend. Generally it is decreasing.

It reveals maximum number of publications by two authors, highest is observed in the year 2016 with 209 publications by 418 authors. Least number of publications (14) in the year 2012 by 28 authors. The maximum number of three authored publications observed in 2009 with 182 publications by 546 authors, 105 publications by 420 authors in the category of four authored in 2009.

Regarding the five authored, a maximum output was recorded in the year 2009 with 36 publications by 190 authors, category of six, seven, more than seven and anonymous shows very less number of publications.

In this analysis two authored publications are the top with 1070 publications by 2140 authors. Also found publications decreasing with increasing authors collaborations from three authors onwards.
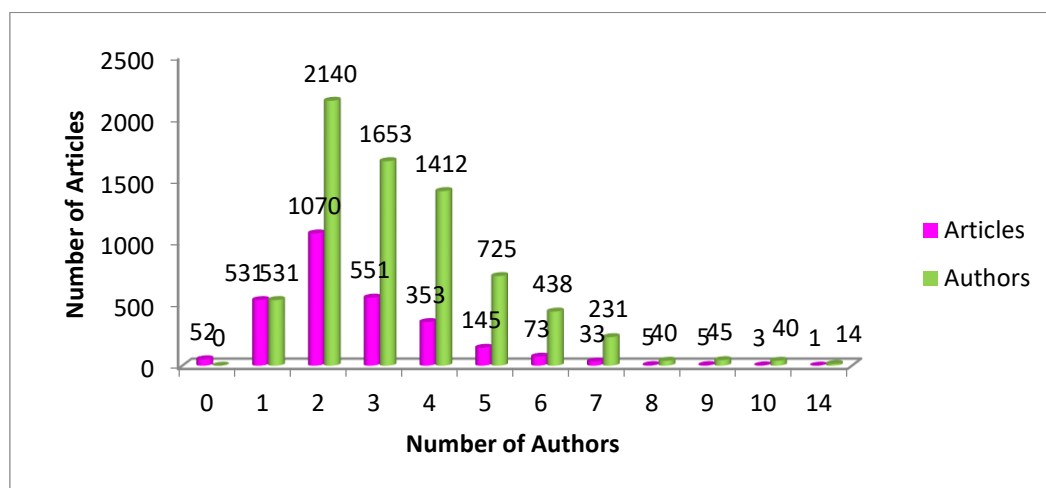
Figure 5.4

2008-2017 Produced Publications by Contributing Number of Authors

5.15 Single Vs multi- authored papers

In the authorship pattern analysis, it is found that two authored papers are highest. When all the multi-authored papers and single authored papers are put together the total number of papers are 2770.Multi authored papers are 2239.and single authored papers are 531. The proportion of single Vs multi-authored papers is 1:4.21.

Table 5.15

Single Vs multi authored papers

Authorship	No.of documents	Percentage
Single	531	19.17
Multi-authored	2239	80.83
Total	2770	100.00

The graphical distribution is shown in the figure 5.4.
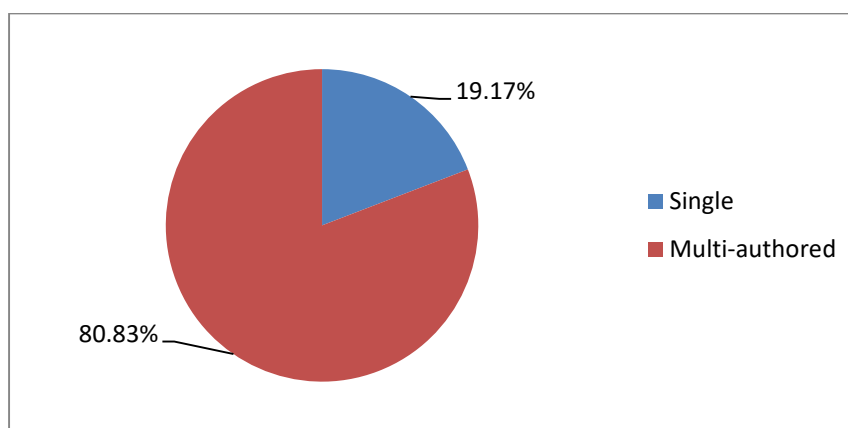
Figure 5.5

Single Vs multi authored papers

5.16 Distribution of authorship pattern and publication counts

Table 5.16 depicts a linear order of the categories of number of authors; grouping in a contribution. The authorship pattern of KAU research publication ranked from single author to more than seven authors. The category of double author paper ranked first forming 29.44% of the total output while the category of three authored publications ranked second by 19.53% publication count by the category of four authors. Category of single author ranked third, had a share of (18.81%) percent which was more in number than some of the other grouping categories.

Table 5.16

Distribution of authorship pattern and publication counts

Number of Authors	Number of Records	Number of Authors
0	52 (1.84)	0 (0)
1	531 (18.81)	531(7.30)
2	1070 (37.92)	2140 (29.44)
3	551 (19.53)	1653 (22.74)
4	353 (12.51)	1412(19.42)
5	145 (5.14)	725 (9.97).
6	73 (2.59)	438 (6.03)
7	35 (1.17)	231 (3.18)
>7	14(0.49)	139(1.91)
Total	2822 (100)	7269 (100)

From Table 5.16 it is clear that the performance of contributing authors. Continuation of previous analysis; among the 7269 authors, 531 (18.81%) authors were contributed only once from KAU. Followed by 2140 (29.44%) of authors were participating only two times; 1653 (22.74%)

authors were participating three times; 1412 (19.42%) authors were participating four times; 725 (9.97%) of author were participating five times; 438(6.03%) of authors were participating six times; 231(3.18%) of authors were participating seven times and 139(1.91%) of authors were participating more than seven times of KAU research output.

5.17 Degree of Collaboration – Year Wise Distribution

To identify the Degree of Collaboration agriculture scientists, researcher adopted C Subramanyam's formula. The formula is

C = Nm / Nm + Ns,

Where C = extent of collaboration

Ns = number of single authored papers

Nm = number of multi authored papers

Thus the percentage of collaboration is,

C= Nm/ (Nm + Ns) * 100.

Table 5.17

Degree of Collaboration – Year Wise Distribution

Sl.No	Year	Single Authored	Collaborative Authorship	Total	Degree of Collaboration
1	2008	115	373	488	76.43
2	2009	114	532	676	78.69
3	2010	154	391	545	71.74
4	2011	39	74	113	65.49
5	2012	4	22	26	84.62
6	2013	16	83	99	83.84
7	2014	4	54	58	93.10
8	2015	52	265	317	83.59
9	2016	3	258	261	98.85
10	2017	0	187	187	100
Total		**531**	**2239**	**2770**	**83.64 (Average)**

Degree of collaboration had the value of 93.10 percent in the year 2014 and this increased to 100 in the year 2017. The average degree of collaboration is 83.64.Collaboration probably improve the impact of dissemination with reducing the cost.

5.18 Single Authored Publications - Trend Analysis

Table 5.18

Single Authored Publications - Trend Analysis

Sl.No	Year (X)	Count (Y)	X	X^2	XY
1	2008	115	-3	9	-345
2	2009	114	-2	4	-228
3	2010	154	-1	1	-154
4	2011	39	0	0	0
5	2012	4	1	1	4
6	2013	16	2	2	32
7	2014	4	3	3	12
8	2015	52	4	16	208
9	2016	3	5	25	15
10	2017	0	6	36	0
Total		$\sum Yi = $**531**	$\sum Xi = $**15**	$\sum X_i^2 = $**97**	$\sum Y_i X_i = $**-456**

Straight Line equation $Y = a + bX$

The Normal Equations are

$\sum Yi = na + b \sum X_i;$

$\sum Y_i X_i = a \sum X_i + b \sum X_i^2$

By solving the above Two Equations, We get,

  a= 78.32, b= -16.81.

Estimated literature in 2020 is when X = 2020 – 2010= 10;

$= 78.32 -16.81*10 = 78.32- 168.1 = $**-89.78.**

The results of the calculations, it is found that the future trend of research output by single author may show up decreasing trend in the year 2020.

5.19 Collaborative Authored Publications – Trend Analysis

Table 5.19

Collaborative Authored Publications - Trend Analysis

Sl.No	Year (X)	Count (Y)	X	X^2	XY
1	2008	373	-3	9	-1119
2	2009	532	-2	4	-1064
3	2010	391	-1	1	-391
4	2011	74	0	0	0
5	2012	22	1	1	22
6	2013	83	2	2	166
7	2014	54	3	3	162
8	2015	365	4	16	1460
9	2016	258	5	25	1290
10	2017	187	6	36	1122
Total		$\sum Yi = 2239$	$\sum Xi = 15$	$\sum X_i^2 = 97$	$\sum Y_i X_i = 1648$

Straight Line equation Y = a + bX

The Normal Equations are

$\sum Yi = na + b \sum X_i;$

$\sum Y_i X_i = a \sum X_i + b \sum X_i^2$

By solving the above two Equations, We get,

a= 258.34, b= -22.96.

Estimated literature in 2019 is when X = 2020– 2010= 10;

$$= 258.34 \text{ -}22.96*10= 258.34\text{- } 229.6 = 28.74.$$

The results of the calculations, it is found that the future trend of research output by multi author may show up an increasing trend in the year 2020.

Estimated literature in **2021** is when X = 2021 – 2010= 11;

$$= 258.34 \text{ -}22.96*11= 258.34\text{- } 252.56= \text{-}5.78.$$

The results of the calculations, it is found that the future trend of research

5.20   **Relative Growth Rate and Doubling Time of Overall Output**

Relative Growth Rate is a tool to measure the information growth. When, the growth rate of a function is always proportional to the functions current size. Such growth is said to follow an exponential law. The Mean Relative Growth Rate (RGR) over the specific period of interval can be calculated from the following equation.

$$1\text{-}2R= (\log w2\text{-}\log w1)$$

$$t_2\text{-}t_1$$

1-2R-Mean relative growth over the specific period of interval

Logw1-log of initial number of articles

Logw2-log of final number of articles.

t2-t1- the unit difference between the initial time and final time.

Doubling time (DT) is the amount of time it takes for a given quantity to double in size or value at a constant growth rate. There exist a direct equivalence between the relative growth rate and the doubling time. If the number of articles of a subject is doubles during the given period. Then the difference between the logarithms of numbers at the beginning and end of this period must be the logarithm of number 2.If natural logarithm is used this difference has a value of a 0.693.Thus the corresponding doubling time for each specific period of interval is calculated the following formula.

DT=0.693

R

The relative growth rate and doubling time on research output of Kerala Agricultural University has been calculated based on the above formula and the same is shown in table 5.20.

Table 5.20

Relative Growth Rate and Doubling Time of Overall Output

Year	No. of Output	Cum. No. of Output	W1	W2	R = W1-W2	Mean of R	DT = 0.693/R	Mean of DT
2008	500	500	0	6.21	0		0	
2009	685	1185	6.21	7.07	0.86		0.80	
2010	566	1751	7.07	7.46	0.39		1.77	
2011	114	1865	7.46	7.53	0.06		10.98	
2012	26	1891	7.53	7.54	0.01		50.05	
2013	100	1991	7.54	7.59	0.05	**0.17**	13.44	**12.26 Years**
2014	58	2049	7.59	7.62	0.02		24.13	
2015	325	2374	7.62	7.77	0.14		4.70	
2016	261	2635	7.77	7.87	0.10		6.64	
2017	187	2822	7.87	7.94	0.06		10.10	
Total	**2822**				**1.73**		**122.66**	

RGR shows decreasing trend up to 2012.After it increased from 0.01 to 0.14 up to 2015, again it reduced to 0.06.the mean relative growth rate is 0.17.

The doubling time ranges from 0.80 to 50.05.Doubling time is very low in 2009(0.80) and it is too high in 2012(50.05).

This also shows fluctuating trend in the years to double the research output of KAU. The mean DT is 12.26 years, which indicates KAU research output doubles once in every 12 years.

5.21 Ranking of authors

According to AACRII cataloguing rules, the first author is primarily responsible for any work. Therefore only the principal author is consider for analysing the author. Among 7269 authors, top twenty most productive authors of KAU are identified. They are listed in table 5.21.

Table 5.21

Most prolific authors

Sl.No.	Name of author	Name of institution	Records	Percent (7269)	Rank
1	Suseela P	C A Vellayani	74	2.76	1
2	Jose Mathew	C A Vellayani	63	2.35	2
3	Jose Joseph	C A Vellayani	47	1.75	3
4	Abraham C T	Agronomic research station Chalakkudy	46	1.71	4
5	Chungath J J	Veterinary and animal science	45	1.68	5
6	Harshan K R	Veterinary and animal science	45	1.68	5
7	Sheela M S	C A Vellayani	41	1.53	6
8	Mini C	C A Vellayani	37	1.38	7
9	Joy P P	College of forestry	35	1.30	8
10	Jacob J	College of Forestry	31	1.16	9
11	Lucy K M	Veterinary and animal science	29	1.08	10
12	Sudheer K P	C A Vellayani	27	1.01	11
13	Ambily Paul	C A Vellayani	27	1.01	11
14	Karthikeyan K	Climate change education research	27	1.01	11
15	Rajeevan P K	FSRS Sadanandapuram	26	0.97	12
16	Reji Rani O P	Veterinary and animal science	26	0.97	12
17	Prasannakumari Amma	C A Vellayani	25	0.93	13
18	Nandakumar C	C A Vellayani	24	0.89	14
19	Soshamma Jacob	C H Vellanikkara	23	0.86	15
20	Devanesan	C A Padannakkad	22	0.82	16

From the above table 2.20, Suseela P(74 records) got top rank from CA Vellayani followed by Jose Mathew(63 articles) from C A Vellayani; Jose joseph(47) from C A Vellayani; Abraham C T(46) from Agronomic Research Station, Chalakkudy are 2nd,3rd and 4th rank respectively. Chungath J J (45) and Harshan K R (45) from College of Veterinary and Animal Science hence same no. of publication got fifth rank; Sheela M S (41) from CA Vellayani 6th and Mini C (37) from C A Vellayani got 7th rank in the publication of articles.

Joy P P (35) and Jacob J (31) from college of forestry got 8th and 9th rank respectively. Lucy K M(29) from College of Veterinary and Animal Science; Sudheer K P(27) and Ambily paul (27) from C A vellayani; Karthikeyan K(27) from Climate Change Education and Research ranked as 11th;Rajeevan P K (26)from FSRS Sadanandapuram and Reji rani O P(26) from Veterinary and Animal Science ranked as 12th.

Prasannakumari amma (25) and Nandakumar C(24) from C A Vellayani; Sosamma Jacob(23) from C H Vellanikkara and Devanesan(22) from C A Padannakkad got 13th ,14th ,15th ,and 16th rank respectively.

From it are clearly shows that Suseela P is found to be the highly productive author of KAU during study period. Majority of the authors listed from C A Vellayani.

5.22 Pattern of Co-Authorship Index

The Co-authorship Index (CAI) obtained by calculating proportionately the publication by single, two and multi-authored papers (Gargi & Padhi, 1999). Authorship values are categorized single, two, three and more than three authors.

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CAI > 100 indicates that the number of publications is higher than the average.

The Co-Authorship Index (CAI) is to analyse the pattern of co-authorship index and explained below

$$\text{CAI} = \frac{\frac{N_{ij}}{N_{io}}}{\frac{N_{0j}}{N_{00}}} * 100$$

Nij : Number of papers having j authors in block i

Nio : Total Output of Block i

Noj : Number of papers having j authors for all blocks;

Noo : Total number of papers for all authors and all blocks

J=1, 2, 3, > 4

CAI < 100 indicates that the number of publications is lower than the average.

CAI = 100 indicates that the number of publications corresponds to the average within a co-authorship pattern.

CAI >100 indicates that the number of publications is higher than the average

Table 5.22

Pattern of Co-Authorship Index

Year	Single authors		Multiple authors		Total
	No. of Research Output	CAI	No of Research Output	CAI	
2008	115	124.55	1149	98.07	1264 (17.39)
2009	114	105.69	1721	99.56	1865 (25.66)
2010	154	145.29	1297	96.43	1454 (19.96)
2011	39	212.70	212	91.11	251(3.45)
2012	4	85.56	60	101.13	64(0.88)
2013	16	81.12	254	101.49	270(3.71)
2014	4	30.09	178	105.51	182(2.51)
2015	52	80.79	829	101.51	881(12.12)
2016	3	6.37	642	107.38	645(8.87)
2017	0	0	396	107.88	396(5.45)
Total	531		6738		7269

From the above table, the Co-Authorship Index for single authors is declined from 212.70 in the year 2011 to 6.37 in the year 2016. On the other hand, the Co-Authorship Index for multiple authors is enhanced from 98.07 in the year 2008 to 107.88 in the year 2017, which indicates the pattern of co-authorship is increasing among the contributions of the journal.

5.23 Collaboration index

This is one of the early measures of degree of collaboration derived by Lawani (1980).

Collaboration index (CI) is

$$\frac{\Sigma I_j f_i}{N}$$

Table 5.23

Collaboration index

Year	No of Authors	No of Articles	CI
2008	1264	500	2.53
2009	1865	685	2.72
2010	1451	566	2.56
2011	251	114	2.20
2012	64	26	2.46
2013	270	100	2.70
2014	182	58	3.14
2015	881	325	2.71
2016	645	261	2.47
2017	396	187	2.11
Total	**7269**	**2822**	**2.56 (Average)**

Analysis in the table 5.23 shows the variation in the CI. It varies from 2.11 in 2017 and highest collaboration notices in 2014 i.e. 3.14. The average collaboration is 2.56.This may be due to the geographical or environmental factors of the organization.

5.24 Collaborative Coefficient (CC)

According to Ajiferuke et. al. (1988) who has shown the mean number of authors per paper, the proportion of a multiple authorship is a measure of degree of collaboration in a discipline, is inadequate. Therefore, they have proposed a measure combining some of the merits of both measures into what is known as Collaborative Coefficient.

Table 5.24

Collaborative Coefficient

Year	Number of Authors	Number of Articles	CC
2008	1264	500	0.49
2009	1865	685	0.51
2010	1451	566	0.48
2011	251	114	0.39
2012	64	26	0.49
2013	270	100	0.52
2014	182	58	0.57
2015	881	325	0.55
2016	645	261	0.54
2017	396	187	0.51
Total	**7269**	**2822**	**0.507 (Average)**

The opinion of Ajiferuke is that the CC incorporates the sum of the merits of both CI and DC. It lies between **0 and 1 (0<=cc>1)**. It tends to zero as single authored papers dominate and differentiates among levels of multiple authorship. It is found from the above table the average CC is 0.507.The highest value of CC 2014(0.57).lowest is in 2011(0.39).

The table of DC,CC and CI are merged and given in the table 5.25.

Table 5.25

DC, CC and CI

Year	Number of Authors	Number of Articles	DC	CC	CI
2008	1264	500	76.43	0.49	2.53
2009	1865	685	78.69	0.51	2.72
2010	1451	566	71.74	0.48	2.56
2011	251	114	65.49	0.39	2.20
2012	64	26	84.62	0.49	2.46
2013	270	100	83.84	0.52	2.70
2014	182	58	93.10	0.57	3.14
2015	881	325	83.59	0.55	2.71
2016	645	261	98.85	0.54	2.47
2017	396	187	100	0.51	2.11
Total	**7269**	**2822**	**83.64 (Average)**	**0.507 (Average)**	**2.56 (Average)**

In the study, 2822 publications are contributed by 7269 authors. From the above tables we found that multiple authorship is predominant. The average degree of collaboration (DC) is 83.64, Collaboration coefficient (CC) is 0.507and collaboration index (CI) is 2.56.There is no single author publications in 2017.hence the. Highest value of CC (0.57) and CI (3.14) are observed in the year 2014.

5.25 Lotka's Inverse Square Law of Scientific Author Productivity

Lotka's Law describes the frequency of publication by authors in a given field and states that the number of authors making n contributions is about $1/n^2$ of those making one; and the proportion of all contributors who make a single contribution is about 60 percent.

Table 5.26

Lotka's Inverse Square Law of Scientific Author Productivity

No of Contributors	X	Y	ΣX=logX	ΣY=logY	ΣX*Y	ΣX*X
1	531	531	2.725095	2.725095	7.42614	7.42614
2	1070	2140	3.029384	3.330414	10.0891	9.177166
3	551	1653	2.741152	3.218273	8.821774	7.513912
4	353	1412	2.547775	3.149835	8.025069	6.491156
5	145	725	2.161368	2.860338	6.182243	4.671512
6	73	438	1.863323	2.641474	4.921919	3.471972
7	33	231	1.518514	2.363612	3.589178	2.305885
8	5	40	0.69897	1.60206	1.119792	0.488559
9	5	45	0.69897	1.653213	1.155546	0.488559
10	3	40	0.477121	1.60206	0.764377	0.227645
14	1	14	0	1.146128	0	0
Total	**2770**	**7269**	**18.46167**	**26.2925**	**52.09514**	**42.26251**

Fig 5.6

Lotka's law of author productivity
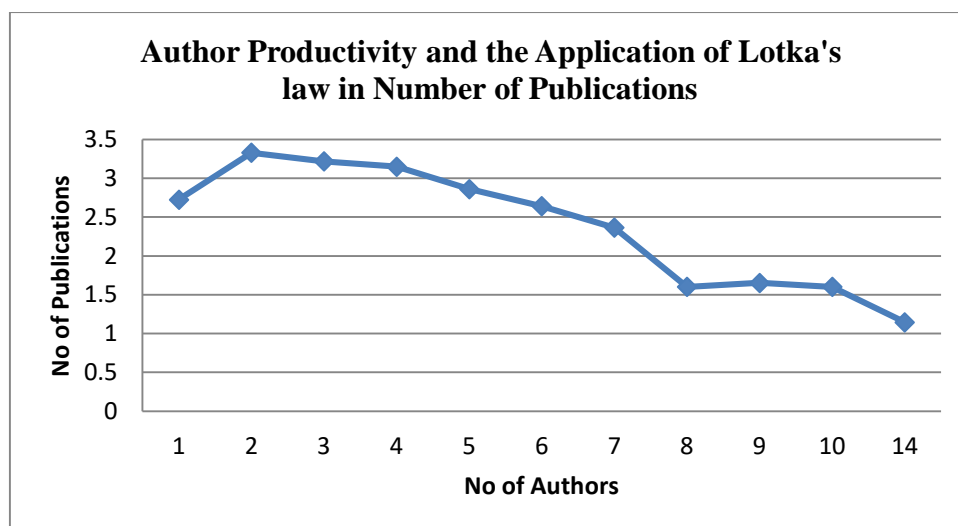
Pao (1989) proposed the way to calculate n-value and c- value of

Lotka's law is,

$$\mathbf{n} = \frac{n'\Sigma XY - \Sigma X\Sigma Y}{n'\Sigma X^2 - (\Sigma X)^2}$$

$$n = \frac{14*52.09 - 18.46*26.29}{14*42.26 - (18.46)^2}$$

$$= \mathbf{0.972}$$

5.26 Application of Price's Square Root Law for Research Productivity

In order to validate whether the distribution status of authors fulfil.

Price's Square root law, the following calculation is,

$$\boxed{\begin{array}{c} \mathbf{PSQ = \sqrt{N}} \\ \mathbf{= 85.26} \end{array}}$$

Price's Square Root law, which states that half (50%) of the literature on a subject will be contributed by the square root of total number of authors publishing in that area.

Table 5.27

Application of Price's Square Root Law for Research Productivity

No of Contributors	No of Contributions	Percentage of 69	A*B	%A*B	Cumulated Value of A*B
1	531	1.449275	531	7.304994	7.304994
2	1070	2.898551	2140	29.44009	36.74508
3	551	4.347826	1653	22.7404	59.48549
4	353	5.797101	1412	19.42496	78.91044
5	145	7.246377	725	9.973862	88.8843
6	73	8.695652	438	6.025588	94.90989
7	33	10.14493	231	3.177879	98.08777
8	5	11.5942	40	0.550282	98.63805
9	5	13.04348	45	0.619067	99.25712
10	3	14.49275	30	0.412712	99.66983
14	1	20.28986	14	0.192599	**100**
69	**2770**	**100**	**7269**	**100**	

Based on Price's Square Root Law, the only one contributor, produced 531 numbers of articles by single contributor are given publications, the square root value located at just 7.3 percent of publications. Most of the authors are contributed very less number of times research. The contribution percentage of 531 (Nearly closed are root value of 7269) contributors is located at 7.3 percent of publications. The value is very far away from 50 % (half of the literature on a subject), so this result is not in compliance with Price's Square Root Law. The above table has shown the related result values to be highlighted.

5.27 Pareto Principle (80 X 20 Rule)

Pareto Principle (80/20 Rule) states that, for many events, roughly 80%of the effects come from 20 percent of the causes. The original observation was in connection with income and wealth.

Table 5.28

Pareto Principle

No of Contributors	No of Contributions	Percentage of 69	A*B	%A*B	Cumulated Value of A*B
1	531	1.449275	531	7.304994	7.304994
2	1070	2.898551	2140	29.44009	36.74508
3	551	4.347826	1653	22.7404	59.48549
4	353	5.797101	1412	19.42496	78.91044
5	145	7.246377	725	9.973862	88.8843
6	73	8.695652	438	6.025588	94.90989
7	33	10.14493	231	3.177879	98.08777
8	5	11.5942	40	0.550282	98.63805
9	5	13.04348	45	0.619067	99.25712
10	3	14.49275	30	0.412712	99.66983
14	1	20.28986	14	0.192599	100
69	**2770**	**100**	**7269**	**100**	

The researcher has used for this analysis in same values from the above table to validate Pareto Principle and test whether 80 percent of contributions have come from 20 percent of contributors. Since total authors number is

7269, that mean the 20 percent of total authors number is 120. Total number of publications is 2770 and its 80 percent of publications value is 2650. Based on analysis, the value of "Accumulated % of A*B" is 88.88 percent of authors contributed more than twenty percent of contributions, once the "Accumulated Contributors" is 120 (but 20 percent of authors 798). In 80 X 20 rule view, the value should be very close to 80 percent. It can conclude this that the result is fully compliance with Pareto Principles.

5.28 Subject wise analysis

Kerala Agricultural University used DDC for subject classification. According to DDC 14 subjects of Kerala Agricultural University are identified. They are listed in table 5.29.

Table 5.29

Subject wise analysis

Sl. No	Subject	Frequency	Cumulative frequency	Percent	Cumulative percent
1	Biotechnology and applied microbiology	639	639	22.64	22.64
2	Food science and technology	402	1041	14.25	36.89
3	plant breeding and genetics	385	1426	13.64	50.53
4	Genetic heredity	312	1738	11.06	61.59
5	Horticulture	214	1952	7.58	69.17
6	Agriculture engineering	177	2129	6.27	75.44
7	Veterinary science	161	2290	5.71	81.15
8	Entomology	146	2436	5.17	86.32
9	Environmental science	130	2566	4.61	90.93
10	Forestry	87	2653	3.08	94.01
11	Materiology, atmospheric science	74	2727	2.62	96.63
12	agriculture chemistry	41	2768	1.45	98.08
13	pest and weed control	34	2802	1.20	99.28
14	Mathematics (statistics)	20	2822	0.72	100.00
	Total	2822		100.00	

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From the analysis, majority of publications produced from biotechnology and applied microbiology 639(22.64%).Next food science and technology 402(14.25%) and plant breeding and genetics 385(13.64%)These three subject constitute 50% of the total publications of KAU. Genetic heredity 312(11.06%), Horticulture 214 (7.58%) and agriculture engineering 177 (6.27%). Other 25% of the total publication from remaining 8 subjects, such as, veterinary science 161(5.71%) entomology 146(5.17%), environmental science 130 (4.61%); forestry 87(3.08%); meteorology 74(2.62%); agricultural chemistry 41(1.45%) pest and weed control 34(1.20%) and mathematics 20(0.72%).

5.29 Institution wise analysis

Kerala Agricultural University (KAU) is the primary and the principal instrumentality of the Kerala state in providing human resources, and skills and technology, required for the sustainable development of its agriculture, defined broadly encompassing all production activities based on land and water, including crop production (agriculture) and forestry through conducting, interfacing and integrating education, research and extension in these spheres of economic endeavour. It is situated in Vellanikkara, Thrissur, and Kerala. KAU consist of 7 faculties, 16 research stations, 6 RARS, KVKs and extension centres.

The publications produced from these in-house institutions of KAU are given in table 5.30.

Table 5.30

Institution wise analysis

Sl.No.	Faculties& research stations	No.of records	Percent
Institutions/colleges			
1.	College of agriculture,Vellayani	760	26.93
2.	College of agriculture,Padannakkad	134	4.75
3.	*College of Co-operation, Banking and management,Vellanikkara*	14	0.49
4.	*Academy of Climate Change education and research,Vellanikkara*	17	0.60
5	Kelappaji college of Agriculture engineering and technology,Tavanur	14	0.49
6.	College of forestry, vellanikkara	157	5.56
7.	College of Horticulture, Vellanikkara	708	25.08
Regional Agricultural Research Stations(RARS)			
1	RARS Ambalavayal	27	0.96
2	RARS Pattambi	137	4.85
3	RARS Pilicode	12	0.43
4	RARS Kayamkulam	17	0.60
5	RARS Kumarakam	10	0.3
6	RARS Vellayani	33	1.17
Research Stations			
1.	*Agriculture research station,Anakkayam*	40	1.42
2.	*Agriculture research station Mannuthy*	3	0.11
3.	*Agriculture research Chalakkudy*	33	1.17
4.	Banana research station Kannara	57	2.02
5.	Cardomom research station pampadumpara	3	.11
6.	Cashew research station Madakkathara	8	0.28
7.	Pepper Research Station,Panniyur	14	0.49
8.	Plant Propagation & Nursery Management Unit, Vellanikkara	10	0.35
9.	Agricultural Research station, Thiruvalla	10	0.35

10.	Aromatic& Medicinal Plants Research Station Odakkali	52	18.44
11.	Coconut Research Station, Balaramapuram	39	1.38
12.	Farming Systems Research Station, Sadanandapuram	37	1.31
13	Integrated Farming Systems Research Station, Karamana	61	2.16
14	Pineapple Research Station, Vazhakkulam	17	0.60
15	Rice Research Station,Monkompu	8	0.28
16.	Rice Research Station,Vyttila	6	0.21
Extension centers&Krishi Vigyan Kendras (kvks)			
1.	Krishi Vigyan Kendra Kollam	36	1.27
2.	Krishi Vigyan Kendra Kottayam	8	0.28
3.	Krishi Vigyan Kendra Thrissur	140	4.96
4.	Krishi Vigyan Kendra Palakkad	10	0.35
5.	Krishi Vigyan Kendra Malappuram	3	0.11
6.	Krishi Vigyan Kendra Wayanad	3	0.11
7.	Krishi Vigyan Kendra Kannur	17	0.60
8.	Agricultural Technology Information Centre,Mannuthy	31	1.2
9.	The Information and Sales Centre, Mannuthy	8	0.28
10.	Communication Centre, Mannuthy	3	0.11
11	College of fisheries	55	1.95
12	College of veterinary and animal science	66	2.34
Total		**2822**	**100.00**
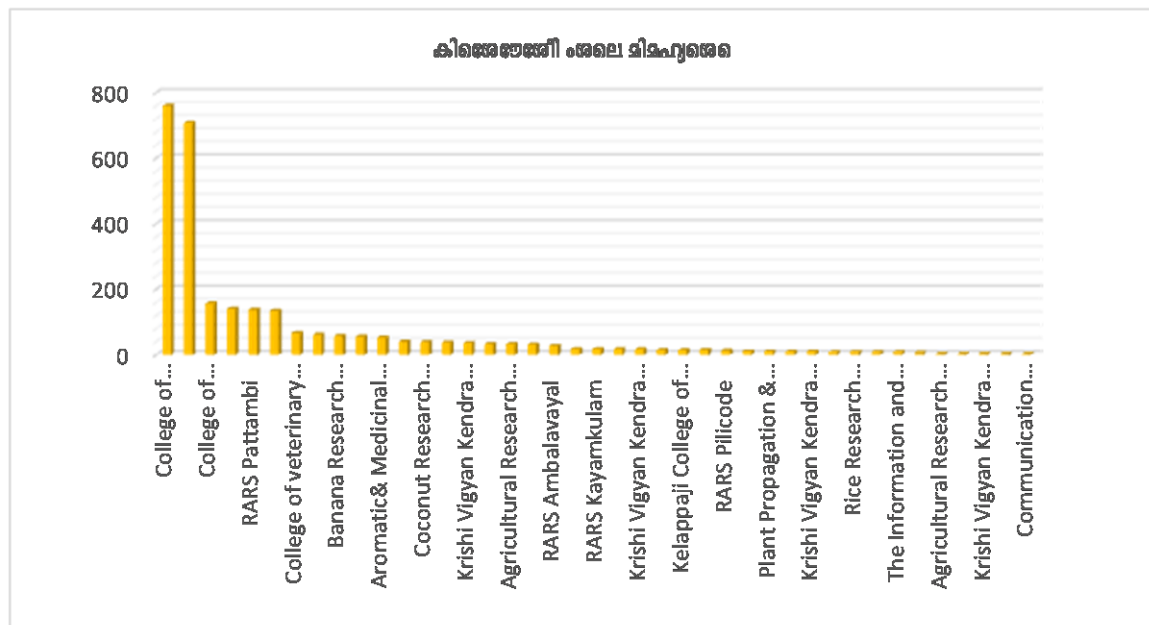
Fig 5.7

Institution wise analysis

From the table 5.30 shows that among the faculties of KAU, College of Agriculture Vellayani top with 760 publications followed by College of Horticulture, Vellanikara 708,College of Agriculture ,Padannakkad 134,College of co-operation and Banking management and College of Engineering& Technology, Tavanur 14 each and Academy of Climate change education and research,17 respectively.

Among the RARS, RARS Patambi top with 137 publications followed by RARS, Vellayani 33,RARS Ambalavayal 27,RARAs Kayamkulam &, RARs Pilikkode12 and RARS Kumarakam 10 respectively.

Among the research stations IFSRS, Karamana top with 61 publications followed by Banana Research Station, Kannara with 57 publications ,Aromatic and Medicinal Plant Research Station,Odakkali 52,FSRS Sadanandapuram with 37 publications Coconut research station Balaramapuram 39,Agriculture research station,Anakkayam 40,Agriculture

research station Chalakkudy 33,Pinapple research station Vazhakkulam 17,Pepper research station Panniyur 14,Plant propagation & Nursery management unit and Agriculture Research Station Thiruvalla with 10 publications each, Rice Research Station Mankombu and Cashew research station Madakkathara 8 Publication each. Rice Research Station Vytila(6) and Cardamom Research Station and Pampadumpara with 3 publications.

Among KVKs and extension centers, KVK Thrissur top with 140 publications followed by College Of Veterinary And Animal Science 66, College of Fisheries 55,KVK Kollam 66,Agricultural technology information centre mannuthy 8 each and KVK Malappuram, Wayanad and Communication centre mannuthy 3 each respectively.

The result reveals that College of Agriculture, Vellayani tops with 760 publications which is the premier institution in the field of agriculture in Kerala; which is followed by College of Horticulture, Vellanikkara with 708 publications, College of Forestry Vellanikkara with 157 publications, KVK Trissur 140 publications and RARS Pattambi 137 publications among research stations,Cardamom research station Pampadumpara has only three publications .As such KVK Malappuram and Wayanad also.

5.30 Conclusion

The analysis of publication productivity of Kerala Agricultural University during 2008-2017 reveals that year wise distribution shows fluctuation trend,2009 is the most productive year.in the document analysis,3/4th of the publications are scientific articles followed by thesis and popular articles. Only the thesis productivity is increased during the study period, but the scientific articles shows fluctuating trend, the publication of monograph, paper presentation, review and brochure are very less.most preffered language is English. Second most preferred language is Malayalam

and also they prefer Hindi and Kannada language. The scientists prefer high impact factor journals for publishing their work. The "*Journal of Tropical Agriculture*" got top position with 133 publications. It is an international peer reviewed in-house journal of Kerala Agricultural University. About 80% of scientific articles are published in Indian journals than foreign journals. Among the preferred journals top five quality journals according to the NAAS rating are identified as Geoderma, Genome, Environmental of Fishes, Indian paediatrics and Indian journal of Experimental Biology. The Bradford's law of scattering of journals not well fit. The authorship pattern of publications, collaborative authorship is predominant; the trend analysis of authors, single authorship is decreasing while multiple-authorship is increasing. Most prolific author is Suseela P. The Relative Growth Rate of KAU publication shows that decreasing trend. Hence the doubling time increased for 12.5 years. Lotka's law, Paretto principle and prices square root law are well fit with KAU publications. Among the subject, majority of publications produced from biotechnology and applied microbiology 639(22.64%). Next food science and technology 402(14.25%) and plant breeding and genetics 385(13.64%). Majority of the publications are from college of Agriculture, Vellayani during the study period.

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CHAPTER VI
FINDINGS AND CONCLUSION

6.1 Introduction

The main objective of the study is to examine the publication productivity of Kerala Agricultural University, Mannuthy, Trissur. The analysis in the previous chapter has revealed the publication productivity and the publication trend in the near future. This chapter contains the summary of major findings, suggestions and further area of research related to the present topic are following heads. The study verified the tenability of the hypothesis based on the findings evolved in the study.

6.2 Summary of findings

Growth analysis

1. During 2008 -2017, the publication of Kerala agricultural university showed a fluctuating trend. In 2008 and 2009 has shown raise in publication that is 509. (17.78%).and 685(24.3%) respectively. But in 2010 it is decreased to 566(20.1%). After 2010 it shows zig-zag growth.

2. Highest number of publication observed in 2009 is 685 (24.8%). The least in 2017. This variation is due to the bifurcation of KAU in Kerala veterinary and animal science university (KVASU) Kerala fisheries science university (KUFOS).

Document wise analysis

3. Total 2822 records observed, 21 document types are identified. Among it, above half of the publications are scientific articles. It is followed by theses. These two constitute about 75% of total publications.

4.   About 298 publications are popular articles followed by book chapter (121).technical bulletins (76), conference proceedings and dissertation. Other document such as posted presentation 19), leaflet (15), booklets(12), newsletter(11), extension literature(5) technical report(4), abstract(2) ,handbook (2) and patent are very few. Monograph, paper presentation, review and brochure are one publication each.

5.   The publication of a scientific paper is observed highest during the study period except in 2012 and 2015.It shows decreasing trend.

6.   Highest number of scientific articles produced in 2009 and least in 2017. Highest number of popular article observed in 2010.

7.   Growth of theses shows an increasing trend during the study period.

8.   A very few paper presentation are observed in the last years; it emphasize ICT use in agriculture field.

Language wise analysis

9.   There are four languages identified they are English, Malayalam, Kannada and Hindi.

10.   The scientists of KAU most preferred language for publication output of KAU staff is English.

11.   Second most preferred language Malayalam; it is the state language of Kerala.

12.   A very few KAU staff are preferred Kannada and Hindi language for publication of reserch output

Authorship pattern

13. The single authored publication is less compared to multiple authored publications.

14. About 80% publications are multi authored; among 2 authored publication is 1070(37.9%).it is followed by 3 authored publications 551(19.5%) and four authored publication 353(12.5%). Hence the collaborative authorship is predominant among KAU scientists.

15. The average degree of collaboration KAU publications is 83.64.

Relative growth rate(RGR) and Doubling Time(DT)

16. RGR shows decreasing trend up to 2012. After it increased from 0.01-0.14 upto 2015. Again it reduced to 0.06.The mean RGR is 0.17.

17. The doubling time ranges from 0.80-50.05.The mean DT is 12.26 years, which indicates KAU research output doubles once in every 12 years.

Prolific author

18. Prolific author who made more contributions in during the study period. Among 7269 authors, Susheela P professor, College of Agriculture, vellayani, Thiruvananthapuram published 74 papers got first rank.

19. Jose Mathew with 63 publications got second rank followed by Jose joseph from College of Agriculture Vellayani with 47 publications got third rank.

20. Majority of the authors contributed from College of Agriculture Vellayani.

Subject wise analysis

21.   Major 14 subjects are identified for Kerala agricultural university publications. Among it, biotechnology and applied microbiology got fist rank with 639 publications; food science and technology with 402 publications with second rank.

22.   It is followed by plant breeding and genetics with 385 publications; genetic heredity with 312 publications; horticulture with 214 publications and agricultural engineering with 177 publications. These six subject constitute ¾th of total publications.

23.   Other subjects veterinary science (161); entomology (146); environmental science (130); Forestry(87); Meteriology, atmospheric science (74); agricultural chemistry (41);pest and weed control (34) and mathematics.

Institutional wise analysis

24.   Institution wise analysis reveals that collage of agriculture vellayani tops with top 760 publication, which is the premier institution in the field of agriculture in Kerala, which is followed by collage of horticulture, vellanikkara with 700 publication.

25.   College of Forestry Vellanikkara with 157 publications, KVK Trissur 140 publications and RARS Pattambi 137 publications among research stations, Cardamom research station Pampadumpara has only three publications .As such KVK Malappuram and Wayanad also.

Ranking of journals

26.   Journals are most preferred communication channel for the scientific articles among 281 journals observed *Journal of Tropical Agriculture* ranked first with 133 articles. It is the official publication of Kerala

agricultural University, devoted to publication of research finding on all branches of agricultural science.

27.   It is followed *by journal of crop improvement* is the peer-reviewed international journal, published from United States. It got second rank with 64 publications.

28.   *Insect environment* (50), spice India(40),Indian journal of marine science (38), trends in bio science (36), Indian paediatrics(30),and pest management in horticultural ecosystems(25)respectively.

29.   Remaining for journals with 17 publications each,10 journals with16 publications each,6 journals with 14 publications each,10 journals with 10 publications each,12 journals with 9 publications each,24 journals with5 publications each,8 journals with 4 publications each,47 journals with 3 publications each,78journals with 2 publications each, and 41journals with 1 article each.

30.   About more than 3/4th of the scientific articles are published in Indian journals, (215). Only a few (66) are in foreign journals.

31.   From it is clear that international reflection of KAU scientists' research output is very low.

Country wise analysis of the journals

32.   Country wise analysis of journal among the 20 countries identified during the study period, India got top position with 1905(84.33%) publications.

33.   It is followed by USA with 118(7.08%) publications; UK with 31(1.86%) publications and Netherland 27 (1.62%).

34.   International collaboration is very low.

NAAS scored journals

35.   According to national academy of agricultural science, the journal preferred by KAU scientists are Geoderma from Netherlands genome from Canada, environmental biology of fishes, Indian paediatrics and Indian journal of experimental biology.

36.   Top ranked journals have NAAS score 8-10, they are foreign. Indian journals got the NAAS score 8 and below.

Lotkas law of author productivity

37.   Lotka's law describes the frequency of publication by authors in a given field. It states that the proportion of all contributors that make a single contribution is in the region of 60%. This means that out of all authors in a given field, 60%will have only one publication, 15% two publications and 7% will have three publications.In this study ,the single contribution is 7% and the remaining contributions percent deviates from the law.

Bradfords law of scattering

38.   The scattering of journals preferred by the KAU staff is too high. The Bradford's distribution in this study observed as 22:58:201. The ratio not well fit to the Bradfords scattering.

6.3 Verification of hypotheses

The tenability of hypotheses had been tested based on findings arrived on the basis of analysis of collected data

Hypothesis 1

The year wise productivity of KAU publications shows increasing trend. From the findings number 1 and table 5.1, year wise distribution

publication shows increasing trend up to 2010 after it, shows fluctuating trend hence the hypotheses is partially substantiated.

Hypothesis 2.

Collaborative research dominate among the KAU publications. It's clear from the table 14 and figure 5.15 that multiple authorship is increasing also the collaborative index is increased, hence the hypothesis is fully substantiated

Hypothesis 3

Journals are most preferred channel of communication KAU publications; this hypothesis was verified and found valid in the light of the finding number 3 and table 5.2. Hence the hypothesis is fully substantiated.

Hypothesis 4

KAU scientist prefer to publish in Indian journals than foreign journals. From the findings number 30 and table 5.11, majority of the scientific articles are published in Indian journals, hence the hypothesis is fully substantiated.

6.4 Further area of research

Following are some of the areas suggested for further research

- The chronological evaluation of same institution should be conduct in the future

- Comparison of KAU research output with other agricultural universities in India

- Impact of publication of KAU In farmers in Kerala

- Social network analysis of agricultural data bases

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- Trend analysis of major type of document /trend of individual document.

6.5 Suggestions for improvement

The analysis and findings of the study lead to the following suggestions

- Based on the findings the scientists may be encouraged to carry out more research activities in the weaker areas of agriculture.

- The environment and infrastructure of laboratories and research institutions are also very important factor for the growth of research productivity. So the funding agencies and government should provide more fund for the development of laboratories and infrastructure of research institutions.

- The KAU publication mostly comes in Indian journals than international journals, so initiative should be taken to publish articles more in International journals.

- If KAU publish their publications in Malayalam language (state language) also, it gets wider impact because research outputs are very useful to people working in agriculture field.

- The KAU should enhance the opportunities for scientist to international collaboration in publications.

- The KAU should conduct more international seminars, conference proceedings, symposiums and encourage the scientist for the participations.

6.6 Conclusion

Measurement of research productivity of an institution plays a vital role in development as well as its science policy making. In this study

"Publication productivity of Kerala Agricultural University, Thrissur during 2008-2017: A scientometric analysis" is to found out growth and development of KAU.

The study found out that there is a fluctuation trend in the growth of publications during the study period. About journal articles and thesis constitute about ¾ th of the total records collected. There four language publications are identified, in which English is the dominant language, followed by Malayalam, Kannada and Hindi. The average RGR is 0.17 and the doubling time is12.26 years. The authors are interested to working in collaborate. The author who made large number of publication is Suseela P., followed by Jose joseph and Jose Mathew. Among the 14 subjects identified in the study, Biotechnology and applied microbiology got top position, among the institutions, College of agriculture vellayani followed by college of horticulture. Journal of tropical agriculture-an in-house journal of kau is the most preferred journal, it is followed by journal of crop improvement, insect environment, spice India and Indian journal of marine science. KAU staff select Indian journals than international, hence international collaboration is low, most preferred journal with highest NAAS score is Geoderma, Genome and environmental biology of science. According to Bradford's law, scattering of journals is high. These results may be useful for students, researchers and research policy makers in the institution.

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APPENDIX 1
Datasheet

Sl. No.	Year	Type of document	Name of journal	Subject	Name of author	Name of institution	Country	Language

Appendix II

Sl. No.	Name of Journal	No of Articles	Cum no.of articles	Percent	cum.per cent	Rank
1	Journal of Tropical Agriculture	133	133	8.01	8.01	1
2	Journal of Crop Improvement	64	197	3.84	11.85	2
3	Insect Environment	50	247	2.74	14.59	3
4	Spice India	40	287	3	17.59	4
5	Indian Journal of Marine Science	38	325	2.28	19.87	5
6	Trends In Biosciences	36	361	2.16	22.03	6
7	Indian Pediatrics	30	391	1.8	23.83	7
8	Pest Management in Horticultural Ecosystems	25	416	1.48	25.31	8
9	Indian Journal of Experimental Biology	17	433	1.05	26.36	9
10	Journal of Farm Science	17	450	1.05	27.41	9
11	Vegetable Science	17	467	1.05	28.46	9
12	Indian Forester	17	484	1.05	29.51	9
13	Indian Horticulture Journal	16	500	0.94	30.45	10
14	Agricultural Science Digest: A Research Journal of Agriculture , Animal and Veterinary Science	16	516	0.94	31.39	10
15	Bioinfolet	16	532	0.94	32.33	10
16	Indian Farmers Digest	16	548	0.94	33.27	10
17	Indian Journal of Agriculture Research	16	564	0.94	34.21	10
18	Intas Polivet	16	580	0.94	35.15	10
19	Journal of Mycology and Plant Pathology	16	596	0.94	36.09	10
20	Journal of Plantation Crops	16	612	0.94	37.03	10
21	Pesticide Research Journal	16	628	0.94	37.97	10
22	Indian Veterinary Journal	16	644	0.94	38.91	10

23	Genome	14	658	0.84	39.75	11
24	Indian Journal of Arecanut,Spices and Medicinal Plants	14	672	0.84	40.59	11
25	Indian Journal of Plant Protection	14	686	0.84	41.43	11
26	Environment and Ecology	14	700	0.84	42.27	11
27	Oryza	14	714	0.84	43.11	11
28	The Cashew and Cocco Journal	14	728	0.84	43.95	11
29	Indian Journal of Agronomy	12	740	0.74	44.69	12
30	International Aqua Horticulture	12	752	0.74	45.43	12
31	Journal of Agro Materiology	12	764	0.74	46.17	12
32	Journal of Progressive Agriculture	12	776	0.74	46.91	12
33	The Andhra Agriculture Journal	12	788	0.74	47.65	12
34	Asian Journal of Dairy and Food Research	12	800	0.74	48.39	12
35	Annals of Plant Physiology	10	810	0.63	49.02	13
36	Current Biotica: international journal of life science	10	820	0.63	49.65	13
37	Environmental Biological Fisheries	10	830	0.63	50.28	13
38	Geoderma	10	840	0.63	50.91	13
39	Himachal Journal of Agriculture Research	10	850	0.63	51.54	13
40	Indian Journal of Plant Protection	10	860	0.63	52.17	13
41	Indian Research Journal of Extension Education	10	870	0.63	52.8	13
42	Journal of Biological Control	10	880	0.63	53.43	13
43	Journal of Krishy Vigyan	10	890	0.63	54.06	13
44	Journal of Medical Aromatic Plant Science	10	900	0.63	54.69	13

45	Annals of Plant Protection Science	9	909	0.53	55.22	14
46	Applied Ecology and Environmental Research	9	918	0.53	55.75	14
47	Asian Journal of Home Science	9	927	0.53	56.28	14
48	The Intensive Agriculture	9	936	0.53	56.81	14
49	Indian Journal of Animal Sciences	9	945	0.53	57.34	14
50	Indian Journal of Forestry	9	954	0.53	57.87	14
51	Plant Archives	9	963	0.53	58.4	14
52	Indian Journal of Horticulture	9	972	0.53	58.93	14
53	Fishing Chimes	9	979	0.53	59.46	14
54	Indian Journal of Weed Science	9	988	0.53	59.99	14
55	Progressive Horticulture	9	999	0.53	60.52	14
56	Acta Physiologiae Plantarum	9	1008	0.42	60.94	15
57	Agro Forestry Systems	7	1015	0.42	61.36	15
58	Annals of Biology	7	1022	0.42	61.78	15
59	Bio Information	7	1029	0.42	62.2	15
60	Ecology, Environment and Conservation	7	1036	0.42	62.62	15
61	Fruit Vegetable and Cereal Science and Biotechnology	7	1043	0.42	63.04	15
62	Green Farming	7	1050	0.42	63.46	15
63	Indian Journal of Agroforestry	7	1057	0.42	63.88	15
64	Indian Journal of Animal Nutrition	7	1064	0.42	64.3	15
65	Indian Journal of Pharmacology	7	1071	0.42	64.72	15
66	Journal of Asia -Pacific Entomology	7	1078	0.42	65.14	15
67	Journal of Agriculture Science	7	1085	0.42	65.56	15
68	Journal of Dairying Foods and Home Science	7	1092	0.42	65.98	15

69	Journal of Food Science and Technology	7	1099	0.42	66.4	15
70	Journal of Horticulture Science	7	1106	0.42	66.82	15
71	Journal of Indian Veterinary Association Kerala	7	1113	0.42	67.24	15
72	Journal of Insect Science	7	1120	0.42	67.66	15
73	Journal of Plant Disease Science	7	1127	0.42	68.08	15
74	Journal of Veterinary and Animal Science	7	1134	0.42	68.5	15
75	Legume Research	7	1141	0.42	68.92	15
76	Natural Product Radiance	7	1148	0.42	69.34	15
77	Scientia Horticulture	7	1155	0.42	69.76	15
78	Seed Research	7	1162	0.42	70.18	15
79	Veterinary World	7	1169	0.42	70.6	15
80	Agriculture Extension Review	7	1176	0.31	70.91	16
81	Animal Science Reporter	5	1181	0.31	71.22	16
82	Annals of Horticulture	5	1186	0.31	71.53	16
83	Beverages and Food World	5	1191	0.31	71.84	16
84	Biology of Reproduction	5	1196	0.31	72.15	16
85	Canadian Journal of Forest Research	5	1201	0.31	72.46	16
86	Geobios	5	1206	0.31	72.77	16
87	Range Management and Agroforestry	5	1211	0.31	73.08	16
88	Indian Journal of Ecology	5	1216	0.31	73.39	16
89	Indian Journal of Fisheries	5	1221	0.31	73.7	16
90	Indian Journal of Nematology	5	1226	0.31	74.01	16
91	International Journal of Multidisciplinary Research and Development	5	1231	0.31	74.32	16
92	International Journal of Agriculture, Environment and Biotechnology	5	1236	0.31	74.63	16

93	International Journal of Applied Pure Science and Agriculture	5	1241	0.31	74.94	16
94	Journal of Bio pesticides	5	1246	0.31	75.25	16
95	Journal of Environment and Bioscience	5	1251	0.31	75.56	16
96	Journal of Extension and Research	5	1256	0.31	75.87	16
97	Journal of New Seeds	5	1261	0.31	76.18	16
98	Journal of Plant Protection	5	1266	0.31	76.49	16
99	Journal of Tree Science	5	1271	0.31	76.8	16
101	Progressive Research; International Journal	5	1276	0.31	77.11	16
102	Sugar Tech	5	1281	0.31	77.42	16
103	Times Food Processing Journal	5	1286	0.31	77.73	16
104	Advanced Plant Science	5	1291	0.31	78.04	16
105	Agricultural Economics Research Review	5	1296	0.31	78.35	17
106	Allelopathy Journal	5	1301	0.31	78.66	17
107	Asian Agri History	4	1305	0.22	78.88	17
108	Asian Journal of Soil Science	4	1309	0.22	79.1	17
109	Asian journal of Horticulture	4	1313	0.22	79.32	17
110	Journal of Veternary Parasitology	4	1317	0.22	79.54	17
111	Biosciences	4	1321	0.22	79.76	17
112	Biological Forum: an International Journal	4	1325	0.22	79.98	17
113	Caspian Journal of Environmental Science	4	1329	0.22	80.2	17
114	Current Advances in Agriculture Science	4	1333	0.22	80.42	17
115	Current Journal of Tropical Agriculture	3	1336	0.21	80.63	18
116	Electronic Journal of Plant Breeding	3	1339	0.21	80.84	18

117	Envis Bulletin Himalayan Ecology	3	1342	0.21	81.05	18
118	Indian Journal of Agricultural Science	3	1345	0.21	81.26	18
119	Indian Journal of Animal Research	3	1348	0.21	81.47	18
120	Indian Journal of Biotechnology	3	1351	0.21	81.68	18
121	Indian Journal of Clinical Biochemistry	3	1354	0.21	81.89	18
122	Indian Journal of Entomology	3	1357	0.21	82.1	18
123	Indian Journal of Extension Education	3	1360	0.21	82.31	18
124	Indian Journal of Poultry Science	3	1363	0.21	82.52	18
125	Indian Journal of Tropical Biology	3	1366	0.21	82.73	18
127	international journal of agriculture engineering	3	1369	0.21	82.94	18
128	international journal of applied science	3	1372	0.21	83.15	18
129	international journal of paultry science	3	1375	0.21	83.36	18
130	international journal of science and nature	3	1378	0.21	83.57	18
131	Journal of Arecanut and Spices	3	1381	0.21	83.78	18
132	Journal of Agriculture education and extension	3	1384	0.21	83.99	18
133	Journal of Indian academy of wood science	3	1387	0.21	84.2	18
134	Journal of orchid society	3	1390	0.21	84.41	18
135	journal of plant crops	3	1393	0.21	84.62	18
136	journal of plant development science	3	1396	0.21	84.83	18
137	journal of plant nutrition	3	1399	0.21	85.04	18
138	journal of soil and water conservation	3	1402	0.21	85.25	18

139	Journal of sustainable agriculture	3	1405	0.21	85.46	18
140	Journal of thretened taxa	3	1408	0.21	85.67	18
141	Journal of veternary science and medical diagnosis	3	1411	0.21	85.88	18
142	journal of Virological methods	3	1414	0.21	86.09	18
143	Kerala journal of ophthalmology	3	1417	0.21	86.3	18
144	Biosciences	3	1420	0.21	86.51	18
145	Plant Disease Research	3	1423	0.21	86.72	18
146	Pollution Research	3	1426	0.21	86.93	18
147	Sustainable Crop Protection Strategies	3	1429	0.21	87.14	18
148	Tamilnadu Journal of Veterinary and Animal Science	3	1432	0.21	87.35	18
149	Thai Journal of Agriculture Science	3	1435	0.21	87.56	18
150	The Cashew Journal	3	1438	0.21	87.77	18
151	Advanced Horticulture Science	3	1441	0.21	87.98	18
152	Advances in Life Science	3	1444	0.21	88.19	18
153	Advances in Pollen Spore Research	3	1447	0.21	88.4	18
154	Agriculture Research	3	1450	0.21	88.61	18
155	Agriculture Reviews	3	1453	0.21	88.82	18
156	An Asian Journal of Soil Science	3	1456	0.21	89.03	18
157	Andhra Agriculture Journal	3	1459	0.21	89.24	18
158	Annals of Agribio Research	3	1462	0.21	89.45	18
159	Aqua Culture International	3	1465	0.21	89.66	18
160	Aqua Culture Nutrition	3	1468	0.21	89.87	18
161	Archives of Phytopathology and Plant Protection	3	1471	0.21	90.08	18
162	Arya Vaidyan	2	1473	0.11	90.19	19
163	Asian Fisheries Science	2	1475	0.11	90.3	19
164	Asian Journal of Bioscience	2	1477	0.11	90.41	19

165	Atmospheric Environment	2	1479	0.11	90.52	19
166	Bee World	2	1481	0.11	90.63	19
167	Biosystems Engineering	2	1483	0.11	90.74	19
168	Cherion	2	1485	0.11	90.85	19
169	Crop Research	2	1487	0.11	90.96	19
170	Current Science	2	1489	0.11	91.07	19
171	Economic and Political Weekly	2	1491	0.11	91.18	19
172	Electronic Research Journal	2	1493	0.11	91.29	19
173	Economical Journal of Plant Breeding	2	1495	0.11	91.4	19
174	Energy Policy	2	1497	0.11	91.51	19
175	Entomon	2	1499	0.11	91.62	19
176	Environmental monitoring and Assessment	2	1501	0.11	91.73	19
177	Euphytica	2	1503	0.11	91.84	19
178	Ciheam Journal	2	1505	0.11	91.95	19
179	Fish Tech	2	1507	0.11	92.06	19
180	Fishery Technology	2	1509	0.11	92.17	19
181	Floriculture and Ornamental Biotechnology	2	1511	0.11	92.28	19
182	Gene;Genomes and Genomics	2	1513	0.11	92.39	19
183	Genetic Resources and Crop Evolution	2	1515	0.11	92.5	19
184	Horticulture Science	2	1517	0.11	92.61	19
185	Imperial Journal of Interdisciplinary Research	2	1519	0.11	92.72	19
186	In Vitro Cellular and Developmental Biology	2	1521	0.11	92.83	19
187	Indian Journal of Agronomy	2	1523	0.11	92.94	19
188	Indian Birds	2	1525	0.11	93.05	19
189	Indian Coconut Journal	2	1527	0.11	93.16	19
190	Indian Farming	2	1529	0.11	93.27	19
191	Indian Food Industry	2	1531	0.11	93.38	19
192	Indian Food Packer	2	1533	0.11	93.49	19

193	Indian Journal of Agriculture Science	2	1535	0.11	93.6	19
194	Indian Journal of Plant Protection	2	1537	0.11	93.71	19
195	Indian Journal of Agricultural Economics	2	1539	0.11	93.82	19
196	Indian Journal of Expressive Biology	2	1541	0.11	93.93	19
197	Indian Journal of Mushrooms	2	1543	0.11	94.04	19
198	Indian Journal of Physiotherapy and Occupational Therapy	2	1545	0.11	94.15	19
199	Indian Journal of Plant Genetic Resources	2	1547	0.11	94.26	19
200	Indian Journal of Plantation Crops	2	1549	0.11	94.37	19
201	Indian Journal of Soil Conservation	2	1551	0.11	94.48	19
202	Indian Journal of Veterinary Medicine	2	1553	0.11	94.59	19
203	Indian Perfumer	2	1555	0.11	94.7	19
204	Indian Psychopath	2	1557	0.11	94.81	19
205	International Journal of Agricultural Science and Research	2	1559	0.11	94.92	19
206	International Journal of Management	2	1561	0.11	95.03	19
207	International Journal in Management and Social Science	2	1563	0.11	95.14	19
208	International Journal of Agriculture Sciences	2	1565	0.11	95.25	19
209	International Journal of Agriculture Innovations and Research	2	1567	0.11	95.36	19
210	International Journal of Agriculture Research	2	1569	0.11	95.47	19
211	International Journal of Applied and Natural Science	2	1571	0.11	95.58	19

212	International Journal of Biometeorology	2	1573	0.11	95.69	19
213	International Journal of Current Research	2	1575	0.11	95.8	19
214	International Journal of Environmental Biology	2	1577	0.11	95.91	19
215	International Journal of Home Science Extension and Communication Management	2	1579	0.11	96.02	19
216	International Journal of Interdisciplinary Social Sciences	2	1581	0.11	96.13	19
217	International Journal of Medicinal mushrooms	2	1583	0.11	96.24	19
218	International Journal of Pharmaceutical Sciences and Research	2	1585	0.11	96.35	19
219	International Journal of Plant Protection	2	1587	0.11	96.46	19
220	International Journal of Pure and Applied Science	2	1589	0.11	96.57	19
221	International Research Journal of Agriculture Economics and Statistics	2	1591	0.11	96.68	19
222	International Research Journal of Plant Science	2	1593	0.11	96.79	19
223	International Journal of Biological and Pharmaceutical Research	2	1595	0.11	96.9	19
224	International Journal of applied and Pure Science and Agriculture	2	1597	0.11	97.01	19
225	Ipr and Ippin Biotechnology	2	1599	0.11	97.12	19
226	Journal of Medicinal Aromatic Plant Science	2	1601	0.11	97.23	19
227	Journal of Tree Science	2	1603	0.11	97.34	19
228	Journal of Agricultural Economics	2	1605	0.11	97.45	19
229	Journal of Agriculture and Forestry Science	2	1607	0.11	97.56	19

230	Journal of Agriculture Extension Management	2	1609	0.11	97.67	19
231	Journal of Agro echo Natural Resource Management	2	1611	0.11	97.78	19
232	Journal of Animal and Veterinary Advances	2	1613	0.11	97.89	19
233	Journal of Applied Bioscience	2	1615	0.11	98	19
234	Journal of Biochemistry and Biotechnology	2	1617	0.11	98.11	19
235	Journal of Community Mobilization and Sustainable Development	1	1618	0.06	98.38	20
236	Journal of Current Science	1	1619	0.06	98.44	20
237	Journal of Entomological Research	1	1620	0.06	98.5	20
238	Journal of Environmental Economics	1	1621	0.06	98.56	20
239	Journal of Food, Agriculture and Environment	1	1622	0.06	98.62	20
240	Journal of Forensic Research	1	1623	0.06	98.68	20
241	Journal of Forestry	1	1624	0.06	98.74	20
242	Journal of Herbs, Spica and Medicinal Plants	1	1625	0.06	98.8	20
243	Journal of Hill Agriculture	1	1626	0.06	98.86	20
244	Journal of Hill Research	1	1627	0.06	98.92	20
245	Journal of Indian Farming	1	1628	0.06	98.98	20
246	Journal of Indian Society Soil Science	1	1629	0.06	99.04	20
247	Journal of Indian Society of Remote Sensing	1	1630	0.06	99.1	20
248	Journal of Renewal and Sustainable Energy	1	1631	0.06	99.16	20
249	Journal of Resources, Energy and Development	1	1632	0.06	99.22	20
250	Journal of Science India Research	1	1633	0.06	99.28	20

251	Journal of Science Translation Environment Technology	1	1634	0.06	99.34	20
252	Journal of Social Science	1	1635	0.06	99.4	20
253	Journal of Soil Biology and Ecology	1	1636	0.06	99.46	20
254	Journal of Spices and Aromatic Crops	1	1637	0.06	99.52	20
255	Journal of the Indian Academy of Wood Science	1	1638	0.06	99.58	20
257	Journal of Weed Science	1	1639	0.06	99.64	20
258	Journal of Agriculture Economics	1	1640	0.06	99.7	20
259	Millennium Zoology	1	1641	0.06	99.76	20
260	Physiological and Molecular Plant Pathology	1	1642	0.06	99.82	20
261	Physiotherapy and Occupation Therapy Journal	1	1643	0.06	99.88	20
262	Plant	1	1644	0.06	99.94	20
263	Plant Discipline Research	1	1645	0.06	100	20
264	Plant Omics: Journal of Plant Omics and Molecular Biology	1	1646	0.06	100.06	20
265	Research Journal of Biotechnology	1	1647	0.06	100.12	20
266	Research Journal of Seed Science	1	1648	0.06	100.18	20
267	Research Lines	1	1649	0.06	100.24	20
268	Rjpbcs	1	1650	0.06	100.3	20
269	Seed Technology	1	1651	0.06	100.36	20
270	Smart Journal of Business Management	1	1652	0.06	100.42	20
271	Soil Biology and Bio Chemistry	1	1653	0.06	100.48	20
272	Studies of Tribes and Tribals	1	1654	0.06	100.54	20
273	The Asian and Australian Journal of Plant Science and Biotechnology	1	1655	0.06	100.6	20

274	The Bioscience	1	1656	0.06	100.66	20
275	Journal of Hydrolic Engineering	1	1657	0.06	100.72	20
276	The Open Horticulture Journal	1	1658	0.06	100.78	20
277	The Journal of Orchid Society of India	1	1659	0.06	100.84	20
278	Tropical Plant Pathology	1	1660	0.06	100.9	20
279	Veterinary Research Communications	1	1661	0.06	100.96	20
280	Vijnanakairali	1	1662	0.06	101.02	20
281	Zoo'S print	1	1663	0.06	101.08	20
	Total	1666		100		

(Note:Theses,Dissertation,Newspaper article,poster and Newsletter are not included)