5.1 Introduction:

Present research deals with the biblioprofile consolidation information package on entomology. Main theme of the research was to assess the overall status of entomology in four agricultural and non-agricultural universities of Maharashtra and to develop information package on entomology to create awareness among the users of entomology and optimize the use of available resources. After data analysis and interpretation major findings, summary and conclusions are given as under.

5.2 Findings and Conclusions:

1. About the subject of research in the responded data it was found that 14 i.e. nearly 50% of the total respondents research was on economic entomology, followed this 11 i.e. below 50% entomologists research topics were on general entomology. Only 1 respondent’s problem was on medical entomology and 1 was on social entomology. Remaining 7 respondents have not responded the question.

2. Respondents were asked to indicate under which area their research comes. Information provided by them shows that Agriculture entomology was mentioned 20 (31.74 %) times, Economic entomology 10 (15.87 %), Social entomology 9 (14.28 %), General entomology 8 (12.69 %) times, rests were below 8. The branch Techno entomology was suggested only one time By Dr. A L Narangalkar along with other branches.

The position of research states that most of the entomology researchers prefer research in agricultural and economic entomology where as no considerable research has been carried out on other branches of entomology.

Besides it was also noticed that the subject entomology is treated as one subject. There is no clear line between the branches or sub-subject of entomology.

Considering the picture about the medical entomology, investigator would like to state that research on medical entomology was noticed less because the data collected from the respondents of agricultural and non-agricultural universities from malaria department no respondents have responded the questionnaire even after many
requests. Orally they have told that, they just work on taking precautions of malaria, Dengue, Elephantiasis and other mosquito vector which spread diseases. This information supports no research is carried out on medical entomology in Medical and Malaria department.

3. About the application areas of their research i.e. to whom it is useful. In response to this respondents have suggested applications of their research was maximum 21(30%) times for farmers, followed this 13(18.57%) times for educational purpose, 12(17.14%) times for research institutes, 6(8.57%) times for common people and 5(7.14%) times for entrepreneurs. Besides this respondents have also suggested applications of their research in combination of more than one area 13(18.57%) times. Other fields of entomology viz. medical, forest, forensic and other branches of entomology are relatively less explored perhaps on account of lesser relevance or lack of expertise in these fields of entomology.

Hence on the basis of this information it can be concluded that outcome of entomology research is mainly associated with agricultural, economic and educational entomology.

1. An attempt was made to know their current field of research in respect of changing environment. Out of 35 (100%) respondents 27 (77.14%) respondents have answered this question. From the given information it was observed that 16 (59.25%) entomologists have stated that their current field of research was Economic Entomology, 4 (14.81%) have indicated medical entomology, 3 (11.11 %) General Entomology and 2 (7.40 %) agriculture entomology whereas 1(3.70%) respondent each working in field of Insect ecology and Forensic entomology.

From the above information it is seen that the Entomologists from Agricultural Universities prefer the current field of research as Integrated Pest management. Insecticides and Biological control together come under economic entomology whereas for the entomologists from non agricultural universities current field of research is on different aspects of insects i.e. it is more wide and not limited to agricultural field only.
5. Based on the response of 28 (100%) respondents about their research work on useful and harmful insects, it was noticed that 8 (28.57%) entomologists focus their research work on Useful Insects, 6 (21.42%) on Harmful insects and remaining 14 (50%) on both categories i.e. useful and harmful insects.

It was found that nearly fifty percent entomologists work on both categories i.e. useful and harmful insects. This data specifically indicates mostly entomologists work on agricultural and economic branch and less on other branches of entomology.

6. Since all branches of entomology are associated with human being and their related field, the researcher tried to seek out the information regarding special institutions on different branches of entomology. 20 respondents have suggested names of entomology institutes having speciality in sub branches of entomology. Numerical analysis indicates that maximum institutes i.e. 36 (57.14%) have speciality of agriculture, where as for other branches such as Economic entomology, General entomology, Medical entomology there are less number of institutions i.e. below 10.

The respondents have suggested nearly 70% institutes of agricultural and economic entomology. Less number of institutions was suggested for General entomology, Medical entomology, Forensic and Forest entomology.

Besides it was also found that no respondent suggested names of institutions having speciality in Insect ecology, Techno entomology and any other branch of entomology and other than these. Maximum research work on entomology is carried out in Agriculture and Non-Agriculture Universities whereas less work in other institutes.

7. Regarding higher studies in the area of entomology, respondents have suggested 53 institutes where research on entomology is being carried out. In the suggested institutes, Indian Agriculture Research Institute, New Delhi and RTM University, Nagpur were found at the top as their names have been suggested eight and five times respectively. Also there are 32 institutes suggested one time only.

In the concluding remark researcher would like to state that the RTM University Nagpur being a Non-Agriculture University seems to be actively involved in entomology work along with the Agriculture Universities.

8. While suggesting the names of renowned entomologists, 25 respondents have suggested 72 well known entomologists. Out of these it was noticed that Dr. D B Tembhare’s name has been suggested 6 times hence put at first number and then Dr. S. N. Purri ‘s name suggested 5 times comes at second number. Further 5
entomologists viz. Abrham Verghese, Dr. Barsagde, A M Khurad, V V Ramamurthy and C.A Virakthamath names have been recommended 4 times each, 14(19.44%) entomologists names 2 time each and 51(70.83%) entomologists name suggested 1 time each.

On the basis of the data given it can be said that there are enough number of entomologists in economic, Agriculture and General Entomology. The branches like insect ecology, medical entomology, social entomology and forest entomology are at primary stage of development i.e. not yet fully developed as there is less number of expert entomologists. Forensic and Techno entomology seems to be new emerging branches of entomology because no expert name has been suggested for these.

On the contrary it can be stated that entomologists’ number mentioned in economic entomology branch is not restricted to this branch only because economic entomology is the part and parcel of Agriculture entomology and it is not possible to separate them from one another. Hence NM number shown in agriculture entomology will not be the firm base to categorize expert of Agriculture and Economic entomology.

9. Regarding the status of minor and major projects undertaken by entomologists, it was found that 19 respondents have received total 57 (100%) projects of which 20 (35.08%) are Minor and 30 (52.63%) Major projects. Besides this Minor or Major type was not mentioned for 7 (12.28 %) projects.

This data indicates that out of 57 projects, 26(45.61%) projects have principal investigator and other 26 have co-investigator, whereas principal or co-investigator were not mentioned for remaining 5(8.77%) research projects.

The status about completed and ongoing projects noticed that 42 projects were completed and remaining 15 are on going.

In the conclusion it seems that there is good trend of taking up research projects among entomologists.

About the subject specification shown in table (10.1) it was found that maximum i.e. 31 projects were on Economic and Agricultural entomology and 9 projects were on General entomology or insect study. There was only 1 project each on Insect ecology and Medical entomology. It was also noticed that no topic name was mentioned for 5 projects and 10 projects were found other than the Entomology subject. It was specifically noticed that no project was taken on Forensic, Forest, Social and Techno entomology.
Hence on the basis of available data it can be concluded that Entomologists of Agriculture and Non-Agriculture universities prefer research works on Economic, Agriculture and General entomology. No considerable research has been conducted on other branches of entomology viz. Forensic, Forest Medical and Techno entomology. There may be lot of scope for research in these areas. There is a need to take initiative in these new areas of entomology.

Attempt was also made to know the number of projects received by the entomologists. From the response it was observed that Prof. T. V. Sathe has been found at the first position as he received 10 projects to his credit and that too Major ones, Prof. G P Bhavane, Prof. Godse and Prof. Narangalkar were at the second position.

So in concluding remark it can be stated that entomologists of non-agricultural universities are also actively involved in research and their work is more diversified as they study different branches of entomology.

10. With respect to publications and authorship it was found that total 72 books were authored by the entomologists and out of these, 32 books were authored by single author, 24 books by 2 authors and remaining 16 books were authored by more than two authors.

It was specifically noticed that entomologists of non-agriculture universities have authored more books than the entomologists of Agriculture Universities. It can also be stated that there is a tendency to write books with co-authors instead of individual. More than 50% books were authored by co-authors and more than two authors.

On entomology subject the distribution of total 72 books shows that maximum 46 books that have been mentioned are published on Agricultural & Economic Entomology, where as less number of books published on other branches of entomology such as Insect ecology, General entomology, Medical entomology and Forest entomology. Besides one book was published other than entomology. Subject was not mentioned for two books.

It was also observed that no entomologist published books on Forensic, Social and Techno entomology.

Insect order wise publication trend of published books shows that insect orders were not specified for 49 books whereas it was mentioned only for 23 books. Out of these 23 books 8 books were of Lepidoptera order, 5 books of Diptera, 4 of
Coleoptera 2 each of Odonata and Orthoptera and 1 each of Hymenoptera and Anisoptera order.

While summarising it seems that most of these orders are associated with agriculture crops and stored grains. Though there are more than 30 insect orders indicated by the American Zoological Records facts show that 6-10 orders are more common and hence entomologists of agriculture and non-agriculture universities prefer to work on it.

Subject wise distribution of research papers on various branches of entomology in journal shows that more than 55 % papers published were on general entomology, 26% on Agriculture & Economic entomology and below 10% on other branches such as medical entomology, insect ecology and other than entomology.

It was also noticed that no papers were published on forensic and techno entomology.

11. Order wise distribution of research papers in journals indicates that out of 598 papers more papers were published on Lepidoptera, Hymenoptera, Coleoptera and then on other orders in decreasing sequence.

So it can be concluded that entomologists mostly work on the order Lepidoptera and less on other orders. Besides it was observed that here is very less work on the order Thysanura. In other way it can be concluded that there are very less number of insect species or population of Thysanura order found in Maharashtra.

While stating in common conclusion data collected through questionnaire shows that larger insects groups like Lepidoptera, Coleoptera, Hemiptera, Hymenoptera etc. have greater number of publications, obviously on account of heavy agricultural losses caused by these pests and their role in biological control. In comparison with insect groups like Thysanura, Collembola etc. have fewer number of publications.

During the publication span from 1977 to 2015 (36 years) it was noticed that more number of papers were published form the year 2001 onwards.

Regarding the authorship pattern in writing of papers in journals it was found that maximum papers were authored by two authors, while three, four and one author respectively in decreasing order.

About the preferred journals of Entomology it was noticed that the journal, Pestology was used 36 times, followed by MPKV Research Journal 27, Hislopia
Journal and Odontologia 16 times each and then remaining 44 journals in decreasing order. 16 journals were used only three times each.

On the basis of given information it can be stated that entomologists mostly prefer two journals i.e. Pestology and MPKV Research Journal.

Trend of pattern of authorship, writing research papers in proceedings show that there were total 123 papers published, out of which, 80 (65.04 %) were of more than two authors, 28 (22.76 %) of Co-authors i.e two authors and 15 (12.19 %) papers were of single author.

Authorship style of publications indicates that entomologists mostly prefer to write paper with collaboration of more than two authors i.e. in the range of 3-6 together especially in the proceedings.

Further efforts were made to know research carried on different insect orders, it was observed that out of total 123 papers, order was not mentioned for 85 papers, may be because papers are on general insect pests and not on specific order.

This scenario looks somewhat inadequate for the new comers in the field of entomology. It would be convenient to the researcher and users to make appropriate suggestions to sustain research on right track. if order is mentioned.

Further it was also planned to know the papers published by the entomologists on different crops. In the given response it was found that 16 (13.00 %) papers were published on Mango fruit and its pests, following this 11 (8.13 %) papers on Coconut and its pests and another 10 (8.13 %) papers were published on cotton. Few papers i.e in the range 1-4 were written on crops such as beans, okra, peagon pea, gram, chilli spice, pulses, vegetables etc.

12. Respondents were asked to provide information about the patents if they have received meanwhile it came to know that living organism cannot be patented. In general entomology researchers are not found in patent awardees list inspite of valuable research contributions by them.

13. As per the information about organization seminars, conferences, symposiums and workshops provided by the 35 respondents it was seen that only 10 respondents had organised total 77 seminars, conferences and workshops, trainings symposium etc while remaining have not organized. Out of the total 77, 68 were workshops, 6 conferences and only 3 were seminars. Besides these 2 Refresher courses were also organised by Dr. Citralekha Deshmukh Amravati University, Amravati.
On the basis of information provided it seems entomologists prefer to organize workshops / trainings as they must have found it more needful than the seminars and conferences. Their involvement in such activities looks average. There is need to create awareness and to promote entomologists to take initiative for organizing seminar and conferences at higher level.

14. As far as resource person invited talks, key lectures, theme lectures delivered at entomology conferences, seminars, symposia, orientation and refresher courses etc. Dr. D. B. Tembhare delivered 30 lectures i.e. 20 in seminars, conferences, workshops training and 10 lectures in Orientation and Refresher courses. Followed by Dr. T. V. Sathe who delivered 22 lectures, Dr. G P Bhawane 20, Dr. C. S Patil 16, Prof. Lavekar R C and Dr. Waykar B B delivered 15 lectures each. The remaining 8 entomologists delivered less than 5 lectures.

Besides this it was also noticed that entomologists of non-agricultural universities delivered more lectures in orientation and refresher courses as compared to entomologists of Agriculture University.

Thus on the basis of information it can be concluded that entomologists of non-agricultural universities studies entomology at wide level which covers various branches and different aspects of entomology.

15. Oral or poster presentation status shows that 227 poster papers were presented in the seminar and conference. Out of these maximum 103 (45.37%) papers were presented on General Entomology, followed 86 (37.88%) on Economic entomology, 27 (11.89 %) on Insect ecology and 1 (0.44 %) each on Medical and Social entomology. Besides, 9 (3.96 %) papers were presented related to other subjects.

Oral & Poster presentations on different orders picture shows that total 227 (100%) papers were presented out of which maximum 52 (22.90 %) papers were of Lepidoptera order, 36 of Coleoptera and 12(5.28%) of Hymenotera. Papers of Odonata and Diptera were below 10 where as only 1 (0.44 %) paper was presented on Anisoptera. Another major thing noticed was that insect orders were mentioned for 93 (40.96 %) papers and 10 ( 4.40 %) papers were not on entomology.

Overall data indicates that order Lepidoptera and Coleoptera have been found common amongst entomologists and it shows these orders are closely associated with agricultural crops and stored food grains. The insects of the order Hymenoptera, Diptera, Odonata and Orthoptera are associated with human health and other activities.
Taking the facts in the consideration it can be stated that though there are more than 30 orders mentioned in American records, hardly 5-8 orders of insects have influence on our activities, crops, human health, domestic animals and role in ecology etc. and hence are studied more.

16. In order to collect information of classic books on entomology entomologists were asked to suggest useful and good titles. 20 respondents have suggested 98 books. Facts mentioned in the table shows that more number of books i.e. 13 (13.26%) on entomology were suggested by Dr. G. P. Bhawane, then after by Mrs. Moulvi Sariya Sarfaraz and Dr. Sawarkar Arun Bhalerao suggested 12(12.24%) and 10 (10.20%) books respectively. Remaining 17 respondents have suggested books below 10.

On the basis of the information, in concluding remark we can say that the entomologists who have suggested more titles are more updated in field than the others.

Status of suggested books on various branches or subjects of entomology shows that maximum books were suggested on General entomology and Economic entomology. Books on other branches of entomology such as Insect ecology, Medical entomology were found less. No respondents have suggested books on Forest, Forensic, Social and Techno entomology. It was also found that few of the entomologists have suggested 10 books other than entomology.

This situation about collection of literature on entomology indicates that there is shortage of literature on Forest, Forensic, Social and Techno entomology. These may be the new emerging branches of entomology. There is a need of making awareness among entomology professionals regarding these branches.

17. As the Information consolidation is the most feasible way of bringing relevant information together and that too in usable form for the target group of users, they were asked to give their opinion whether they need ICP on entomology. In response to this query 20 respondents have answered the question. They have demanded total 40 information packages on various aspects of entomology. Out of these maximum i.e. 4 information packages each were demanded by the three entomologists viz. Dr. T. V. Sathe, (Non-Agri) Dr. Shekhar Krishnaji Mendale (Agri) and Dr. Andrew Remond Joseph(Non-Agri). Followed this, 3 information packages each were expected by the four entomologists viz. Dr. A. L. Narangalkar (Agri), Dr. V S Desai
(Agri), Dr. Unnithan Anju Rateesh (Non-Agri) and Dr. Suresh Madhavrao Dadmal, 2 information packages each were demanded by Dr. S M Thakare (Agri), Dr. Arun Baburao Sawarkar (Non-Agri) and Naik Kumud Vitthal. Further remaining 10 entomologists have demanded 1 package each.

This scenario says that more information packages were demanded by the entomologists of agriculture universities hence it will be more useful if information packages are developed for the entomologists of these universities.

In the list of suggested topics for information packages by the respondents it was observed that information package on Biological control was suggested 4 times, educational entomology and Pest of Horticulture crop were demanded 3 times each. Information package on Host plant resistance and Insect systematic or Taxonomy was demanded 2 times each. For remaining 26 topics information packages was demanded 1 time each.

18. About the position of departmental libraries only 9 respondents of Agriculture Universities have stated that they have separate departmental library in addition to central library. In Non-Agriculture Universities out of 25 respondents 16 respondents said, they have separate departmental library and remaining 9 entomologists said they do not have separate departmental library. Entomologists of ZSI mentioned that they have their special library.

About the participation of Indian entomologists in three databases CeRA, CAB and ISA survey it was found that entomologists focus more on Agricultural and Economic entomology as 70% papers are found on these subjects, whereas other areas of entomology are not explored among the entomologists and its users.

This overall information indicates that most of the agriculture and non-agriculture universities have departmental libraries for their use. Hence it is a good sign for growth of entomology but it may not be final remark about the development of entomology because literature on various branches of entomology such as General, Forest, Forensic, Insect ecology, Medical, Techno Entomology etc were not mentioned.

19. Out of 35 respondents who have answered the question (Yes or No) regarding the availability of volume of literature on entomology in libraries, 10 (28.58%) respondents have stated that their libraries do not have enough literature on the specializations of entomology where as 25 (71.42%) respondents have said that their library possess enough literature.
These facts indicate that majority of the entomologists find enough literature of entomology in their libraries and thus there should be good awareness about the subject entomology among the users. There is a need to create awareness and to take initiative for the growth of this subject where respondents have said that their libraries do not have enough literature of their specialization in entomology.

Lots of literature is available on entomology particularly on agricultural and economic entomology and relatively less on other branches such as forensic, medical forest entomology etc. Among insect groups (i.e. orders) maximum work was found on the group Lepidoptera as compared to other insect groups. It was revealed that present classification system of library is inadequate and therefore needs improvement for better utilization of the existing entomology literature. This will greatly help the entomology researchers and experts in advancement of knowledge.

Thus the hypothesis made earlier in the pre-synopsis is justified as per the results and conclusions based on data.
5.3 Recommendations:

Recommendations of this research study are given as under.

1. The concepts of entomology and its branches such as General entomology (i.e. study of insects, social nature of insects, use of ICT for insect study), Agricultural entomology, Applied or Economic entomology, Medical entomology, Forensic entomology, Forest entomology, Insect ecology or diversity etc. should be clearly defined and they should be treated as main branches of entomology put in proper order of classification so that they will get proper position.

2. The class number in DDC Schedule assigned for Insecta i.e. 595.7 should be extended to all branches of entomology as mentioned in recommendation one.

3. In the libraries, the literature of entomology should not be shelved at two places separately in Zoology under the class number 595.7 and in Agricultural 632.7 because it is time consuming while searching and leads to confusion.

4. There is a need to develop information packages on various topics of entomology to enable users to study the subject in detail and in a convenient manner. There is need to provide information package on the topic 1. Biological control, 2. Educational entomology. 3. Pest of Horticulture Crops 4. Host plant resistance, 5. Insect systematic or Taxonomy and then as per the demand.

5. Besides agriculture and economic entomology there is a need to conduct research on other branches of entomology.

6. Entomologists of non-agricultural universities should be motivated to study new branches of entomology.

7. There is also need to promote research on harmful insects as their populations is more and they damage crops, stored grains, households things at a large scale and spread various kinds of diseases.
8. The entomology is the basic and important branch associated with all field in our life and it has made great impact, therefore it should be included as a compulsory subject at UG course where science faculty exists.

9. Government should establish highly specialized institutions with updated and developed laboratories on different branches of entomology.

10. IARI, New Delhi as Govt. authorized body should conduct survey to identify the institutions engaged in carrying out high level of research and should provide them financial support to promote expertise.

11. Entomologists should write books and research papers on other branches of entomology such as agriculture and applied entomology so that it will help to increase the volume of subject literature for the users.

12. While giving bibliography or citations, the author should duly mention the order of the insects whenever he /she writes research paper on related specific order to enable users to understand it properly.

13. ICAR should publish the list or directory of expert entomologists periodically. The criteria may be considered as number of papers published in standard journals, number of books authored, number of lectures delivered in refresher and orientation courses, number of research projects completed and that too within the subject area of entomology.

**Future Scope:**

Based on the present research project researcher would like to state here that there is scope for study in following areas.

1. Information packages of new subjects ex. Biophysics, Bioinformatics.
2. Reorganisation of bibliographic database on specific topics.

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