

PREPARATION OF SCIENTIFIC PAPERS IN AGRICULTURAL RESEARCH

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Introduction

The purpose of agricultural research project is not only to find solutions to particular problems but also to communicate the results obtained to those who can benefit from this information. The reporting of results of agricultural research is intended for four distinct groups:

1. Scientists in the same or related fields
2. Agricultural extension workers
3. Farmers
4. Research management.

In most agricultural research projects, preliminary reports are prepared when a certain phase of the research has been completed. In the process of research project management, however, the project manager is often faced with delays of reporting research results. This has been found to be the weakest part of research management since some of the projects provide very poor reports not relevant to the input and sometimes are not provided at all.

Type of Scientific Papers

Scientific papers can be classified into two categories:

1. Primary or research articles:
 - Theses or dissertations
 - Scientific papers for publishing in scientific journals
 - Preliminary research papers to be presented in annual reports
 - Research communications.

Primary articles possess the highest level of originality and are prepared from first hand data which has never been published.

2. Secondary articles:
 - Review articles
 - Technical papers (for extension workers)
 - General papers (for farmers or other interested readers).

Secondary articles are those prepared from second hand data reported elsewhere such as in scientific journals, research reports, newsletters, etc.

In certain research projects, brief reports of each sub-project prepared in the form of executive summary may be required by project management or by donors to make a quick evaluation of the project accomplishments before further action is made.

Writing research papers, therefore, is too wide a field to be able to cover in one short article. There are many paper writing manuals which researchers may study before they start preparing their reports. This article will briefly outline methods used in preparation of certain types of them only.

Research article

A research article is the highest standard research paper which is an account of significant original research that has not been published before. Therefore, it will be prepared for publication in scientific journals or may be presented in a seminar.

Most types of research article follow the classic pattern of:

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1. Title
2. Author (s)
3. Abstract
4. Introduction
5. Materials and Methods
6. Results
7. Discussion
8. Conclusions
9. Acknowledgements
10. References

Each part will be briefly explained as follows:

1. The title

This tells the reader what paper is about. So it should be concise, accurate and informative because this is the most important part of the paper which will draw the attention of the reader. The length of the title is about ten words.

2. The authors

Addresses of each author should be included and the one intended for later correspondence should be identified.

3. The abstract

An abstract is the same as a summary regardless of what a dictionary says. This part of the paper is found in most scientific articles, therefore it should be clearly prepared. It is usually not longer than 250 words. It includes one or two sentences of introduction, objectives, a very short section on materials and methods, major results and significant implications. No references are cited in an abstract.

4. The introduction

This part answers the questions of why you want to do the work and what you want to find out. It contains:

- 4.1 The background of the work. In this section, you have to explain why it is really important for you to study that problem.
- 4.2 A brief review of relevant literatures must be made as background information of your experiment. Information from reviewed papers is arranged either chronologically or distantly.
- 4.3 A clear statement of the objectives.

5. Material and Methods

This part describes how the work was done and what materials were used. It should be described in sequence just like the description of activities in undertaking that research. This section should include

answers to the questions of where, when, how and what (was used). It should be detailed enough so that other workers will be able to repeat the same experiment and obtain the same result. To avoid lengthy description on conventional methods, references could be used.

6. Results and Discussion

The results of an experiment deal with what happened in your experiment. Some papers will present only the results without any comments or interpretations. Some may present these parts together in the same section. This method will work best in a short or simple experiment. Results from an experiment may be (1) described in the text, (2) presented in tables or (3) presented in graphs, bar charts etc. However, they should not be presented in duplicated form. All the above means of presentation should be highly concise and need a careful treatment.

In the discussion, the following points should be kept in mind:

- 6.1 What do your results mean? Interpret them clearly. This means you provide scientific reasoning and interpretation to the results.
- 6.2 Are the findings related to your hypothesis and in relation to other works?
- 6.3 Assess validity, comment on significance.
- 6.4 Do not introduce new materials or details not previously mentioned.
- 6.5 The discussion should be included in all papers. If it is not, the scientific reasoning and interpretation will not be strong. The high value of many research papers is often overlooked due to the lack of convincing evidence presented by the authors.

7. Conclusions

The conclusions may be included in the final section of the discussion. If they are not, it may be useful to present in a separated section to bring all your findings together in a consolidated whole.

8. Reference lists

Lists of reference should be prepared according to the journal's style. Authors of an article should read the style manual for a particular journal or observe previous articles published in it. However, in general, the cited papers should include the names of all authors, the year of publication, the full title, the title of the journal, the volume number, and the

first-last page numbers. In the reference list, one may list the references in alphabetical order or in numerical order (where they are used).

Preliminary articles

These may be called by other names, but they are papers appearing in Research Reports or Annual Reports of a research project. Formats simpler than those of research articles are used in this kind of article.

1. Sub-project title

This is the title of each experiment. It may be a part of a larger research project.

2. The author or researcher

The name of all scientists involved in conducting the research will be included. However, in most system research, there are many scientists taking part in the experiment. Therefore, it must be the choice of the project leader to include ones which contribute more than others.

3. The introduction

The introduction part in the annual report may include the background of the experiment. The results and conclusions of previous experiments in the same series should be reviewed to help the reader understand the progress of the project. Pertinent problems that elicit the experiment must also be included. However, this information must be relevant to the project.

4. The materials and methods

This section is not much different from research articles explained previously. However, the detail may be less precise and includes only important components. These reports are read by project management, researchers in the same or different fields, extension workers and even by farmers. Therefore, complicated parts should be excluded. If included, try to make it as simple as possible.

5. The results/discussion/conclusions

In most papers for annual reports, the results, discussion and conclusions are presented together. The purpose of these sections is the same as the one for research articles. However, it is not surprising to see that, in many research projects, the standard of annual reports is as high as research articles and the same formats are applied.

6. Other sections

Acknowledgements and a reference list need not be presented in a paper for the annual report.

This is a general guide for preparation of annual reports. Many reports do not show the heading of each format but all the sections are still there with the same sequence as that mentioned above.

These annual reports are very useful for future project evaluation and implementation by extension workers. Research without annual reports is a sterile undertaking.

Review article

A review article is a kind of secondary paper prepared by reviewing papers in particular fields or subjects. It is very useful as a background paper used in the formulation of future research projects, as materials for formulation of extension procedures, etc. For example, research on rice may be reviewed after 10 years of intensive research within the country. This means all the research publications, seminars, annual reports, newsletters, or whatever, must be read and consolidated in the same short paper. The reviewer might add some conclusions at different points to make the review more meaningful.

Technical papers

A technical paper is a secondary paper prepared from research articles, annual reports and review articles. It will be used for extension purposes such as papers on weed control in soybean, intercropping of young rubber, pasture legumes for beef cattle and so forth. This paper possesses the following format:

1. Title
2. Author and address
3. Introduction
4. Text
Section A _____
Section B _____
etc.
5. Discussion and conclusions
6. References or bibliography.

The introduction part of this paper contains the background of the subject and explains why it is important economically and socially. When you prepare a paper on weed control in soybean, the introduction must include the economic importance of soybean. Where is it grown? What are the production areas, production rate, amount exported? Then explain about the enemies of soybean such as pests, diseases and weeds. For example, weeds are the major enemy in all production areas which adversely affect yield potential of soybean. A

systematic study showed that yield gap in soybean production is concerned primarily with weeds. Only then can the actual or main text can be started.

The text is the main part of the article. It can be divided into many sections depending on the scope of the paper and the availability of information to be included in the article. In writing this part, the author should thoroughly search the information, arrange in logical order and put them into words or sentences. It seems easy, but it requires a lot of skills. Some scientists have never written a technical paper at all while others can write one paper per week.

The discussion and conclusion parts. These parts serve as the place where the author adds comments and consolidated ideas covered by previous paragraphs. For example, among many weed control procedures, which one would be the most economical and should be extended to farmers.

The references or bibliographies are the list of papers used for the above technical articles. The

procedure in preparing the list is the same as that used in research articles. It is called a "reference" if that paper is cited clearly at a specific location in the article prepared. It is called a "bibliography" if we cannot locate where exactly it is cited in the text but it is used here and there to prepare the article.

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