How (not) to write research papers in agroforestry

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Abstract

Communication of research results is an integral part of research. The most recognized way of doing that is through well-presented publications. In order to get published, papers should be written well; but many writers, especially early-career professionals, have difficulty with that. This paper presents some of the common problems the author has come across in his capacity as the Editor-in-Chief of Agroforestry Systems and suggests ways for alleviating them. Journal articles are the most important type of scientific publication; others include book chapters, reviews, research notes, books, and monographs. Most journal articles are presented in the IMRAD format: Introduction, Materials and Methods, Results, and Discussion; other sections such as title, abstract, and references are also important. Each has specific norms and ‘do’s and ‘don’t’s to follow. Different journals and disciplines have different norms and styles, but the bottom line for all is that scientific writing should be clear, concise, and coherent. Various style manuals and books are available. Additionally, each journal has its own Instructions to Authors, which should be followed while preparing the manuscript. The manuscript should be got reviewed by as many colleagues as possible and scrutinized by a science editor before it is submitted to the journal.

Introduction

As the Editor-in-Chief of Agroforestry Systems since 1994, I have come across several writing problems that are common to many young scientists (and senior scientists too) irrespective of their national origin or language background. This prompted me to write an article to present the common problems that I have come across in agroforestry manuscripts and ways of alleviating them and offer some tips that might be helpful for future scientists, i.e., early-career professionals.

First of all, this paper is about writing papers for publication; it is not about research designs or procedures. Writing style and norms change over time; therefore it is likely that some of the things mentioned here are not followed in Agroforestry Systems or in my own publications. Furthermore, the paper is written in an imperative mode of writing (‘do this, don’t do that’). I believe that is an effective way of putting across the ideas; it should not be misconstrued as indicative of lack of respect to the reader.

Why should we write and write well? Communication is crucial to the development of science. We know about the work of all the great scientists because they published their results. Writing or talking about the research helps us to clarify our thoughts and present the research in a wider context. Thus, communication of research results is an integral part of the research process. The most recognized way of doing that is through well-presented research publications.

The ‘publish or perish’ dictum has been around for a long time: in my own experience, that was the rule 35 years ago, and that is the rule today.
Perhaps the rule is more strictly followed now and in more countries and organizations than ever before. Scientists of all categories, particularly those in their early career stages, are under increasing pressure to publish. Thus, publishing research results is important to a scientist for professional recognition and career prospects. It is also important to the community of scientists for advancement of knowledge in the discipline, and to the society at large for accountability of research funds. Scientists certainly have a responsibility to publish their results.

In order to get published, we should write well. As in everything else, getting published is a highly competitive endeavor. Most journals receive more papers than they can publish; the more prestigious a journal is, the higher the number of submissions received and rejected by it. Poorly written papers will be the first ones to be rejected. With the explosion of electronic publication and retrieval facilities, readers today are faced with an enormous array of publications. If your article is to be read, it must be presented well. For that reason, editors are forced to accept only well-presented articles.

Good writing is also an essential aspect of ‘marketing’ your research. In scientific research, our immediate products are often publications. In order to market any product, style is as important as substance. Good packaging cannot make up for poor content; but poor packaging can mask the quality of content. Indeed, over the years, as an editor and reviewer, I have had the most unpleasant task of rejecting manuscripts because of their poor quality of writing and presentation.

**Types of research publications**

Various types of publications are available for communicating research results. The most important and highly rated are journal articles that report, for the first time, results of ‘original’ investigations in a scientific journal. Next in order of importance of technical content are book chapters and research reviews that critically examine and synthesize the current state of knowledge on a specific topic and suggest areas for future research. Research Notes or Short Communications represent a category of publications to report ‘work in progress’ that are not yet ready as full-fledged journal articles. Conference presentations are another transient category that may often lead to more permanent forms such as book chapters or journal articles. Theses and dissertations embody results of research on a specific topic undertaken in fulfillment of the requirement of advanced degrees at master and doctoral levels. They too have relatively short lifespan; it is customary that results from theses and dissertations are published as journal articles soon (usually within two years) after the student’s graduation. As a corollary, the academic career of a graduate with an advanced degree depends very much on the publication status of his or her thesis/dissertation research. Other research publications include monographs and research reports that embody results of several years of research, often by a team of scientists, on as specific topic. All these different forms of research publications have some common norms of writing. But journal articles, which represent the most important among all types of scientific publications, will be the focus of subsequent sections of this paper.

**Journal articles based on location-specific research**

Although I have stated in the beginning that this article ‘is not about research designs or procedures,’ some explanation on the nature of research is warranted here. Most authors would like to see their papers published in international journals, and they are disappointed when their manuscripts are returned for the reason that the study reported is too-location specific to be of relevance to the international audience of the journal. They argue that the nature of research is required to be application-oriented (because of institutional mandate, funding restrictions, etc.) and are therefore location-specific. While regional or local journals, most of which are supported by country-specific public institutions and professional societies affiliated to them, may accept more of such location-specific studies, most international journals would prefer to publish research results that have applicability in regions wider than the study location. This situation, which is quite common – and is indeed a problem – in agroforestry research and publications, is a reflection of the perception of the role of research and science.

The nature of the paper written will depend on the type of investigation. Research involves not
only investigation and experimentation aimed at
the discovery and interpretation of facts but also
revision of accepted theories or laws in the light of
new facts, or practical application of such new or
revised theories or laws. Most (if not all) agro-
forestry research is application-oriented (as op-
posed to basic: the proverbial ‘Newton’s apples
and Darwin’s finches’) in nature. But being appli-
cation-oriented is not the same as being location-
specific. What is important is to identify the ‘right’
questions and establish clear objectives before the
research is undertaken. In agroforestry research,
many field investigations, including surveys, that
are undertaken as research are limited to finding
out ‘what happens when something is done’: plant-
ing trees and crops together in certain com-
binations, using tree-biomass as nutrient source
for crops, collecting farmers’ perceptions on some
issues, and so on. The data are then analyzed using
statistical packages and papers are written to
report that one treatment was better or different
from another, farmers did not like a particular
technology, and so on. These are examples of
‘what’ type of research: what happens when
something is done. Even if the research is repeated
for several seasons, the result will be of the same
nature, and the unasked questions will, naturally,
remain unanswered. These results might, at best,
be applicable to the specific location where the
study was conducted, but has uncertain applica-
bility at locations with different biophysical and
socioeconomic characteristics. If the research were
planned to answer the questions ‘why’ and ‘how’
did things happen the way they did, the results
would be more widely applicable. In other words,
research should be aimed at establishing cause–
effect relations and exploring the principles that
form the basis of observed behavior. Remember
that a practice cannot surpass principles. Often
times, the effort needed to do the ‘how’ and ‘why’
type of research is not much more than that for
‘what’ type of research. For example, in a study to
compare the *Leucaena leucocephala* and *Calliandra
calothyrsus* as sources of biomass for crop nutri-
tion, just reporting that one species was better than
the other would not be a publishable research
paper. On the other hand, supposing the research
showed that the biomass of the two species were
different in, say, tannin content, and therefore they
decomposed and released nutrients differently,
a paper reporting that as the reason for the
differences in response to the two sources of bio-
mass will have scientific value. That sort of data
could then be used in a wider context than the
study location for explaining decomposition
characteristics and crop-nutrition value of tree
biomass of local species. Thus, application-ori-
ented research is not just reporting what is ob-
served, but explaining what is observed based on
known facts (or new theories). Absence of this sort
of analytical insight and reasoning based on the-
oretical foundations and experimental evidence is
a commonly observed technical deficiency in
agroforestry manuscripts.

### Sections of a scientific paper

Most journal articles have traditionally followed,
and still follow, the ‘IMRAD’ format (Introduction,
Materials and Methods, Results, And, Discussion).
In addition, we need to pay attention to other parts of
the paper such as title, keywords, abstract, tables and
figures, and literature citations.

#### Title

The title of your paper will be read more than any
other part. The general pattern of readers’ ap-
proach to reading an article is in the following or-
der: title, abstract, graphical results (tables and
figures), materials and methods, discussion. Sta-
tistics show that for every person who reads the full
article, 10 will look at the tables and figures, 100
will read the abstract, and 1000 will read the title.
Titles are read by both scientists scanning the
contents of a journal and those depending on
searches through secondary sources, which always
carry the title and author but may or may not carry
abstracts. The title may be reprinted in bibliogra-
phies and subject indexes, stored in bibliographic
databases and cited in other articles. Needless to
say, a good title is essential – not only to attract
readers who might not otherwise read the paper,
but also to help future researchers find important
information.

A good title should describe the contents of the
paper accurately; describe the subject as specifically
as possible within the limits of space; avoid
abbreviations, formulas and jargon; avoid verbs;
be easy to understand; and report the subject of the
research rather than the results. The following are some of the common ‘do’s and ‘don’t’s for titles:

- The title should contain as few words as possible; the word limit for most journals is 15 or less.
- Low-impact words such as ‘effect of,’ ‘study of,’ and ‘influence of’ should be avoided (realize that every research article reports the effect or influence of something).
- The titles should not be too brief or bland; it should be intellectually stimulating.
- Titles should reflect the content accurately and adequately.
- Flashy titles (e.g., ‘Agroforestry can stop deforestation’) should be avoided for journal articles.

A title such as ‘Plant species found in homegardens in xx region of xx country’ could have been appropriate for an article some 20 years ago, but it is uninspiring to a demanding reader today. We (the readers) know that homegardens involve multiple species, and if we know the location of the study site, we can ‘guess’ the species that are likely to be present there. But, if the title suggests an innovative investigation such as ‘Does nearness to markets affect species composition of homegardens?: A case study from xx region of xx country’ or ‘Species richness and diversity in homegardens: a boon or bane?’, it has a much better chance to attract the attention of the discerning, busy reader.

In some journals, the place of study is given on the title; this is particularly useful for agroforestry articles because of the enormous diversity of the practice in different places. Such study locations should not, however, be in excessive detail (xxx watershed of xxx province of xxx region of xxx country). By the same token, the location should be understandable to the international readership of the journals (e.g., ‘Oyo State’ alone is inadequate; say, ‘Oyo State, Nigeria’; similarly ‘Western Province’ or ‘Midwest’ should be followed by the name of the country or wider geographical region.

- All listed authors should also have helped in the preparation of the paper.
- Technicians and other helpers are usually mentioned in the acknowledgments.
- Each coauthor should give final approval to the version that is to be published.

Unless names appear alphabetically and are stated so, the first person listed is the principal author; others may be listed according to the importance of their contribution to the effort. The battle to get listed as an author may become severe. A related problem that I have encountered is that some of the listed authors, especially those who are well known, may not even have seen the manuscript before it is submitted to a journal. This is objectionable: not only that all authors should contribute substantially to the work reported, but it is unethical to publish something in somebody’s name without that person’s approval. In several instances, I had the unpleasant task of asking the first authors to get their manuscripts scrutinized by their listed coauthors.

Keywords

These are words by which the paper should be indexed by abstracting services. Many journals do not list keyword anymore; they use words on the title as keywords. When keywords are given, the abstracting services list the article by title and keywords. Therefore, words that appeal on the title should not be repeated as keywords. Keywords should be mentioned in the abstract of the paper. The number of keywords is usually limited to five, maybe six. These should be ‘words,’ not phrases or long clusters of words. Moreover, the words should be specific to the article; common words such as plants, soils, models, and people are too general to be of any value as keywords.

Abstract

The abstract should be definitive not descriptive; it should give facts rather than say the paper is ‘about’ something. It should be meaningful by itself, not a teaser. Since the abstract will be read by about 100 times more people than those who will read the full paper, it should convey the information itself, not
just promise it. For example, instead of saying ‘the effects are described,’ mention what the effects are; and, instead of saying ‘the factors will be presented,’ say what the factors are. If the readers are interested in learning how those effects or factors are important, they will read the paper for details.

A good abstract is short (journals usually allow 150 to 250 words); is written in one paragraph (multiple paragraphs may be allowed for review papers); should stand on its own, i.e., be complete in itself; starts with a statement of rationale and objectives; reports the methods used, the main results including any newly observed facts, and the principal conclusions and their significance; and should contain all the keywords by which the paper should be indexed. Sometimes keywords are listed separately below the title or the abstract. The Abstract will be strengthened if quantitative information is included. For example, a statement such as ‘the trees had an adverse effect on the crop’ cannot stand on its own unless it is accompanied by quantitative data to support that statement; however, do not include quantitative data and the accompanying statistical values in too much detail. The Abstract should not contain literature citations or references to tables or figures in the paper, abbreviations or acronyms (unless they are standard or explained), or any information or conclusion not in the paper itself. Latin names of plants should be given within parentheses after common names when mentioned for the first time in the Abstract, and again the first time in the text. Make sure that your objectives and conclusions are tied together in the Abstract.

Introduction

A good introduction tells why the reader should find the paper of interest, explains why the research was carried out, and gives the reader the background that is needed to understand the paper. Specifically, it defines the nature and extent of the problems studied, relates the research to previous work (usually by a brief review of the literature, but only that which is clearly relevant to the problem), explains the objectives of investigation, and defines any specialized terms or abbreviations to be used in what follows. Remember that the Introduction leads logically to and clearly states the hypothesis or principal theme and well-defined objectives of the work reported.

The Introduction should be relatively brief, not more than 400 words. Avoid repetition: do not repeat the Abstract in the Introduction or the Introduction in the Discussion. Do not go into an extensive literature review; two or three most relevant citations are plenty to corroborate a statement. Do not repeat well-known facts nor state the obvious. It is disappointing that even now, i.e., after more than 25 years of concerted efforts in scientific agroforestry and publishing more than 60 volumes of Agroforestry Systems (not to mention scores of books and hundreds of other publications – an Internet search by Google lists 429,000 entries on agroforestry!), some manuscripts submitted to Agroforestry Systems still start with a definition of agroforestry and a description of how it can solve the world’s problems!

Materials and methods

The purpose of this section is to present in as simple and direct manner as possible what has been done, when, and how, and how the data have been analyzed and presented. You must provide all the information needed to allow another researcher to judge your study or actually repeat your experiment. It is a good idea to organize this section chronologically. The section should include:

- The description of the study location, including climate, soil (by US soil taxonomy and/or FAO system), vegetation, etc., to the extent such information is relevant to the study.
- The design of the experiment or survey or other modes of investigation.
- Any plants or animals involved, with exact descriptions (genus, species, strain, cultivar, line, etc.).
- The materials used, with exact technical specifications and quantities and their source or method of preparation (generic or chemical names are better than trade names, which may not be universally recognized).
- The assumptions made and the methods followed, usually in chronological order, described with as much precision and detail as necessary. Standard methods need only be mentioned, or may be described by reference to the literature as long as it is readily available. For example, if the
data are analyzed by SAS (as most researchers do) just say so; it is no longer necessary to give even a literature citation to SAS (but this depends on the journal). Similarly, standard and specific soil test methods or plant measurements need not be described or even referenced to some obscure or antiquated citation. Remember, however, that sometimes different methods are available for estimating (obviously different forms) of a nutrient or parameter; in such cases, the specific method must be given; e.g., it is just not sufficient to say that ‘available phosphorus was determined’; specify by what method: Bray I or Mehlich I or whatever. If the method is new it should be described in detail. Furthermore, methods of interpreting data should be described.

- Do not go overboard with excessive description of common procedures. Keep in mind and respect the general level of the readers’ understanding and familiarity with your procedures. For example, in a manuscript for a journal targeted at researchers in biophysical aspects of agroforestry, it is not necessary to narrate all minute details of how sampling materials/sites were selected, and how samples were drawn and prepared for analysis, and so on. Remember, however, that the journal’s editors may ask for additional details of any item, and in such circumstances the authors should oblige.
- Make sure that there are no ambiguities in abbreviations or names, all quantities are in standard units, all chemicals are specifically identified, experimental designs and details are stated, nothing is included that does not relate to the results that follow, and that there are no unnecessary details that may confuse the reader.
- It is customary to write Materials and Methods in past tense. There is no standard ‘rule’ on the use of active or passive forms (‘I/we took ten samples’ versus ‘Ten samples were taken’); follow the journal’s norms, and if the journal is not strict about it, use your personal preference.

Units

SI system (Système International d’Unités) is used for reporting measurements in all research publications. SI units are indicated by the respective symbols in singular and without periods (full stops) except as demanded by the English language (e.g., a period at the end of the sentence); thus g, kg, cm, m, h, and so on, for both singular and plural usages; leave a space between the numeral value and the unit (6 m, 25 kg).

The general rule ‘use only SI units’ has some exceptions especially when it comes to applied disciplines such as agroforestry. For example, in scientific publications with a regional focus, locally popular non-SI units may be used if that would help clarify interpretation or understanding of the data, but such units should be explained in relation to SI units at their first mention in text. A commonly used and widely understood unit of mass is ton (t), which is 1000 kg or 1 Mg. When reporting yields, the term Mg ha\(^{-1}\) is preferred; do not write ‘metric ton’. While reporting plant growth data, the base unit of time (second, s) is often impractical; use hour (h), day (d), week (w) or year (yr) as appropriate. In biological papers, use of months (mo) may be avoided, especially for periods less than 6 mo; even for more than 6 mo, use a qualifier such as about or approximate (e.g., about 9 mo).

The US National Institute of Standards and Technology maintains online resources for SI (http://physics.nist.gov/cuu/); most other countries will have comparable offices/institutions with similar responsibilities. Consult a good style manual (see the list of Recommended Readings at the end of this article) for guidance.

Results

This is the core section of the paper, presenting the data that you have found. It is usually easiest to follow the results if you present them in the same order as you gave the objectives in the Introduction.

- Present your results simply and clearly.
- Report only representative data rather than endlessly repetitive data.
- Do not report large masses of data; reduce them to statistically analyzed summary forms and present in tables or figures along with essential statistical information to understand and compare them (least significant differences and multiple range test in tables and standard error bars in figures).
• Repeat in the text only the most important findings shown in tables and graphs.
• Include negative data – what was not found – if (but only if) they affect the interpretation of results.
• In the text, refer to every table and figure by number.
• Include only tables, figures and graphs that are necessary, clear and worth reproducing.
• In the text, write single-digit numbers in words unless followed by a unit. But do not start a sentence with a numeral even if followed by a unit (e.g., Twenty hectares – not 20 ha – of field was selected for the study.).
• While presenting an approximate value, use a definite number not a range (e.g., approximately or about 200 plants, not approximately 80 to 200 plants).
• In text, use ‘to’ instead of a dash to express a range (e.g., 2 to 4 plants, not 2–4 plants).

Tables and figures

Tables and figures are an integral part of a well-written scientific paper. Quite often, tables and figures appear in the Results section; but there are exceptions. While tables present accurate numbers, figures show trends and features. Do not present the same data in tables and graphs.

Tables and figures are used to present data (quantitative data, illustrations for trends or comparisons) that cannot clearly be presented in text. By the same token, if the information can be presented in a sentence or two in the text, do not present them as tables or figures. Do not assume that a table or figure is always better. Journals do not allow too many tables and figures; the usual range is three to four of each. Therefore, be judicious in the selection of materials to be presented as tables or figures. Climatic data during the study period is a ‘usual candidate’ for a table or figure in biological field experiments. I discourage that when climate data are not research data. Although the information is essential for understanding the results, such information can often be mentioned in a sentence or two. Therefore, unless there are convincing reasons, use of figures (and tables) for reporting such ‘routine’ information is not justifiable.

As said before, readers typically study tables and figures before reading the text (in the ratio of about 10 to 1). Therefore, each table and figure should stand on its own; i.e., the reader should be able to understand it fully without having to read the text. If the reader is asked to ‘see text for details,’ the chances are that the reader will rather leave this paper and go to another one than spend time on your paper.

In order to make the tables and figures stand alone, each should have a complete heading/caption. Tables have headings and figures have captions; but sometimes these words are used synonymously. Usually, headings are printed on top of tables, and captions at the bottom of figures; however, some journals and other publications do not follow this pattern nowadays. It is not uncommon to receive manuscripts with table headings such as ‘Table 1. Height of trees (in meters) and yield of crops (kg/ha);’ sometimes several long sentences are used as table headings. These are not acceptable. Table headings and figure captions should give complete information for the reader to understand the contents of that table or figure, and be limited to one sentence; they should not contain units; units should be given at the appropriate positions (usually below column subheadings in tables and axes in figures). Remember that units are essential for understanding the data reported in the table or figure, but headings and captions report only the nature not details of data. For example, if a table is reporting biomass yield, the heading need not specify if the values are g, kg, or Mg. Additional information or explanation that is essential for understanding the table or figure should be added at the bottom of the table; for figures, they should be added as subsequent phrases or sentences after the caption. Statistical significance is expressed universally by * and ** to indicate significance at 0.05 and 0.0 levels of probability, respectively. Unfortunately, some use them in the reverse order: * for 0.01 and ** for 0.05. For absolute clarity, it is better to explain what you mean by these asterisks, at the bottom of the table. In any case, asterisks (*) should not be used in tables and figures to express anything other than statistical information. Notations such as a, b, c, etc. that are used to delineate differences based on multiple range tests (such as DMRT: Duncan’s) also should be explained at the bottom of the table. In agroforestry literature, it is
recommended that the place of study is included in each table heading and figure caption (as in the case of the main title of the paper). Do not be concerned about repeating the place-of-study information for each table and figure; the chances are most readers will not look at all tables and figures.

Data reported in tables and figures (as well as in text) should not contain more digits than the precision of the methods warrant. Usually, more than four digits including decimal points are unwelcome. These four digits could be in any of the following forms: 0.123, 1.234, 12.34, 123.4 or 1234. But there is no point in reporting a four-digit number followed by two decimal points. For example, the grain yield of a crop may be reported as 5234, not 5234.36, kg ha$^{-1}$. In the SI system, the unit can easily be changed to avoid listing too many numerals: 50 000 g can better be expressed as 50 kg; write 2.4 million instead of 2 400 000.

For values less than one, add a zero before the decimal point (0.2 instead of .2; 0.5 instead of .5; and so on). In tables, round off the treatment means to one-tenth of their estimated standard error (SE) values. For example, if the estimated SE is 1.27, means should be rounded off to the nearest 0.1; if the SE is 12.5, the means should be rounded of to the nearest 1.0.

Tables and figures should not report too much information. Remember that all results need not be reported; only important ones need to be. Manuscripts with too many long tables are really frightening! Imagine how a table (or figure) will look like if it reports data for all treatments and interactions of a factorial experiment with, say, 27 treatment combinations and five sampling dates in a field experiment, or 14 plant characteristics of all 95 trees that were examined in an indigenous-tree-improvement study! If all such data are important to your research and must be reported, the best way will be to report a summary in the paper and post the details in a website and draw the readers’ attention to that. Analysis of variance tables are not usually allowed as tables in text.

Photographs are seldom allowed nowadays in journal articles unless the information cannot be presented quantitatively in graphs or other forms of visual presentations. When allowed, photographs are also numbered as figures (unlike in some old publications that used to label them as ‘Plates’).

Discussion

This is the section where you explain what the results mean and what their implications are. Here, you pull everything together and show the importance of your work through analytical interpretation of your results. The reader should not end up saying, ‘So what?’ Undoubtedly, this is the most difficult part of the paper.

A good discussion should:

- Not repeat what has already been said in the review of literature.
- Relate the results to the questions that were set out in the introduction.
- Show how the results and interpretations agree, or do not agree, with previously published work.
- Present the theoretical implications of the work.
- Indicate the significance of the results.
- Suggest future research that is planned or is needed to follow up.
- Deal with only the results reported in the study, staying away from generalizations and conjectures that are not substantiated by the results presented.
- State conclusions, with evidence for each.

A major problem in many manuscripts is that instead of ‘discussing’ the results, the authors simply state – often repeat – the results. Drawing reference to previously published work is impor-
tant. But, sometimes discussion degenerates to superficial statements such as ‘this work agrees with the work of author X (some unknown author’s work, published several years earlier)’ as though the objective of research was to see if the results agreed with some other author’s (obscure) work published 20 or more years earlier! Analytical insight is what we should strive for in the Discussion section; but, unfortunately, it is difficult to describe how to accomplish that.

Another common problem in Discussion sections is the tendency to move away from the stated objectives and try to ‘solve all problems.’ Admittedly, agroforestry researchers are often under pressure from funding agencies and administrators to produce fast and easy results and technologies for immediate dissemination. Authors therefore tend to ‘please’ the authorities by indulging in pedantic discussion and conclusions that do not emanate logically nor are substantiated by the results presented. Some amount of speculative discussion is, however, in order to elicit excitement and motivate future research.

The classical joke of “Sherlock Holmes and the mystery of stars” is worth repeating here: “Mr. Sherlock Holmes and his sidekick Dr. John Watson went on a camping trip. They pitched their tent under the stars and went to sleep. During the night, Holmes awoke and nudged his friend ‘Watson, look up at the stars, and tell me what you deduce.’ Watson replied, ‘I see millions and millions of stars. Astronomically, it tells me that there are millions of galaxies and potentially billions of planets. Astrologically, I observe that Saturn is in Leo. Theologically, I can see that God is all powerful and that we are small and insignificant. Meteorologically, I suspect that we will have a beautiful day tomorrow. What does it tell you?’ Holmes went silent for a moment, then said: ‘Watson, you idiot, somebody has stolen our tent.’” The point is: do not take your interpretations too far! The line between ‘optimum’ and ‘excess’ is often faint; the scientist has to do some balancing act to separate rote from reasoning.

Some journals, but not all, allow a Conclusion/Summary section. If a separate section is not allowed, the last paragraph or a few sentences of the Discussion can be used to state the conclusions. Conclusion should, rather than just repeating results, state well-articulated outcome of the study and briefly suggest future line of research in the area based on findings reported in the paper. It is not uncommon to find ‘conclusions’ such as ‘more research is needed before conclusions can be drawn.’ Well, then, why do you want to publish this now?

Mismatch between stated objectives and discussion/conclusion is a very common problem in manuscripts. Indeed, all sections of the paper should be tightly and coherently tied together. For example, if the title suggests that the study is on insect population in a mixed-plant system, the paper should focus on that, not on, say, reporting and discussing yield of crops and elucidating how adopting such as practice can reduce deforestation!

References

The reference list must include all, but only, works cited in the text. Unfortunately, there is no standard norm or regulation regarding literature-citation style or listing journal abbreviations; each journal/publisher follows its own style. However, irrespective of the style, all journals ask for names of authors, journals (or other publications such as books), and relevant volume and page numbers of the article. Most journals list the title of the article, but some do not. Journals may list the last names and initials, or first and last names, of all authors. Most journals list literature in name – year system, but some follow the numbering style. My recommendation is: follow the journals’ Instructions to Authors and look up the recent issues of the journal.

References cited should be the most appropriate ones for the context. I have seen manuscripts giving definitions of agroforestry and citing sources that are quite unfamiliar in agroforestry literature. As mentioned before, it is not necessary to define agroforestry anymore in most writings, certainly not in manuscripts submitted to Agroforestry Systems (indeed, the journal does not accept agroforestry even as a keyword). But if a citation is warranted (for example, while writing for a journal/publication where it is a relatively new subject), reference it to a well-known source in the subject.

Another common problem is citing literature out of context. As an example, a manuscript submitted recently to Agroforestry Systems states “Beer’s Law presents a model on the effects of
plant canopy structure on PAR (photosynthetically active radiation) interception and attenuation...” The author gives the Beer’s Law equation and gives two literature citations, from 1995 and 2003, to make it look ‘perfect’. This is an excellent example of a wrong citation. Beer’s (or Beer-Lambert) Law is a fundamental physical chemistry principle dating back to the 19th century. The principle has been used in the study of a large number of media, including 20th century studies on light interception in plant canopies. Quite understandably, such studies have yielded varying results. Quoting two recent references listed by the author implies that those are the original authorities for this law, and that the law was proposed to study ‘the effects of plant canopy structure on PAR interception.’ The listed authors may, at best, have tried to apply Beer’s Law to their study; but so have many others.

Quote only citations that are most relevant and recent. If books are listed, cite the latest edition. Cite only publications that are easily accessible by international abstracting services. Limited-circulation publications and work in progress (working paper, discussion paper, abstract of paper presented at a conference, extension pamphlets, and such other so-called ‘gray literature’) should not be listed. Manuscripts ‘in preparation’ or ‘submitted’ or ‘in review’ should not be listed; but those in ‘press’ can be. The ‘in press’ category includes manuscripts about which the authors have received written notification from the journal that they have been accepted for publication following the journal’s pre-publication procedures such as peer review. While citing ‘in press’ articles, remember to update the publication status before, your paper is finally printed. To ensure that, you should notify the editor of the change in status as soon as an ‘in press’ article is published, and then, at the proof stage, update the listing of the article.

Any information that is pertinent to the paper but is not available in literature that can be accessed by libraries may be cited as ‘personal communication’ when the information is from someone other than the authors, or ‘unpublished data’ when the information is from one or more authors of the current paper. These should be listed in text (not under References), and should include the source as well as year and if possible month. Example: P. K. R. Nair, J. G. Bellow, and M. E. Bannister, unpublished data 2004 [when these are the authors of the manuscript and all authors are responsible for the data] or [J. G. Bellow, personal communication, February 2004 [when J. G. Bellow is not an author of the manuscript under consideration and he is responsible for the data referred to]. Electronic sources may be listed under References or as personal communications depending on their nature. For example, e-mail messages or information posted on an individual home page come under personal communications, whereas institutional Web-pages can be cited under the References section. Remember to give the full URL (uniform resource locator), e.g., http://conference.ifas.ufl.edu/wca/, and the date of posting of the Web page or the date you accessed it.

Each listed reference should have a specific purpose and be the best for the situation. Journals usually allow only about 25 references for a research article and publications that are ‘old’ (published more than 15 years ago) are discouraged (unless they are seminal works). Repeated references to the same author’s various publications on the same topic, no matter how outstanding that author is, may also be avoided.

Other general guidelines

English language and style

Today, English is the language of science. The English used in science is, however, slightly different from the English used in other forms of communications such as news media and literature. Furthermore, each discipline has its own special usages and terms.

Science is international, and the chances are that English will not be the first language for many who read your paper. It is therefore essential that your writing is clear, consistent, logical, and coherent. Indeed, accuracy, brevity, and clarity constitute the ABC of science writing.

English, though spoken in various ways throughout the world, is written principally in two styles: the US and UK versions. Basically, these two forms are similar; but there are some differences in spelling of some words and a few expressions. There is nothing right or wrong between these two forms; either can be used. What is important is to be consistent throughout your paper. If you choose to write in US English, stick to
it throughout your paper; do not use colour (UK spelling) and plow (US spelling) in the same paper; and vice-versa. Again, the recommendation is: follow the journal’s instructions; if you are contributing a chapter to a book, follow its editors’ or publisher’s instruction.

Presentation style involves a whole host of issues. It is difficult to address them even superficially in an article like this. Several style manuals, other books, and electronic manuals are available to help us write better. At the very minimum, we should strive to present our ideas clearly and concisely. Choose your words accurately and carefully so that they mean exactly what you want to say, and the words are familiar and easy to understand. Minimize (if not avoid) use of relative and qualitative terms that could be understood differently in different situations (e.g., adjectives such as good, bad, low, so on); if they have to be used, explain them at first mention. Note that farm of less than 100 ha may be ‘small’ holdings in some places, but unimaginably ‘large’ in others! Use the minimum number of words to express your ideas. Most journals insist on maximum of 6000 words for a full-fledged journal article. The famous example of an article of about 1000 words on DNA structure by J. Watson and F. Crick (Nature 171: 737, 1953) winning the Nobel Prize must have been cited tens of thousands of times as the best example to emphasize that substance rather than length is what matters in scientific articles. If you are presenting an idea or term that the readers may not be familiar with, explain that; do not leave it to the reader to guess. Avoid long-winding sentences and jargons. This does not mean that all sentences should be brief, or subject-specific-technical terms should be avoided. Avoid short paragraphs (of less than three sentences) except in some special circumstances. Using long strings of multiple adjectives and nouns is unfortunately becoming common (e.g., ‘nutrition impact and radiation use efficiency components’! I do not understand which word qualifies which here).

Scientific-writing style involves more than proficiency in English language. Even so, non-native English users could sometimes be at a disadvantage. The only way to overcome this problem is to practice and try more and more. Do not hesitate to share your drafts with your colleagues and do not hesitate to revise, revise, and revise again! It is always a good idea, even for native English speakers, to get your draft reviewed by a competent English (science) editor before submitting it to the journal. Remember, however, that there is difference between English and ‘scientific English’. The story goes that an English editor who was consulted by a doctoral candidate advised the student to change ‘not significant’ to ‘insignificant’ throughout the dissertation!

Other presentation-style and English-related issues include: active and passive voice (this has been mentioned briefly in this paper under Materials and Methods section), double negatives, parallel construction, positioning subject and verb, pronouns, punctuation, sentence construction, tense, transition (between paragraphs as well as sentences), and proper use of words that are similar but have different meanings (e.g., affect vs. effect; principle vs principal).

It is your work!

Keep in mind always that it is your paper, and the primary responsibility for the paper is yours. Reviewers and editors will help you to improve the paper; but they can only help, and you have to help them to help you! Do not expect them to do what you are supposed to do.

Publishing good-quality papers early in your career is certainly the best thing you can do for advancing your career. But working under the pressures of ‘publish or perish’ culture, many fall into the trap of ‘number craze’ and sacrifice quality for numbers by breaking up data and even unethically reporting the same (or almost the same) data in different manuscripts in different journals! While numbers are important, too many skimpy papers even in good journals will do more harm than good in the long run. Equally damaging would be the other extreme of waiting for the most perfect paper only to end up with no or very few publications in your career. It is important to strike a balance between quality and quantity. Papers should be written only when you have something new to report, and we should strive to make every paper an improvement over the earlier one.

One final word: Please be open to criticism, and the more the better. In some cultures, criticisms are less (or not) tolerated. But, professional criticisms
(from colleagues, anonymous reviewers, editors, etc.) will help you sharpen your paper; so do not take them as personal affronts! You may not be able to accept or accommodate all comments and suggestions; but you certainly stand to gain by having an opportunity to receive and consider them.

Unfortunately, there are no short cuts to fame and prestige in science. The path is long and challenging; but it is an exciting journey. Good luck!

Recommended readings

Books recommended for help in writing science papers are listed here alphabetically by title.

A standard dictionary, such as Oxford or Webster’s.


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