The Green Book

A Guide to Effective Graduate Research in African Agriculture, Environment and Rural Development

The Green Book:

A Guide to Effective Graduate Research in African Agriculture, Environment, and Rural Development

Edited by

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The African Crop Science Society
P.O. Box 7062, Kampala, Uganda

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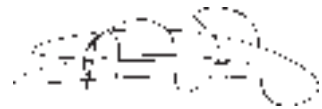
We would like to keep The Green Book relevant. Please help us to update the book and CD with examples, references and any comments, suggestions and criticisms you may have. Please e-mail the African Crop Science Society acss@starcom.co.ug for the attention of Dr John Tenywa, who will forward your comments. Credit will be given to inputs received in subsequent editions.

Foreword

Achieving food security and poverty alleviation in sub-Saharan Africa will require a large cadre of well-trained agriculturists, and development partnerships that derive their agenda from the needs and voices of the continent's populace. It will require team work, combined with a new set of leaders who use participatory approaches and tools relevant to Africa's socio-economic situation. Institutions in Africa must develop new ways of teaching with tools that can be adapted to the training needs of African scholars so that they can re-orient their students to: think creatively, value team work and partnerships, recognise that they belong to a global world, and that whatever they do, should contribute to the improvement of the welfare of African's people. Unfortunately African scholars and fieldworkers often lack reference materials that are based on local experiences.

The Green Book is intended to equip young African scholars with guidance for their thesis study, and to prepare them for the leadership roles that will be expected of them on completion of their studies. The book is written as a guide and examples from the continent are used to highlight the issues. It implores students to always be aware of the bigger picture – the development goal – and to realise that he/she is not operating in a box. We are all part of a community, and indeed, of a global world that is changing – and we must adjust in order to cope with the changing needs of society. This first edition is relevant to all students, but is biased towards those in eastern and southern African universities. It is hoped that the second edition, that will be published in both French and English, will be broader in scope and will include West African reality. The editors welcome all comments and suggestions for improvement in future editions.

The Green Book is linked to many other books, organisations, institutions, and dedicated persons, we acknowledge their contributions and those of all contributors. This book is published under the aegis of the African Crop Science Society (ACSS) which is pan-African in its coverage. The ACSS was the brainchild of staff at Makerere University where it is based, thus, it was a natural choice as publisher. The ACSS has been closely associated with the Rockefeller Foundation since its inception and is grateful for the provision of funds to develop and publish the Green Book.



Professor Adipala Ekwamu
Founder President of the African Crop Science Society


MEET
GEORGE
AND
CHARITY..
GRADUATES,
JUST LIKE YOU!
ALEYA

Foreword

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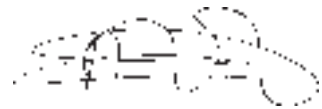

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The Green Book and how to use it

There are many books and materials available to graduate students but most are targeted to students in the developed world and very few are specifically directed at rural development and African students. Graduate studies play an important role in contributing to research and development in African agriculture. Combining research and development, working for and with rural people, and making a real difference to the future requires special skills and approaches that are not often required in the industrialised world. Students need to be able to balance their academic requirements with the needs of projects and rural participants. They need the skills and adaptability to work in interdisciplinary teams and to understand what is required both for their specific discipline and the broader requirements.

This book arose from the experience of the editors who have worked closely with agriculture, environment and rural development postgraduate students in African universities. All the authors who were invited to contribute have wide experience and close connections with universities mainly in eastern and southern Africa.

The information is presented in four main parts, each containing several chapters. Each chapter's title page has a set of bullet points in the left-hand margin that guide you to the chapter's content. These four main parts are followed by a short chapter that is intended to inspire further efforts. Within the text are hints and highlights printed in italics and bold type. These are not an excuse to skip the main text, but rather as aide-memoires to points of emphasis in the chapter.

The Green Book CD includes the full text linked to additional information and resources in publications, software and PowerPoint presentations. Cross references in the text and to the CD are printed in bold green type.

Enjoy the Green Book, we hope you will find it useful, and that it will fulfil part of the Declaration on the African Universities made in Nairobi on 9 February 2001.

'Through the promotion of research and free enquiry; the open contestation of ideas, and the appreciation and tolerance of difference, African universities must generate and disseminate knowledge and understanding, foster the values of openness and respect for merit, and enrich the general quality of the social life of their communities'.

The Editors


RESEARCH
EXTENSION
FARMING
Service Industries
Marketing
MANUFACTURING
Tourism
FORESTRY
?
DECISION TIME !!
ALEYA

1.1 Research? What, why and how?

Tony Greenfield

- **Why do you want to do research? Have you chosen a research project? Do you feel strongly about an outstanding problem or will your study be guided by your professor or research organisation?**
- **Research is about solution of problems but they must be problems that attract funds, a supervisor and collaborators**
- **Will your project fit into a wider strategy? Will it make a valid contribution to the big picture?**
- **Your abilities will yield surprises, results and benefits that nobody predicted. You can be creative**
- **Write clearly and honestly. Avoid deceit and obfuscation**

'We have three principal means: observation of nature, reflection, and experiment. Observation gathers the facts, reflection combines them, and experiment verifies the results of the combination. It is essential that the observation of nature be assiduous, the reflection be profound, and that experimentation be exact. Rarely does one see these abilities in combination. And so, creative geniuses are not common.'

Denis Diderot (1753)
On the Interpretation of Nature

Introduction

You are stuck. You are a graduate on the ground floor and you have been there for several years. There's a hard ceiling to your career and you can't climb the staircase to the floor above without showing a ticket to pass. What is that ticket? It is, at least, a portfolio of published papers. Better, it is a research degree, a master's or a doctorate. Your work experience has sparked many worthy ideas that you know you could develop with well-supported research. So, how do you start?

Even if research doesn't immediately attract you, you realise that a higher degree is essential for any promotion. You may be working in a government department or in some non-governmental organisation or in a company that does not have a research mandate, yet you know that an MSc or a PhD will enable you to climb the staircase to higher management, greater responsibility, and wider opportunities. Research must be part of this process, for it is through doing research that you will learn to learn, to observe, and to marshal new knowledge to the greatest effect.

Or: You are about to graduate. Your head is bursting with knowledge and ideas. The world, you hope, is waiting for you to make it a better place. How will you do this? There must be a job just right for you. Farm management? Well, you'd have to start as a junior and work your way up. How long would that take? Supplier of materials such as fertilizers, pesticides, seeds, machinery? That might be quite interesting, even exciting: travelling about in a company car as a representative and discussing the needs of your customers, the farmers. Or even politics? Could you persuade governments, local, national or international, to direct their resources to where, in your opinion, they are most needed?

But: "You've done well," your professor says. "You might consider staying here and doing research."

Research? Now here's a chance to use your knowledge and ideas to make the world a better place, to improve the quality of

the lives of fellow humans, to give them the security of good food supplies, to protect and improve the environment. At the same time you will gain a qualification that may assure you of an interesting and well-paid(?) career; you will publish reports of your work, present them at international conferences; you'll feel good. You might pursue your theoretical studies in Europe and do your field studies in Africa where the farmers' problems exist. If your work is in a university, you will mix with researchers in other sciences, in engineering, in economics and in business. You could teach, become a professor. You might even create a new product or process that will lead you to commercial as well as academic success.

"Show me the lab," you say. "I'll put on my white coat and start to work."

But wait. What will you do? Who will pay you? Who will pay for your research? Will you be paid at all? Perhaps, but not a lot. Are you sure you have the skills for research and understand the procedures?

You will need a grant: money to live on, funds for materials and equipment, travel, conference fees. So you must persuade somebody that what you propose to do is worthy of their investment. So here's a skill that you might not have contemplated: how to write a research proposal.

To me, research is an art aided by skills of enquiry, experimental design, data collection, measurement and analysis, by interpretation, and by presentation. A further skill, that you can learn and develop, is creativity or invention. These are a few of the many skills and methods of research that you should know and understand.

So this book is for you, for graduate students, whether MSc or PhD, at universities throughout Africa if you want to work in agriculture, in natural resources, in rural development or the environment, with people whose livelihoods depend on the land. It is for your supervisors too: those who are appointed to guide you through your first major research project.

Research is a big subject and it would not be possible to write a single volume about it in any depth. This book is intended to be a general reference on all aspects of research methods and should be used as notes for guidance. Its content is intended to be fairly simple and easily intelligible by most readers. There are references to more substantive texts and to websites, and plenty of additional information on the CD.

The many viewpoints and components of research methods demanded that several contributors would be needed. Fortunately, there are enough qualified people in universities, research organisations and consultancy, who volunteered eagerly to write one or more chapters each. The editors asked them to write in a light style that you could read easily so that you can pick up the general themes. We have tried to make it a book not only of general guidance but also of relevance to the reality of current research and agriculture in Africa and to hopes for the future of this continent.

If there are parts that you don't understand, or that could be expressed more clearly, or if there are important omissions, please write to the editors or the publishers. Everything can be improved, especially the first edition of a book, and your opinions will help us.

These notes for your guidance have been divided into four main parts, with several chapters in each. Look through the contents list and see how the topics have been grouped. You may feel that some of the chapters are not for you. For example, do you know how to design a survey? Of course you do! You have often been asked to answer survey questions so you know what questions should be asked. But there is much more to a survey than that. How do you choose your target population and then a sample size? How do you ensure that you get a good response? How do you code the questionnaire for analysis? How do you

analyse and interpret results. Read **Chapter 4.4** and learn. How do you attract financial, material and intellectual support? There are chapters to help you with these. You will run into difficulties. You will find problems of management, of resources, of people. There's a chapter telling you who can help. I suggest you read it before you meet those problems. There are also chapters on planning your work, about keeping documents, about examining your research process and keeping it on course.

Glance quickly at the chapter on data analysis and you may think 'I can leave that until much later, when I have some data to analyse.' Scientific method is about observing the world and collecting information so that you can understand the world better. The way in which you do this must surely depend on how you will process the information when you have collected it. The data you collect will depend on how you will analyse the data. Analysis is an essential feature of research and you will make easier progress with your research the more you understand analysis. To some people it is hard and daunting. They would prefer to ignore it. To other people it is a challenge. Whichever is your viewpoint, make it a challenge and face it now. Honestly, the more you understand about how you will analyse and interpret data, the better will be your planning and management of the way you collect it. The design of a good experiment depends on how the data from the experiment will be analysed.

How do you communicate your results so that other people will notice and act on your advice? Whatever research you do, you must present your results: in a thesis or dissertation, in reports and published papers, and in stand-up talks to live audiences. There are many books about presentation and some are recommended. The CD also contains helpful guidance.

Your problem within a strategy

Your first problem is to find a problem; the solution of problems is what research is about. You must also find a problem that is of interest to other people: those who might provide your funds and those who might support you, supervise you and collaborate with you. Does that restrict you too much? You have already chosen to work in agriculture, natural resources, the environment and rural development so you have defined the domain in which to find a research problem. Thousands of research problems have already been identified. These have led to research projects that have yielded results: published papers, dissertations and theses, books and, most important, changes in the way things are done out there on the land and in the lives of real people.

So, are there any problems left for you?

The more we know, the more we know we don't know

The more problems we solve the more problems we find that need to be solved. There is no shortage of problems, there never will be, even if you narrow your search down to problems of farmers.

The finding and expression of problems and their translation into research proposals are discussed at length in **Chapter 3.2.** But that chapter starts with 'You have decided on the area you want to research'. Have you?

There are strategies at work and you would do well to consider them because it is within these strategies that research projects are created, are inter-related and are funded. If you can identify a problem for your research that fits into an existing strategy, then you will have a good chance of approval by colleagues, by assessors of your ideas, by grant-funding panels.

The strategy is the big picture. Your project is just a part of it. But if you can understand how a strategy is constructed you will be well equipped to challenge it with such questions

as: 'Has it been motivated by political and economic considerations rather than the needs of the farmer?' and to ensure that your research project makes a valid contribution.

Strategy is about answering two questions:

1. How will things be done in the future?
2. What changes and investments must be made to achieve that future?

Answers will be found by following nine concurrent steps (while you read this, think about the farmer and his problems and think about the research that you might do to solve his problems)

1. Understand how well the current products and practices meet current needs so that you can measure the gap in performance and identify the constraints against closing the gap.
   - Specify the needs:
     - eradicate hunger, reduce poverty and safeguard the environment
     - larger harvests through higher yields
     - better nutrition through improved food quality
     - empower people to build their own capacities, self-confidence and self-reliance
     - develop agriculture where water is very scarce, with poor and degraded soils, and where social infrastructure is weak or non-existent
     - provide subsistence farmers with opportunities to increase their income by pursuing opportunities for commercialisation.
   - Identify the constraints:
     - low rainfall
     - inadequate water storage and distribution
     - poor and degraded soils
     - weak or non-existent social infrastructure
2. Determine local trends along four main themes.
   - Changing customer needs (often driven by geopolitical changes such as climate changes, urbanisation, wealth, labour and other resources, irregular markets, and perceptions of what might be)
   - Legislation (genetic modifications, crop type restrictions, land access)
   - Science and technology
     - improved water use through water conservation
     - improved water use and drought tolerance in crop genotypes with plant breeding and biotechnology
     - improved farming machinery, processing, storage, transportation
     - improving social structure, education and health.
   - Competition (what products are wholesalers and distributors asking for and at what prices?).
3. Who are the farmer's current and future customers? (Self-sufficiency defines small-scale farmers' prime customer: themselves followed by local markets and cooperative marketing companies. Large-scale farmers must think about wholesalers, packaging companies, super-markets and exporters).
4. Extrapolate the science, technology, political and social structure, economy, environmental management and consumer trends to create the vision of rural transformation and of how African agriculture will look 3–10 years into the future.
5. Determine what farmers must do to continue to be successful in their future markets (change soil management and irrigation, crop varieties, harvesting, pest control, storage, processing, join co-operative partnerships).

6. Determine what investments may be needed to deliver these changes (investments in the research need to find out how to deliver the changes as well as investments in equipment and materials).
7. Convince farmers themselves that the changes are worth the investments and convince other providers of funds (governments, donors, marketing companies) that their support is needed and will, somehow, pay dividends.
8. Promote partnerships and sponsor projects that bring results of research to rural communities, farmers and their families.
9. Translate the investment plans into implementation plans.

A strategy that has room for you may already exist within the university department or in some research institution. With good fortune, enthusiasm and guidance, you will find or be directed to a problem that will occupy you for 2–3 years: the time you need to complete your post-graduate research.

But .... Your head is bursting with knowledge and ideas. The world, you hope, is waiting for you to make it a better place. "If the strategy is already defined, if my problem is but a small part of that strategy, if my proposal for research must be written so as to earn the approval of my supervisors and my fund granters and has to be so tightly defined as to guarantee a satisfactory conclusion within 3 years, where", you might ask, "is there any opportunity for my originality?"

Don't worry. You have been encouraged to do research because you have already shown a potential, if not already proved ability, for problem-solving. Your supervisors know that you can:

- Assimilate, analyse and evaluate complex information
- Identify key issues and principles
- Think critically
- Learn from mistakes
- Challenge established assumptions
- Avoid prejudices
- Take a broad view
- Think conceptually and creatively

These are abilities that you already possess – abilities that will ensure that, no matter how tightly defined, your research project will yield surprises, results and benefits that nobody predicted.

Creativity

'Creativity is what cannot wait, cannot stop, cannot back step: faster or slower, it always goes ahead: through, alongside, above, regardless of crises or systems.'

Jose Rodrigues Migues

There are many ways to solve a research problem. A formal procedure will often yield a solution, provided you keep an open mind and look for the unexpected.

If you look at the most outstanding of creative leaps in the history of science you will see that they were all founded on an irrationality of thought. Well known examples are: Watt's invention of the separate condenser for the steam engine as he strolled in the country; Poincare's theory of Fuchsian functions as he boarded a bus; Kekule's discovery of the benzene ring as he dozed by the fireside. So, be prepared to note any odd thought you might have at an unexpected time in an unexpected place. And don't discard unexpected results.

'If you do not expect the unexpected, you will not find it; for it is hard to be sought out, and difficult.'

Heraclitus of Ephesus

in Khan (1979)

'Just because something doesn't do what you planned it to do doesn't mean it's useless.'

Thomas Alva Edison

You don't have to wait for that magical moment or a bang on the head to spark an original idea. There are some well-established methods of intellectual discovery that you can apply to your problem:

- **Analogy.** Look for similarity between your problem and one for which you know the solution. Electrical circuits are perceived as water flowing through tanks, pipes, pumps and valves; brain function is studied by comparison with computers. The more remote your analogy is from your problem, the more creative will be your solution
- **By parts.** Break the problem into a series of sub-problems which you hope will be more amenable to solution
- **By random guesses.** Edison used it extensively and brain-storming is a modern version
- **Generalise.** If a specific problem is baffling, write a general version of it; an algebraic model leads to simplified solutions compared with tackling complicated arithmetic head-on
- **Add.** A difficult problem may be resolved by adding an auxiliary sub-problem
- **Subtract.** Drop some of the complicating features of the original problem; this is a trick used in simulation to make it more tractable
- **Particularise.** Look for a special case with a narrower set of conditions, such as tackling a two-dimensional example of a three-dimensional problem
- **Stretch or contract.** Some problems are more tractable if their scale or the range of variables is altered
- **Invert.** Look at the problem from the opposite viewpoint; instead of 'When will this train arrive at Nairobi?' ask 'When will Nairobi arrive at this train?'
- **Restructure.** In clinical studies we do not ask if a treatment will cure a disease, but if an inert treatment will fail to cure the disease
- **The method of Pappus.** Assume the problem is solved and calculate backwards
- **The method of Tertullus.** Assume a solution is impossible and try to prove why.

Check each of these approaches, asking yourself how you might bring it to bear on your problem. Then, if you need any more stimulation, read:

The Art of Scientific Investigation a book by W I B Beveridge published in 1950 but still, half a century later, stimulating to read; G Polya's *How to Solve It* offers practical recipes; and Arthur Koestler's *The Act of Creation* for a discussion of the working of the mind.

My personal approach to solving a problem that has defeated me at my desk:

- Go for a long and lonely walk in the country
  or
- Drowse in a hot bath.....Inspiration comes.

Ethics of research

'Creativity is great but plagiarism is faster.'

Anon

If you are researching into some aspect of the environment, or into the development of genetically altered viruses for the control of crop pests or in some area of medicine, either human or animal, you will almost certainly have thought about ethical aspects of your intentions. But if your research is in some other area such as sociology, education, water

storage and distribution or poor and degraded soils, you may think that there are no ethical questions for you to consider.

You would be wrong to think that.

Fraud is an obvious ethical matter but surprisingly so are experimental design, planning, management and execution; and so is publication.

If you know yourself to be thoroughly honest, you must be confident that you will never be deliberately unethical. Unfortunately, no matter how good a person you are and how well intentioned, there is the possibility, indeed it is very likely, that you will be inadvertently unethical, insomuch as you infringe the accepted code of research behaviour. Anybody who embarks on research is at risk of such inadvertent unethical behaviour. Avoidance demands good advice at all stages. Where will you find that advice?

Ethics, in its widest sense, is the set of principles of good human behaviour.

Most professional organisations have their own codes of conduct that are largely about the ethical standards that are expected of members. I have distilled the following points from several professional codes:

- It is unethical to conduct research which is badly planned or poorly executed
- Research must conform to generally accepted scientific principles based on adequately performed experimentation and on a thorough knowledge of the scientific literature
- Every research project should be preceded by careful assessment of predictable risks in comparison with foreseeable benefits
- In publication of the results of research preserve the accuracy of the results. Inaccurate and incomplete reports of experiments should not be accepted for publication
- The research proposal should always contain a statement of the ethical considerations involved
- Special caution must be exercised in the conduct of research that may affect the environment
- Within your chosen field, you must have an appropriate knowledge and understanding of relevant legislation, regulations and standards and comply with such requirements
- Have regard to basic human rights and avoid any actions that adversely affect such rights
- Accept responsibility for the social consequences of your work
- Seek to avoid being put in a position where you might become privy to or party to activities or information concerning activities that would conflict with your responsibilities
- Never cast doubt on the professional competence of another without good cause
- Do not lay claim to any level of competence that you do not possess
- Any professional opinion shall be objective and reliable
- You must not allow any misleading summary of data to be issued
- Views or opinions based on general knowledge or belief should be clearly distinguished from views or opinions derived from the statistical analysis being reported.

It is worth remembering that:

'Precise conclusions cannot be drawn from inadequate data.'

Pearson and Hartley (1966)
Biometrika Tables for Statisticians

Fraud

While much unethical science is inadvertent, caused mainly by poor management, there is a long history of scientific fraud reaching back several centuries. Charles Babbage, who was Lucasian Professor of Mathematics at Cambridge University (a chair held by many great

scientists including Isaac Newton and Stephen Hawking), published a book in 1830 entitled *The Decline of Science in England*.

One chapter in his book was about scientific fraud under which he described four methods of fraud: Hoaxing, Forging, Trimming, and Cooking. To these I would add Obfuscation. For the first four, I cannot do better than quote him directly.

Hoaxing

'In the year 1788, M Gioeni, a knight of Malta, published an account of a new family of Testacea of which he described, with great minuteness, one species. It consisted of two rounded triangular valves, united by the body of the animal to a smaller valve in front. He gave figures of the animal, and of its parts; described its structure, its mode of advancing along the sand, the figure of the track it left, and estimated the velocity of its course at about two-thirds of an inch per minute. ... no such animal exists.'

There have been many more hoaxes since Babbage's day, including the saga of the Piltdown man.

Forging

'Forging differs from hoaxing, inasmuch as in the latter the deceit is intended to last for a time, and then be discovered, to the ridicule of those who have credited it; whereas the forger is one who, wishing to acquire a reputation for science, records observations which he has never made. ... The observations of the second comet of 1784, which was only seen by the Chevalier d'Angos, were long suspected to be a forgery and were at length proved to be so by the calculations and reasoning of Encke. The pretended observations did not accord amongst each other in giving any possible orbit.'

Statistical methods now exist to discover forged data. Examples may be found in industrial research and in clinical trials. If you are tempted to forge your data, be warned. A good examiner will detect your forgery and you will be humiliated.

There can be great pressure on students to complete a research project within the time specified by the university rules or before their grant expires. Under such pressure the student may be tempted to forge data which they have never observed. Or, if they have made some measurements that don't properly meet their expectations – they may be tempted to cook the results. Cooking is described below by Babbage.

Trimming

'Trimming consists in clipping off little bits here and there from those observations which differ most in excess from the mean, and in sticking them on to those which are too small ... the average given by the observations of the trimmer is the same, whether they are trimmed or untrimmed. His object is to gain a reputation for extreme accuracy in making observations .... He has more sense or less adventure than the cook.'

Cooking

'This is an art of various forms, the object of which is to give to ordinary observations the appearance and character of those of the highest degree of accuracy.

'One of its numerous processes is to make multitudes of observations, and out of these to select those only which agree, or very nearly agree. If a hundred observations are made, the cook must be very unlucky if he cannot pick out fifteen or twenty which will do for serving up.

'Another approved receipt, when the observations to be used will not come within the limit

of accuracy, is to calculate them by two different formulae. The difference in the constants, employed in those formulae has sometimes a most happy effect in promoting unanimity amongst discordant measures. If still greater accuracy is required, three or more formulae can be used.

'It sometimes happens that the constant quantities in formulae given by the highest authorities, although they differ amongst themselves, yet they will not suit the materials. This is precisely the point in which the skill of the artist is shown; and an accomplished cook will carry himself triumphantly through it, provided happily some mean value of such constants will fit his observations. He will discuss the relative merits of formulae ... and with admirable candour assigning their proper share of applause to Bessel, to Gauss, and to Laplace, he will take that mean value of the constant used by three such philosophers which will make his own observations accord to a miracle.'

Obfuscation

Obfuscation means 'to make something obscure'. It is a deliberate act which is intended to convey the impression of erudition, of being learned, of great scholarship. Hence it is fraudulent. There is a style of academic writing, increasingly common in recent years, i.e., long-winded with long paragraphs, long sentences, long words, passive statements and tortuous structures (see **Part 3**). It is intended to deceive and it does so easily because the reader, even an examiner, is tempted to skim such verbosity and subsequently fears to confess he or she has not understood every word.

It is a trick that is apparent today in many academic papers and theses but it was not uncommon a hundred years ago:

'The researches of many commentators have already thrown much darkness on this subject, and it is probable that, if they continue, we shall soon know nothing at all about it.'

Mark Twain (1899)

... or even 400 years ago:

'The ill and unfit choice of words wonderfully obstructs the understanding.'

Francis Bacon (1620)
(in Novum Organum)

Perhaps some people can't help writing obscurely but if a post-graduate research student does so we should be suspicious.

'People who write obscurely are either unskilled in writing or up to mischief.'

Peter Medawar (1984)

Resource material and references

Babbage, C. 1830. *Reflections on the Decline of Science in England.* (Republished 1971.) Irish University Press, Dublin, Ireland.

Khan, C.H. 1979. *The Art and Thought of Heraclitus.* Cambridge University Press, Cambridge, UK.

Koestler, A. 1973. *The Art of Creation.* The Dell Publishing Co., New York, USA.

Medawar, P. 1984. *Science and Literature in Pluto's Republic.* Oxford University Press, Oxford, UK.

Pearson, E.S. and Hartley, H.O. 1966. *Biometrika Tables for Statisticians*, Vol. 1. Third edition. Cambridge University Press, Cambridge, UK.

Twain. Mark. 1899. *The Sciences* (September–October).


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1.2 Research: a path through the maze[1]

Tony Greenfield and *Tom Bourner*

- **There are many paths through the research maze. Some paths will pose more difficulties than others, present more limitations, and take you down fruitless side tracks; others will present greater insight and surprises**
- **Every path should have four parts to it: review; theory building; theory testing; and reflection**
- **A review will identify a gap in the literature and a problem that is worth solving**
- **Theory building is the most personal and creative part of research**
- **Theory testing is a challenge to your theory, using all available information including your experimental results and their analysis**
- **Reflection: You must reflect on how your research findings relate to current thinking in the field of your research topic and identify further questions and new avenues to explore**

'Life is a maze in which we take the wrong turning before we have learned to walk.'

Cyril Connolly (1944)
The Unquiet Grave

Introduction

Research may seem, at first sight, like a mysterious world full of very clever people, remote from the rest of us, talking in strange languages about weird subjects, chalking obscure symbols and diagrams on blackboards, writing unintelligible papers for academic journals: an unreal world like a nightmarish fairground full of wonders and coloured lights but also strewn with hazards and pitfalls. Certainly it will seem like a box of tricks, even a disorganised mix of activities, a maze in which you could easily lose your way.

In this chapter, we offer a different view of research that we hope will encourage and guide you along a fascinating and adventurous path of exploration. Yes, research is a maze but there are many paths through it and, by example, we shall take you along those paths.

Research is about solving problems: overcoming the obstacles between the first statement of a problem and its solution.

We can start with a problem that might face you during your post-graduate studies. When you have decided on the topic for your research you may be encouraged to visit a research establishment, an agricultural college or a university in South Africa or Tanzania for the theoretical aspects of your research. The plan might be to return home to run some field trials and then to visit southern Africa, again, for support in the analysis of your results. Your immediate problem is: how should you travel to South Africa from, say, Nairobi? What is the most economical and enjoyable way, following a route that is within your means and takes you through some interesting places? How would you go about it? Well, you would probably start by opening an atlas. You would mark a possible route, putting rings round the names of places that you would like to visit: Lake Tanganyika, Lake Rukwa, Zambia, the Victoria Falls, Okavango Delta, Botswana and on to Johannesburg. Or you might consider travelling through eastern Tanzania to Dar es Salaam, Lake Malawi, Mozambique and Zimbabwe. There are a number of possible routes from Nairobi to Johannesburg; there may be several possible ways to solve any problem. You could find

1. This chapter is adapted from a chapter by Tom Bourner, with his permission, in the book *Research Methods for Postgraduates*, Second Edition, Arnold (2002).

out from friends and relatives what they know about travel options. You could go to the bus stop and make enquiries of people returning along those routes. You could go to the library and read some travel books to learn about modes of travel in each of the countries through which you might pass. The Lonely Planet series can offer plenty of advice. Is hitchhiking safe? Would it take too long? What are local buses like, where is it possible to use trains? How frequent are the ferries? How much would they cost? What sort of accommodation would you expect? Do people in the villages offer accommodation and food to travellers? Are there hostels or cheap hotels? Perhaps you would carry a small tent and sleep in the open. Local weather patterns, local laws and safety might influence you. You might plan three or four possible routes, write down the details of each and a list of pros and cons. You might even devise a scoring system to help you to decide which route to follow. Later, when you have reached your destination and are still marvelling at the differences between Nairobi and Johannesburg, and some similarities, as well as all the wonderful adventures you have had on the way, you will probably reflect on the process: the extent to which your journey met your original aspirations, what your first-hand experience has told you about travelling cheaply across Africa, and what you have learned from your experience.

Now if you take off your traveller's spectacles and put on instead a pair of researcher's spectacles you will observe some similarities between that process of planning a long journey and the process of research. First, you did a literature review (atlas, travel books, bus and rail time tables, tourist leaflets) to get an overview of the field. Second, you developed a theory of which of the available routes would be to your requirements (your short list). Third, you tested the theory by inspecting and scoring those on your short list. The testing continued by making your journey, by doing your fieldwork. Finally, you reflected on the experience and your results. Stated formally, the process contains four parts:

Part 1 Reviewing the field
Part 2 Theory building
Part 3 Theory testing
Part 4 Reflecting and integrating

Perhaps this sequence seems familiar. Perhaps you recognise it from other significant decisions you have made in your life: choosing an undergraduate course, buying a new suit, finding a vacation job.

With some decisions, it's not possible to go through all the stages. For example, when you choose a job the final test of your theory that you have chosen the right job is by doing the job. Unfortunately, this is possible only after you've committed yourself to the job. Perhaps that's why so many unsatisfactory job decisions are made. The literature on labour turnover often refers to the period immediately following recruitment as the 'induction crisis' when job expectations are tested by the job realities.

The four stages are four parts of the path through the research maze. But this is no ordinary maze in which there is a unique path to follow. Side turnings in an ordinary maze will take you to dead ends. Some side turnings in the research maze will also have dead ends but others will reach the goal, a solution to the problem. But will it be the best solution? Another path through the maze might have been better. There are usually several ways to solve a problem, to do research. Some ways will pose more difficulties than others, present more limitations, take you down fruitless side tracks.

Once you recognise that you are already familiar with each of the major parts of the research process through your experience of making the larger decisions of your life you will

have a valuable resource to draw on. Reflection on those experiences will also give you an indication of the possible pitfalls.

That four-part process can help you to put what you are doing into a broader picture when you start to get bogged down in the detail of research. It can also be useful in designing your research project.

Let us examine the parts of the process in more detail.

Part 1 Reviewing the field

Many research projects arise from a study of current thinking in a field. The research project follows from identifying a gap in the literature. Most other research projects arise from awareness of a problem that is worth solving. In either case, a good start is an overview of current thinking in the field.

In case you are impatient with this part of the process and want to start immediately with fieldwork, here are some reasons for spending time and effort on a review of the field. It would help you to:

- Identify gaps in current knowledge
- Avoid reinventing the wheel (at the very least this will save time and it can stop you from making the same mistakes as others)
- Carry on from where others have already reached (reviewing the field allows you to build on the platform of existing knowledge and ideas)
- Identify other people working in the same and related fields (they provide you with a researcher network, which is a valuable resource indeed)
- Increase your breadth of knowledge of the area in which your subject is located
- Identify the seminal works in your area
- Provide the intellectual context for your own work, (this will enable you to position your project in terms of related work)
- Identify opposing view
- Put your own work in perspective
- Provide evidence that you can access the previous significant work in an area
- Discover transferable information and ideas (information and insights that may be relevant to your own project)
- Discover transferable research methods (research methods that could be relevant to your own project).

Part 2 Theory building

Theory building can be the most personal and creative part of the research process. Some people find it the most exciting and challenging part of the whole business.

In some cases, data collection precedes theory building and, in other cases, it follows it. Have you ever bought a second hand bicycle? If so, you may have identified some possibles before narrowing down to a few probables. You collected data and then formed a theory about which of the bicycles would best meet your needs. In that situation, theory building followed data collection. The process of developing a theory by inspecting individual cases has a special name: **induction**.

Our journey from Nairobi to Johannesburg is another illustration of induction. If each time you are sent the times and prices of a train journey from one city to the next in a faraway country you notice that it is more expensive than you can afford, you may develop the theory

that all the train journeys in that country are too expensive for you. Acting on that theory, you may ask the travel agent to stop sending details of train journeys in that country and you ask for details about buses instead. That is the process of induction at work again: forming a theory from information about specific instances. Induction is a type of generalisation.

The other side of the coin from induction is **deduction** that involves reaching conclusions about specific instances from general principles. Here is an example of deduction: 'I can't afford to stay in a Lagos hotel so don't bother to send me the details of hotels in Lagos'. In this example 'I can't afford to stay in a Lagos hotel'– is the generalisation and deduction leads you to the conclusion about any specific Lagos hotel, i.e., that you can't afford it.

Induction is a thought process that takes you from the specific to the general. Deduction is a thought process that takes you from the general to the specific.

We have seen how a theory can emerge from the data. However, theory can also emerge from armchair theorising, introspection, deduction following a review of the literature, personal experience, a fortuitous remark, a brainstorm, an apt metaphor, or pure inspiration. Creativity has a role to play in all aspects of the research process, but especially in the theory-building part.

We said earlier that data collection can precede theory building and that it can follow it. In the case of induction, data collection comes first. When data collection follows theory building then it is usually for the purpose of testing the theory. That is the part of the research process to which we turn next.

Part 3 Theory testing

'Experience has shown each one of us it is very easy to deceive ourselves, to believe something which later experience shows us is not so.'

C. Rogers (1955)

When we were planning our long journey, we wanted to check whether those attractive routes that we marked in our atlas would really meet our needs. Likewise, when we are doing research we will want to check if the theory (or theories) that we have formulated fulfil our hopes and expectations.

The sort of theory testing we do will depend on our ambitions and claims for our theory. If we want to claim that our theory applies generally, e.g., 'All hotel rooms in Lagos are more expensive than all hotel rooms in Dakar' then we may want to use statistical methods (known as inferential statistics) which have been developed to enable us to make claims about whole populations from information about a sample from a population.

But if your claims are only about the accuracy of your theory in the context of a particular situation, e.g., 'The route that suits me best is via Zambia and Botswana' then theory testing may involve checking your conclusions (theory) from other perspectives. You may have gathered a lot of information about a particular route (bus and train fares, hostel prices, sights to see) but you might find people who have already visited some of the places on the route. They could tell you from their own experiences what to expect. In research in the social sciences, the term **triangulation** is used to describe the process of checking if different data sources and different methods allow you to reach the same conclusions.

Testing theory can take many forms. At one extreme, you may simply invite the readers of a research report to test the conclusions against *their* own experiences. The test is: does the reader say 'Aha! I can now make sense of my own experience in a new and convincing

way'? But if the reader is unlikely to have first-hand experience for testing the researcher's theory, or if the claims being made involve a high level of generality, then the theory testing stage will be more formal and elaborate. At some level, however, theory testing is likely to be part of any research process.

Part 4 Reflection and integration

'Knowledge doesn't exist in a vacuum, and your knowledge only has value in relation to other people's.'
A.D. Jankowitz (1991)

Reflection and integration is the last stage of the research journey. There may be many things on which you want to reflect: what you have learned about the process of research; what you could have done differently; what you have learned about yourself. But there is one matter for reflection that is a crucial part of the research process itself. It will affect how your research is judged and the impact of your research. You must reflect on how your research findings relate to current thinking in the field of your research topic.

Your reflection on how your research results relate to current thinking will include your assessment of where your research fits into the field of knowledge. It will contain your assessment of your contribution to the field. In this part of the research process you are likely to return to your review of current thinking that you made at the outset and reassess it in the light of your results. It's as if the current thinking in your field of study is a partially complete jig-saw puzzle and you are detecting where your own new piece of the jig-saw fits in.

Relating the outcomes of your research to current thinking in the field may simply involve showing how it adds to what is already known in the field. This would be the case when you have filled a gap in the literature or found a solution to a particular problem in the field. It may involve seeking connections with current thinking. It may involve challenging some parts of the map of the current thinking in the field, so that you will be proposing some reconstruction of that map. It may involve testing the consistency of your research findings with current thinking. It may involve asking 'What if?' questions of your research findings.

Any of these ways of relating your research findings to current thinking in the field may present further questions and new avenues to explore. Successful research usually answers some questions but also raises new ones. It enables researchers to ask questions that would not have been asked before the research. New questions can be an important outcome of research. It is small wonder therefore that the final chapter of most research reports has a section containing suggestions for further research.

A good practical question to ask yourself is: 'What are the implications of my research results for our understanding in this area?' The implications can take many forms. Here are a few:

- You may have filled a gap in the literature
- You may have produced a possible solution to an identified problem in the field
- Your results may challenge accepted ideas in the field (some earlier statements in the literature may seem less plausible in the light of your findings)
- Some earlier statements in the literature may seem more plausible in the light of your findings
- Your work may help to clarify and specify the precise areas in which existing ideas apply and where they do not apply (it may help you to identify domains of application of those ideas)
- Your results may suggest a synthesis of existing ideas
- You may have provided a new perspective on existing ideas in the field

- Your work may suggest new methods for researching your topic
- Your results may suggest new ideas, perhaps some new lines of investigation in the field
- You may have generated new questions in the field
- There may be implications for further research.

Most of all, this last stage in the research process is about seeking to integrate the fruits of your own research with current thinking in the field.

Summary and conclusions

It is sometimes difficult to keep in mind the whole research journey when all of your attention is focused on crossing some particularly difficult ground. Our purpose in this chapter is to help you to keep the whole research process in perspective when you are engaged in a particular research activity. We have done this by giving you an overview map on which the whole journey is plotted in outline. We hope this will help you to plan your research journey.

We have related the process of research to the way that you find information needed for the larger decisions in your life. You already have much experience to draw upon in planning and doing your research.

We have suggested a four-part research process: 1. Reviewing the field, 2. Building theory, 3. Testing theory, 4. Reflecting and integrating.

There is considerable diversity of approaches to research in different fields but this four-part framework is sufficiently broad to encompass most research in the sciences, the agricultural and environmental sciences and the humanities. Much of the literature on research focuses on different parts of the process. For example, in the social sciences it usually focuses on theory-building, whereas in agricultural sciences it may focus on theory-testing.

Your four parts may not follow this sequence strictly. For example, after you have reviewed the literature you may want to monitor developments in current thinking while you are collecting and analysing data. You may engage in some parts of the research process more than once. For example, you may find that data you collect for theory building enables you to test statements found in the literature. Or data collected to test a theory may suggest a new theory so that it becomes an element of theory building.

You may not want to spend the same amount of time and energy on each of the four parts of the process. For example, theory building may be only a token part of your research project if your main contribution lies in testing a theory that you found in the literature. On the other hand, you may direct most of your effort towards theory building, so that theory testing may be little more than establishing the plausibility of your theory in the light of the data you've collected.

The four parts will be present in almost all research projects, at least conceptually. If one of the four parts seems to be missing from your own research project, you should discuss it with other researchers and, if you are registered for a research degree, with your supervisor. If you intend to omit one of the parts from your own research project, you must be able to state clearly why this part has no role.

Resource material and references

Greenfield, T. 2002. *Research Methods for Postgraduates*. Second edition. Arnold, London, UK. 384 pp.

Jankowitz, A.D. 1991. *Business Research for Students*. Chapman and Hall, London, UK.

Rogers, C. 1955. Persons or science: a philosophical question. *American Psychologist*, vol. 10. Reprinted in *On Becoming a Person*. pp. 267–279. Constable, London, UK.

Part 2
Your research in perspective

Agriculture is an important component of rural life. Rural transformation is part of the development process and it implies change. To alleviate poverty and become food- secure we need to improve the productivity of agriculture. The smallholders who are the backbone of agriculture deserve our attention and support. National governments, professionals and outside agencies must all work together to achieve this common goal. Agricultural professionals need to become active change agents. As a scientist or an agriculturalist you need to focus on 'problem solving' and remember that both social and scientific skills are required to navigate and manage rural change.

Everyone's life or research journey will be different, but our target and beneficiaries will be the same. This part of the book focuses on many issues with which you will have to deal or confront throughout your career. You will have to work as a team member in a department, programme, or project. This involves cooperation, sharing ideas, openness, transparency, and honesty. You will be a link in the chain that binds the team together. Be sensitive to the needs of others, especially the small-scale farmers – they deserve feedback and all our professional assistance.

Three chapters of this part are rather personal appeals to adopt certain values and approaches in your research. In the first it is suggested that researchers should see themselves as elements in a change process rather than the bringers of answers. The importance of recognising and using farmer's local knowledge is emphasised. In the second you are encouraged to pursue research which will actually lead to solving substantive farmer problems and improving the welfare of the poorest farmers. The third outlines some approaches to working with farmers that might help this to happen. The authors' views are generally mutually consistent, and are based on years of experience of what has worked and what failed. However, the ideas they present are all the subject of debate, and others with similar experience may choose different points to emphasise. As a student you should become familiar with these discussions, work out their relevance to your situation and think about the extent to which your experience confirms or modifies them.

As a student preparing an MSc or PhD thesis, your work will probably be embedded in a larger project. You may therefore have limited opportunities for influencing the overall strategy and approaches of that project. However you do have to be fully aware of how your work links to the rest of the project. The chapter on developing and managing projects should help with that. If your project meets all the aspirations described here then you are lucky! If not, you have a responsibility to challenge the strategy adopted by the project, and to make your own component as effective as possible.

Bharati K. Patel


ROLE OF THE PROFESSIONAL in Rural Transformation
?
WHO ARE YOU RESEARCHING FOR?
WHAT LEVEL OF TECHNOLOGY CAN THEY ADOPT?
The AGRICULTURAL KNOWLEDGE TRIANGLE
TEAM Building
UNIVERSITY
EXTENSION
RESEARCH
PUTTING A PROJECT TOGETHER
Project Writing
BUDGETING
• TIME • MONEY
• EQUIPMENT
APPROACH
Respect
Empathy
Creativity
ALEYA

2.1 The role of professionals in rural transformation

Joseph Opio-Odongo

- **Science and technology can make a difference in rural transfomation**
- **Agricultural scientists must play a positive role in rural development**
- **Understanding farmer reality and good communication skills are essential for servicing rural communities**
- **Rural communities have the capacity and capability to change their reality**
- **Technologies and innovations must match the needs of the target communities**

'Agricultural research scientists have been reluctant revolutionaries, because while they have wanted to revolutionise technology, they have preferred to neglect the revolutionary impact of technology on society.'

Vernon Ruttan (1982)

Introduction

The development and application of science and technology by agricultural research scientists in sub-Saharan Africa (SSA) are part of the global agenda to liberate people from the limitations of the natural world. However, although both positive and negative socio-economic effects of the liberation should be expected, these have not preoccupied the minds of the agricultural research scientists. Yet how society deals with such change affects both the nature and pace of rural transformation.

Agricultural research scientists, as agents for this transformation, need new ways to deliver the results of applied science if they are to empower farmers to operate as subjects rather than the objects of rural transformation.

Rural transformation

When you read the literature on agricultural and rural development, you will find that the concept of rural transformation is often talked of in terms of the:

- Changing composition and roles of the agricultural and other sectors in national development
- Dwindling size of the rural population engaged in agriculture
- Increasing prominence of agro-processing in the rural economy
- Declining proportion of the population deriving its livelihood from agriculture
- Substantial reduction in the contributions of agriculture to the gross domestic product (GDP).

All these are often used as the indicators of rural transformation. But, an equally important aspect of that transformation is the changing capacity of the rural population to drive the process of change. This capacity is expressed in the people operating as the subject rather than the object of change as they shape their destiny by tactfully dealing with the present situation and strategically working towards capturing the future. It is this aspect of the transformation that is the focus of this chapter. Of particular interest is how agricultural research scientists could work with the farming communities to help them manage self-propelling and people-

driven processes of change that contribute to sustainable livelihoods and the transformation of the rural economy.

For this to happen, four main conditions must be fulfilled.

1. Recognition that rural transformation, as a self-propelling and people-driven process, is possible in any society and that the knowledge system that drives it must be internalised and used appropriately.
2. The internal dynamo for rural transformation has to be recharged after years of debilitation by colonial and post-colonial policies and institutions.
3. Agricultural scientists need to be animators and facilitators rather than interventionists to increase local initiative and reduce dependency.
4. Agricultural scientists must invest in acquiring the skills and art of animation, appreciative inquiry and the others needed to facilitate rural transformation.

Internal dynamo for rural transformation short-chained

Colonial rule influenced agriculture in SSA in three important ways. Firstly, it attempted to divest it of its foundation that was built on a theory of knowledge learned from tried and tested traditional methods. The professional and administrative assault on traditional farming practices was meant to transform agriculture from an African way of life into business-based European models of farming. Traditional agricultural practices such as intercropping, although poorly understood by the Europeans, were deemed inferior and were to be replaced by modern ones.

Secondly, it attempted to develop a cadre of 'master' or 'model' farmers who were to be entrusted with the responsibility of recreating the agricultural system in line with the European model.

And thirdly, it introduced a research support system that predominantly served the interests of science and private capital rather than the developmental needs of local farmers. Champions of the traditional knowledge systems and the innovations developed from them fizzled from the limelight, thereby creating space for the new cadre of extension workers to disseminate information from the research stations.

It was in the process of implementing these changes that the **internal dynamo** for rural transformation was **short-chained**. In many SSA countries this situation changed little during the first half of the 20th century. It was not until the mid-1960s that agricultural research scientists began to validate the theories that underpinned many of the traditional agricultural practices such as intercropping. Until very recently, such validation was performed largely within the framework of a delivery model that treated local farmers more as objects rather than subjects of rural transformation. The internal dynamo for rural transformation still remains stalled in many rural communities in SSA.

Trained incapacity to reckon with local situations

Formal education is a powerful socialisation tool that professional disciplines apply in training those of their calling to enable them to view and interpret the world appropriately. Under the controlled condition of experiments in laboratories, glasshouses or experimental plots, that tool has served agricultural scientists very well. However, for situations outside these controlled conditions, especially in the world of farming where a number of conditions influence farmers' behaviour towards a technology that is being promoted by agricultural scientists, that tool in its conventional form has been less powerful.

The trained incapacity which comes from conventional higher education, results in a tendency to blame farmers for being conservative or backward when they don't implement new technologies, rather than assessing where the recommendations are failing farmers' needs.

'Agricultural scientists and researchers do not usually understand the positive and negative forces and changes facing farmers. Current training does not encourage an understanding of traditional husbandry practices. Even students coming from rural communities consider their new knowledge to be superior and have little real appreciation of the inherent logic of traditional systems.'

Joseph Opio-Odongo (1992)

Students are not trained to develop an appreciation of the basic foundation of traditional agriculture. There is growing evidence that farmers' planting strategies, seed selection and preservation, and crop rotation, are based on knowledge systems developed over generations. The same holds true for the local system of soil classification. Farmers continue to develop a variety of agricultural innovations that help them to deal with the exigencies of rural life but which are unknown or poorly understood by agricultural scientists. Researchers and students rarely appreciate why farmers may adopt, but then adapt the new technologies. An example from Uganda in the 1960s helps to illustrate this.

Despite strong recomendation by the research and extension establishments in Uganda that cotton farmers should plant early and use specific fertilizer applications, the majority of farmers developed their own variations of what was recommended. They planted later and applied lower dosages of fertilizers. When the results of field trials based on farmer practices were published – the farmers' deviant behaviour was proved to be rational and valid.

It is also imperative that students and agricultural scientists be trained to communicate effectively with farmers, and to be exposed to farmer situations so that they can develop vital empathy.

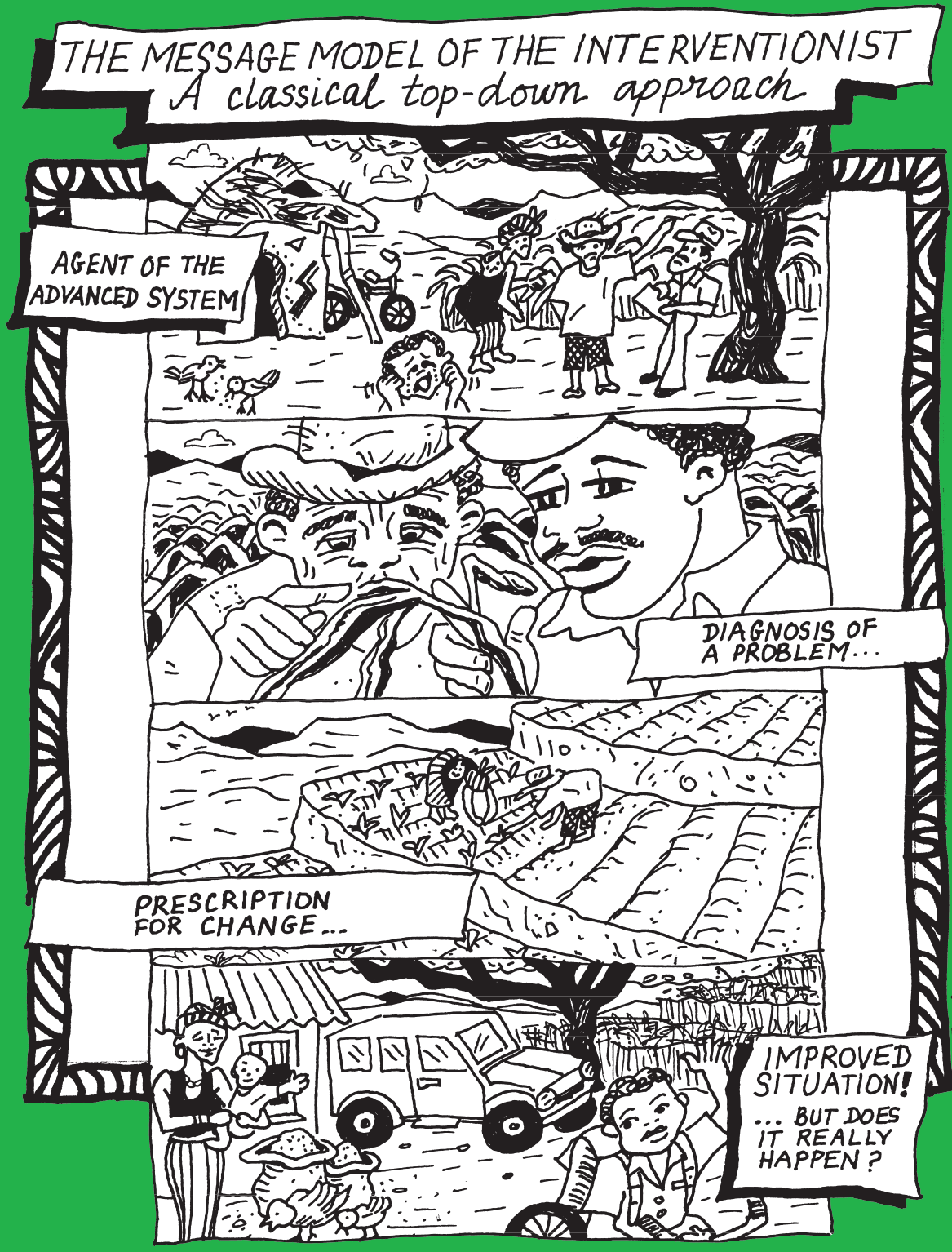
The message model of the interventionist

The usual way services are delivered by agricultural scientists in SSA is to use external expertise to define a problem and then to institute measures to resolve it. The role of farmers in dealing with the situation tends to be largely that of passive implementers. It is an example of the classical benefactor–beneficiary relationship. How it was thought to work is shown on page 24, but in reality it often fails.

An example of this 'message model of the interventionist' is one where a representative of a public health system notices a problem and diagnoses it as by poor nutrition. Arrangements are therefore made to enrich the flour consumed in the area with the aim of improving the nutritional status of the community.

Replace the nutritionist with an entomologist or agronomist and the approach remains valid. The entomologist, for instance, notices a substantial drop in the average household income in a community dependent on maize for its income and food security. His/her diagnosis is that poor pest control is resulting is considerable post-harvest losses. The 'prescription' is that farmers should adopt modern ways of controlling post-harvest losses in order to ensure food and income security in the community.

The gravity of the problem and the inherent superiority of the modern methods being introduced are expected to compel farmers to adopt the modern system of reducing post-harvest losses. To encourage adoption, on-farm trials are conducted to enable farmers to appreciate the efficacy of the modern methods. Little attention is usually given to such


THE MESSAGE MODEL OF THE INTERVENTIONIST
A classical top-down approach
AGENT OF THE ADVANCED SYSTEM
DIAGNOSIS OF A PROBLEM...
PRESCRIPTION FOR CHANGE...
IMPROVED SITUATION!
... BUT DOES IT REALLY HAPPEN?
ALEYA

issues as the affordability, accessibility and sustainability of the recommended methods given local constraints.

The interventionist model is basically one that aims to change the direction of human activity in what the intervener deems to the most appropriate way. The model operates as if its application is based on full information. Yet in most instances agricultural scientists rarely have the full picture of the situation within which they are intervening, especially given their indication to take a mono-disciplinary approach to problem solving. It is rare to find them working in concert with social scientists in multidisciplinary teams. Neither would they normally try to seek information on what solutions have been applied by farmers in response to the problems at hand and with what results.

Becoming an animator or facilitator of rural transformation

Notwithstanding the general intellectual arrogance that delayed the understanding of the traditional knowledge based African farming practices, since the late 1960s there has been an upsurge of interest in such practices, notably in farming systems research. The researcher–extension worker–farmer linkages that farming systems research promoted was consistent with the late President Julius Nyerere's plea that: *"In the interest of becoming more effective in what they do, African intellectuals have to be part of the society, which they are changing; they have to work from within it, and not try to descend like ancient gods, do something and disappear again."*

This was a wake-up call for agricultural research scientists to operate more like animators if they expected to have any impact on agricultural and rural development in Africa. It challenged them to shift from the message model of the interventionist to one that is based on the knowledge and value systems of communities and through which the agricultural research scientist facilitates the process of agricultural and rural transformation. Such a model was described as a 'system model of the explicator' that could be applied by agricultural scientists in facilitating rural transformation.

In the system model of explicator, agricultural scientists accept the inherent capacity of people to take charge of their own destiny, thereby drawing upon the internal capacity of the stakeholder community to activate a self-driven transformation process. The model is underpinned by the principles of communication, reciprocity and partnership that are essential in enabling rural people to apply their knowledge and capacities to activating the process of rural transformation. How it could work is depicted on page 26.

The system model of the explicator

A fundamental assumption of this model is that a farming community is an information-processing structure that draws upon internal and external information to act on situations. The model recognises that farmers have a stock of knowledge and wisdom that agricultural scientists have tended to ignore to their disadvantage.

It is through dialogue with members of any community that agricultural research scientists can tap the farmers' rich wealth of experience and wisdom in agriculture and use it to stimulate rural transformation.

Studies in Africa have validated the merit of using such a model, e.g., the indigenous knowledge on soils that was tapped from the Bété and Senufu communities in Côte d'Ivoire, read Birmingham, 1998. A number of techniques have already been developed to enable researchers to access such knowledge including:


THE SYSTEM MODEL
OF THE EXPLICATOR
PURSUING COMMON GOALS
EXPORTS
MARKETS
PROCESSING
FOOD +
FOOD
RECIPROCITY AND UNITY OF PURPOSE
EXPANDING
HORIZONS
ALEYA

- Participatory Rural Appraisal (PRA)
- Methods of Active Participation (MAP)
- Participatory Action Research (PAR)
- Appreciative Inquiry (AI).

Fundamentally, the system model of the explicator does not pretend that every popular practice within an agricultural system is welfare-promoting, or that there is never room for improvement or innovation. Rather, its most powerful message is that those improvements or innovations are more likely to succeed and become sustainable in the long run if they are introduced with due cognisance of the existing knowledge systems, needs and capacities of the target communities. Using this model, an agricultural scientist interprets the world of rural people not as a set of unsolved problems, a series of gaps and deficiencies and failures, but rather as a set of brave attempts, a series of partial achievements, and a sequence of possibilities that could yield rich rewards if the community and the agricultural research scientists worked together.

Implications for your graduate research training and research in agriculture

If you are to follow this model then you need to:

- Develop skills that allow you to interact effectively with the communities in which you will carry out your research – take some social science courses and try to work with interdisciplinary teams
- Improve your communication and listening skills to capture local knowledge and use it in designing your project
- Be sure that your project really addresses the needs of the people you are trying to help.

The impressions that members of the rural community have of who they think you are and what interests you, substantially influences what information can and cannot be shared with you. If you do not quickly detect and help to dispel a negative perception, it will affect the quality of information you are receiving from the community. If that happens, your interaction with the community could do you more harm than good.

Learn the art of using observations and knowledge of the agricultural systems where you work so that you appropriately factor them into your research design and respond to the priority needs of both the scientific and the farming communities. You also need to understand the interface between science and the economy, or science and commerce. Indeed, many people believe that the increasingly closer interface between science and commerce has been a main factor in the development of biotechnologies. The biotechnology movement did not begin from the usual pursuit of knowledge for knowledge's sake but rather from the decision to strategically apply scientific knowledge to enhance the competitive edge of those investing in the generation of new technologies in a very highly competitive global economy.

You need to be conscious of the primary need that you are serving as an agricultural scientist in the public domain. It may be difficult to hide behind the cloak of neutrality.

The system model of the explicator is not a panacea for all research or rural development problems. Each development situation as it unfolds presents new challenges that pose difficulties in the application of the model. Indeed, given the predominance of the message model of the interventionist in much of rural Africa, farming communities may not initially think that you are serious when you do not provide ready answers to their problems. Helping them to begin taking charge of their situation and destiny is the art that you must possess. It is therefore important that if you try to apply the system model of the explicator, you also make a deliberate attempt to determine what works and what doesn't. Out of that experience, a local research team can then evolve a modified version of the model that is more appropriate to the specific situation in which they are working.

Resource material and references

Birmingham, D.M. 1998. Learning local knowledge of soils: a focus on methodology. *Indigenous Knowledge and Development Monitor* 6(2): 7–10.

Hagmann, J. 1999. *Learning Together for Change. Facilitating Innovation in Natural Resource Management Through Learning Process Approaches in Rural Livelihoods in Zimbabwe.* Margraf Verlag, Weikersheim, Germany. 337 pp.

Hagmann, H., Chuma, E., Murwira, K., Connolly, M. and Ficarelli, P. 2002. Success factors in integrated natural resource managemnt R&D: lessons from practice. *Conservation Ecology* 5(2): 29.

Opio-Odongo, J.M.A. 1992. *Designs on the Land: Agricultural Research in Uganda*, 1890–1990. African Centre for Technology Studies (ACTS), Nairobi, Kenya.

Ruttan, V.W. 1982. Agricultural scientists as reluctant revolutionaries. *Interdisciplinary Science Reviews* 7(2): 170–177.

Young, F.W. 1968. Intervention versus explication in applied science. *Journal of Home Economics* 60(4): 262–267.

2.2 Research for whom?

Bharati K. Patel

- **Two-thirds of the African population reside in the rural areas and are involved in agriculture**
- **Farmers voices must be heard and their participation is essential to bring about change**
- **Africans can and must solve African problems**
- **You can make a difference**
- **Universities must work closely with research and extension services**
- **Learn by doing – get your hands dirty**
- **Be aware of the limitations of your research methods**
- **You should honestly assess the value of your research**
- **There is great satisfaction in being of service to others**

'Whenever in doubt apply the following test: Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to self-reliance for the hungry?'

Mahatma Gandhi
Advice to policy-makers

Research for whom?

Research for the millions of small-scale, resource-poor farmers who have to eke out their livelihoods from agriculture. Nearly two-thirds of the population on our African continent is dependant on, or involved in agriculture. If we want to reduce poverty, feed all our people and develop then agricultural productivity must increase. We cannot ignore or bypass this large sector of our population.

There are many problems to solve in agriculture. Much research has been done and many technologies have been developed, but why are so many of them still on 'the shelf'? There are a number of reasons why this has happened but for the most part it is because the technologies are not relevant to farmer's circumstances. To be effective new technologies must fulfil an identified need.

Farmers' voices must be heard through their active participation in helping to set research priorities. Only then will research and progress be in step.

Agriculture and rural development have progressed significantly in Asia and Latin America, why not in Africa? The development journey began at about the same time for all three regions, but Africa has remained stagnant at best and in some parts has even declined. We can only change this situation if each one of us makes a commitment to serve and better the lot of the majority of Africans.

Some of our governments have slowly come to realise that the small-scale farming sector really needs better support because agriculture is the engine for growth and development, and because poverty-reduction goals cannot be achieved without such support. The Asian governments supported agriculture and benefited from the Green Revolution in feeding their large populace, but African governments wanted to bypass agriculture and leapfrog into industry. Even in those African countries where there was investment in agriculture, it was only in the large-scale sector. Kwame Nkrumah did not heed the report of the economist W Arthur Lewis who

advised that Ghana should give priority to food production before embarking on the road to industrialisation. Nkrumah even abolished the national extension system! Korea and Ghana in 1957 had the same per capita income and Ghana's gross domestic product (GDP) was higher than Korea's. Now Korea is a developed country and Ghana is at long last heeding Lewis's advice, having learnt a bitter lesson. Nigeria's experiment with industrialisation is another glaring failure, yet even today many African countries do not give agriculture the priority it deserves. Small-scale agriculture can be productive; it helps retain earnings in the rural areas and can have a significant impact on unemployment, as experience in Asia has proved.

The World Bank's lending for agriculture is currently at an all-time low. The Millennium Goals give very little emphasis to agriculture. The environment, infrastructure and population density make things different in Africa. The situation calls out for research into what is limiting progress. The contribution you, as a postgraduate, can make is significant.

We need young Africans to take up the challenge and invest their time and brain-power in agriculture. You must lead the way.

My personal research journey

I joined the research service in Zambia in 1971 immediately after getting an MSc degree in plant pathology that required a dissertation and a research study. I did my MSc when chemical control was the in thing and you could always find a chemical control measure to get rid of a disease or pest problem.

The dissertation was on brown spot and blue mould (Wild Fire) of tobacco, and my practical research was on potato dry rot (*Rhizoctonia solani*). During this practical research I learned a lot about varietal reaction to the same pathogen, how size and time of infection affects the quality of potatoes, how long the disease survives in the soil, and how farmers were dealing with the problem.

My first sole assignment when I started work was to solve a disease problem on the greens of the largest golf club in town! I knew nothing about fairy rings, but did manage to identify the cause and provided a chemical solution to the problem.

In those days pathologists and entomologists had to do research and provide a diagnostic service by identifying pests and diseases on samples sent in by farmers – mainly commercial large-scale growers because very few small-scale farmers took advantage of this service. This taught all the staff a great deal about holistic diagnostics and stood them in good stead when they went to the field.

One redeeming feature of the job was an annual tour of one whole province of Zambia and that included visiting farmers of all types – in some areas there were only small-scale farmers. These tours allowed me to observe and learn much about development and problems in the rural areas. We travelled by landrovers over every bump and got stuck many times because the tours were made during the rainy season. It was a wonderful way to see, and learn while building relationships and networking with colleagues from other agricultural divisions – extension, veterinary services, land use planners and those working in the University and the National Council of Scientific Research. In those days I remember we used to have unspent budgets! so adequate funds were available for our research, for travel within the country, to buy books, and to print advisory booklets or pamphlets. Farmer training institutes in the rural districts were well funded. Research centres based in the provinces did

do research for the smallholders. They bred beans for local conditions that were based on taste preferences and would fit into local intercropping patterns, and developed sunflower varieties for smallholder production.

Farming systems came to the forefront in the early 1980s

Integrated research teams were formed involving economists, agronomists, and sociologists. Adequate funding was provided by donors for these teams, and even though they were looked upon as the 'prima donnas' of the research systems, they did do research in the rural areas on smallholder farms. Funds from government coffers were stable but started to shrink in the mid-1980s and fell to critical levels in 1990s. I did my PhD in Australia during this period. Major training efforts were launched in the national agricultural research systems (NARS), extension and other divisions of the ministries of agriculture with support from donors at this time. An expansion in capacity development that was much needed. Interaction with the international agricultural research centres (IARCs) became stronger in the 1980s and in the 1990s non-governmental organisations (NGOs) entered the agricultural scene with a bang! Today there are many players/actors in the agricultural research and extension arena and agriculture involves many more institutions and organisations than the traditional NARS, IARCs and universities.

The two decades after independence can be identified as the period of growth for agricultural research in Africa

Unfortunately small-scale farmers were not clearly identified nor targeted by research services during this period – they just loomed in the background – forming a backdrop – hence, the road to enlightenment, awareness and duty to identify and assist those who most require our assistance was a long one. The smallholders slowly came into the picture and focus and now hold the centre stage for all agricultural developmental activities. I witnessed the transition and participated in the slow change from a classical model of conducting research on-station to advocating and supporting on-farm research by all scientists in the research service.

My personal views on research and development became more focused with time, experience and exposure. What stood out was that **good science** – the currency of researchers, whether in the laboratory or field or participatory-based **is a must**. And that you need well-trained scientists to do the research. You reflect on your life and achievements from time to time – and you do ask yourself the following questions 'What have I achieved/whom have I helped?'; 'Have I made the best of my opportunities?' Honest reflection does often give you the impetus to go the extra mile. Throughout my journey I had ample learning opportunities, met a lot of interesting and dedicated persons, and was lucky to have good bosses, colleagues, and seniors. You have to be curious, open-minded and keen to learn to take advantage of all the opportunities that comes your way. I was very lucky to have worked for my country's research service, for an IARC and finally for a foundation that firmly believes in science-based development. My last job gave me the opportunity to develop and operate a programme which allowed me to put into practice all that I had learned about research and development over time. The programme focused on two fundamental areas of importance in Africa – capacity building through problem-solving research. Mine has truly been an experiential journey.

Your research journey

Researchers of today have a clear-cut focus/goal because smallholders are now specifically identified as the target and beneficiaries of research.

You must be aware that even if your research does not benefit the farmer immediately, ultimately it should. You must also to be aware that you cannot solve all their problems – you have to empower them to be able to carry out some research on their own in order to find solutions to suit their reality. It still stands that farmers need to be provided with a basket of options, such that they can choose or select options or components of a technology that suit their particular conditions.

Many advances have been made in conducting research in the field and in ways of involving the smallholders – their knowledge and participation is now fully recognised as being of core importance. Different ways of engaging stakeholders and integrating their participation are being tried out in many developing countries of the world. Farmer field schools were first tried out in Indonesia in the rice-based systems and have now spread to our continent. **The cost of on-farm research is high.** This high cost of field research makes it imperative that the farmers become part and parcel of the research and development process. The pros and cons of each approach or methodology should be well scrutinised, revised and refined before being used under African conditions. The costs of field research need to come down through the development of new approaches so that we can reach many more farmers. This is a challenge for all of you.

Africa has all the natural and human resources to produce adequate food for its people. Good supportive proactive policies for smallholders, that hold steady over a period of time, would allow the farmers to adapt and grow. **There is much to be done and it can be done.** We need more innovative indigenous approaches that are based on good science if we are to reach enough farmers.

Mapping the landscape/situation analysis

Mapping the landscape and analysing the situation are essential to any research. You need to collect all the available information or data on your topic/pest/disease/soil/system area so that you can sense where your research fits into the agricultural research agenda. This will help you understand what type of research you are doing and where it fits in the research continuum. It took over 20 years of research and interaction with NARS by an IARC for one chickpea variety to be released to farmers. Not much work had been done with chickpeas when the research project started. It began with germplasm collection, evaluation, and selection, and progressed through the initiation of a breeding programme, to field trials, seed multiplication and the eventual release of the new variety. Remember basic or strategic research will take longer to reach the main beneficiary (the small-scale farmer) than applied or adaptive research. The information that you collect while preparing for your research proposal will give you an indication of the importance and relevance of your research. Research results from NARS are usually found in their annual reports. Scientists of the NARS systems do not often publish their results in peer-reviewed journals as do the academics and scientists from IARCs. Most of our National Research and Extension Services (NARES) have a backlog of annual reports. Hence you will need to make personal contact with the staff of these vital services to get the information you need.

The role of universities

The main function of the university is to create and disseminate knowledge. The primary function is to provide degree training. But, since universities have highly trained staff, their research capacity and involvement in carrying out relevant problem-solving research for the country is vital.

In his lecture on 'The Institutions and the African Farmer', Eicher (1999) makes a logical case for the university to be part of the triangle which includes the national research institutes and extension services. The university/faculty needs to be part of this triangle if it is to provide you with the best possible training in agriculture. It is the university that produces the future staff of the national institutions. The three institutions should be closely linked. The need for them to work together collectively is obvious but not so easy to put into practice. In some countries integration has been attempted at some level as in Kenya where universities can apply for grants from the Kenya Agricultural Research Institute (KARI) to carry out specific pieces of research. Uganda has also gone some way along the road to integration. The World Bank's Agricultural Knowledge and Information System (AKIS) also supports closer integration of the three main national agricultural institutions: research, extension and the universities.

At the individual level interaction is possible but institutionalising integration requires much more effort and appreciation of each other's strengths and weaknesses. But working at the field level demands not only the input of research scientists based in provincial research stations but also the extension staff based at district/county or sub-county level.

Graduate research: learning by doing

You may have done a small research study as part of your Batchelor's degree. This might have involved some simple tests or measurements such as monitoring the spread of a disease in a plot or field or examining the effect of the some chemical on disease or pest control. This will have given you an insight as to what goes into a research study and how to measure the effect of something on a plant, or soil. Such experience helps you to become proficient in spotting a trend or an effect and in turn allows you to make a judgement or perhaps reach a conclusion.

The best way to learn is by getting your hands dirty. Share with the farmers, live with them, and learn their problems first-hand.

You learn from practical experience what effort farmers expend on agriculture; the time, energy, opportunity costs and risks they take to eke out a living. The understanding gained will be most useful to you for the rest of your life, and your post-graduate years are the best opportunity many of you will have to gain that first-hand experience.

At the MSc level the research period is usually about 2 years. At the field level this time would allow you to gather data over one or two rainy seasons depending on the crop you are studying and where you are situated in the unimodal or bimodal regions of Africa. At the PhD level your work will cover a period of 3–4 years. In this time you may or may not get a conclusive result but will gain an understanding of the problem or situation and realise that research can be a long process.

More ways than one

You should be aware that there are many ways to get an answer and that your chosen approach may or may not have added advantage over other approaches. You must be realistic in selecting an approach and be objective when drawing conclusions. You need to be aware of the pros and cons of each methodology. Discuss this with the biometricians in your faculty before embarking on your fieldwork. You should also be aware that in a biological living system everything is affected by everything else. The system is complex and the effect can be compounded. We tend to study effects of major variables – the variety being used, the status of the soil, rainfall pattern and management. You can look at the effect of one insect or pathogen or you may choose to look at the effect of a combination of factors such as the effect of diseases or pests on growth, or to study the interactions between the factors on the crop.

Your research could fill a gap in the knowledge, or it might be of an exploratory nature, that focuses on listing of all problems and issues linked to a certain crop and then prioritising the problems from the farmers' perspective and experience. Your research might just validate a result already obtained elsewhere in the country or region, or it could adapt technologies from elsewhere to local conditions.

You should assess the value of your research

Where does it fit in the farmers' priorities list? It may also be useful to see how it fits into district, provincial or national level priorities. What type of research? Is it basic or strategic, applied, or adaptive? Discuss all these aspects with your supervisor, NARS scientists, extensionists and others working in the field.

If possible you must try to work on a relevant and real problem that farmers face. Seek out academics who prefer to work in the field as your supervisors. 'Outreach' is now accepted as function of the universities and hence it is possible to do research in farmers' fields.

'Service orientation' (service to others, to your nation and to the farmers) should be part of the curriculum**.** Whatever type of research you undertake from laboratory-based molecular biology to economic/policy research – what you have to keep in mind is that the ultimate beneficiary is the small-scale farmer. We must all acquire a developmental mind set. As my boss used to say frequently *"Africans must solve Africa's problems"* – outsiders can assist or facilitate but Africans must take the lead in charting their destiny. **Your role is to take up that challenge and serve your country and the rural poor by applying your talents positively.**

At the MSc and PhD level you are just beginning the journey – which path you take will depend on your ambition and/or the jobs or opportunities available. Your first research project is a learning exercise – your first hands-on experience.

The journey is long but the satisfaction of being of service – bettering the lives of others, creating knowledge, training and seeing your name in print – makes it all worthwhile.

Important things to remember

1. Respect for all – everyone is important – the farmers, the extension worker, everyone involved in rural transformation.
2. Learning together – make this your motto – observe, question and keep on learning – you never stop learning because you do not know everything!
3. Be transparent in all your dealings – when you do not know something, say so – you can always find out!
4. Empower others – give them space to learn and lead.
5. Build solid relationships with the farmers – make their reality matter.
6. Development does not occur overnight – it takes time; be patient.
7. You will have to play many roles, researcher, advisor, listener, convenor, negotiator, facilitator, social worker and more.....Be prepared.....
8. Be a good team player.
9. Make room for reflection and enhance your analytical abilities.
10. Have a vision...an individual can make a difference .....one little mosquito can and does!

Resource material and references

Blackie, M. and Gibbon, D. 2003. *Enhancing Impact: Strategies for the Promotion of Research Technologies to Smallholders in Eastern and Southern Africa*. Natural Resources International Limited (NRIL), Aylesford, UK. 60 pp.

Eicher, C.K. 1999. *Institutions and the African Farmer*. Economics Program, CIMMYT, Third Distinguished Economist Lecture (15 January, 1999). Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), Mexico DF, Mexico. 64 pp.

Eicher, C.K. 2001. *Africa's Unfinished Business: Building Sustainable Agricultural Research Systems*. Staff Paper No. 2001-10. (May 8). Department of Agricultural Economics, Michigan State University, East Lansing. Michigan, USA.

Hagmann, J. 1999. *Learning Together for Change. Facilitating Innovation in Natural Resource Management through Learning Process Approaches in Rural Livelihoods in Zimbabwe*. Margraf Verlag, Weikersheim, Germany. 337 pp.

Hagmann, H., Chuma, E., Murwira, K., Connolly, M. and Ficarelli, P. 2002. Success factors in integrated natural resource managemnt R&D: Lessons from practice. *Conservation Ecology* 5(2): 29.

Kolb, D.A. 1984. *Experiential Learning. Experience as the Source of Learning and Development*. Prentice-Hall Inc., New Jersey, USA. 256 pp.

Sayer, J.A. and Campbell, B. 2001. Research to integrate productivity enhancement, environmental protection and human development. *Conservation Ecology* 5(2): 32.
url: http://www.consecol.org/vol5/1552/art32.

World Bank. 1999. *Integrating Universities into National Agriculture Research and Extension Systems; Good Practice for Investment in Agricultural University Programs*. Agriculture Knowledge and Information Systems (AKIS), Good Practice Note, World Bank, Washington DC, USA.

2.3

Approaches to impact-oriented agricultural research

Paul L. Woomer

- **You need patience, vision and teamwork to bring about change**
- **Rural farmers need your help**
- **If possible work through local farmer organisations**
- **You must know what type of research you are doing and where your research fits on the research continuum**
- **There are many successful participatory scaling up projects**
- **Be a life long learner- learn from others**
- **Do not let your research vision be narrowed by disciplinary bias**

'Providing insightful answers to difficult questions in ways that are useful to society is the principle responsibility of the scientific community.'

W.C. Booth *et al.* (1995)

'Documenting good ideas and potentially useful solutions through carefully conducted experimentation and case studies, in a manner that disentangles them from research fads and personal opinions, is the means to achieve these answers.'

Carl Sagan (1996)

Introduction

There is a renaissance in African agriculture. Many farmers in sub-Saharan Africa are moving from subsistence, cereal-based farming to market-oriented and mixed-enterprise agriculture. Threatened households find new uses for available resources that lead first to greater self-sufficiency and then to local and more distant markets. Farmers are diversifying into new enterprises such as confined livestock and poultry keeping and market gardening. They are forming community self-help and conservation groups and independent marketing associations and they are joining out-grower schemes. Several international, national and non-governmental research and development organisations are helping. A decades-long commitment to increasing human resources in agriculture adds force to the changes.

Stephen Carr (1997) identified five components for attaining rural transformation that provide guidelines on where your research could make an impact:

- Access to suitable improved germplasm
- Access to inputs
- Closely linked crop and livestock enterprises
- Road and communication infrastructure
- Information and market access.

What skills are required?

Professionally trained young Africans are keen to contribute to this rural transformation and to apply their knowledge. This is not easy. You will need patience, vision and teamwork: skills that may not be taught to undergraduates. You need patience because progress is always too slow for the eager. Agendas are inflexible, administrators are bureaucratic, donors are cautious, colleagues are preoccupied, sites are remote and farmers are conservative. A project rarely has impact within 2 or 3 years.

Teambuilding and teamwork are essential because successful research and development projects demand a spectrum of skills. The need for particular skills changes over time as the focus of efforts shifts from applied research to its adaptation and dissemination. Each team must be flexible and its members must be willing to move both forward and aside, depending on project needs and achievements. Honest criticism is essential to appraise team performance, and team members must remain open to the suggestions of others, even when they point to shortcomings and mistakes of individuals. As a team member you must be proud of the team's achievement as well as you own contributions; you must also learn to trust the instincts and abilities of others.

Two types of small households that need help

The poorest farmers suffer from food insecurity, and research efforts should focus on improving their food production and storage systems (Figure 1). When food supplies are exhausted from season to season, any improvement must be achieved within one season. The poorest households lack land, labour and the capacity to invest in farm inputs, so you should be realistic about the candidate technologies you explore.

You can help the poorest farmers by examining their management practices, discovering changes that will bring them the greatest improvements, and advising them on how to make more efficient use of their resources. You will find many practical limitations such as nutrient or moisture supply, pests and diseases, weed competition or crop genetic constraints, so a wide range of agricultural disciplines and perspectives are needed within a research team. Food insecurity also affects household nutrition, so you may be able to improve diets with advice on the productivity and diversity of the home garden. Households on very small holdings in peri-urban settings cannot be expected to achieve food self-sufficiency; they are more likely to benefit from research that promotes market-oriented gardening than increasing food production.

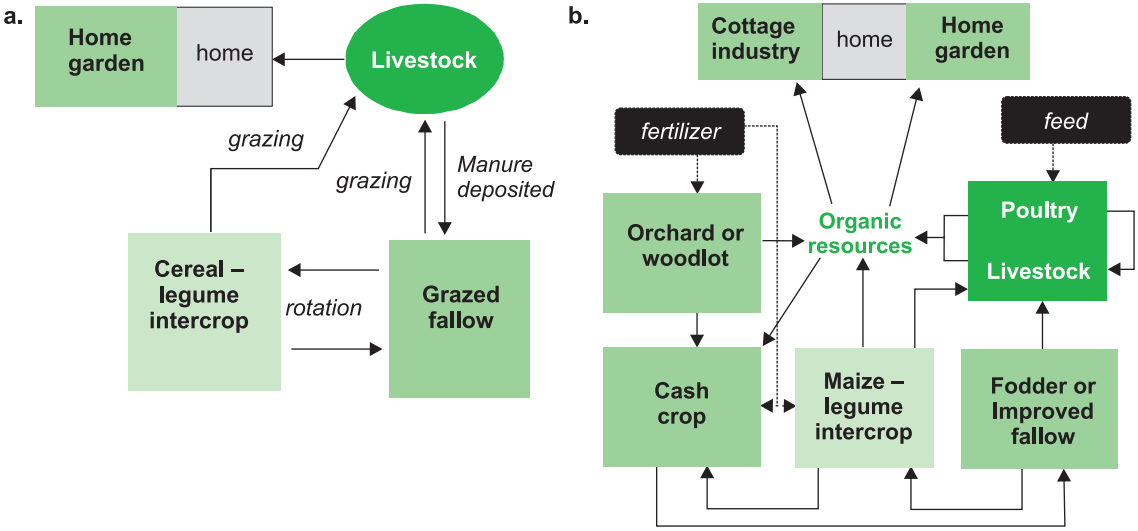


Figure 1. Major organic resource flows within: a. subsistence, cereal-based farming, and b. mixed enterprise, market-oriented agriculture. Note that resource flows within subsistence farming are more passive in nature and that more uses of organic resources emerge as farm operations diversify

Food-secure households offer a more diverse pallet of research and development opportunities. Management systems which economise on inputs and labour, or that substitute one for the other, offer special opportunities for research. Food-secure farmers are market-oriented, more open to changes and place more value on their time (Figure 1).

Working with farmers

Establishing a healthy, productive working relationship with farmers is an essential component of applied and adaptive research. Farmers' involvement in the research process may vary with different types of investigations. In researcher-designed and -managed off-station studies, farmers simply provide the research field and are consulted about local growing conditions. In researcher-designed, farmer-managed studies, the farmers' actions determine the experimental outcomes. In farmer designed-and-managed studies, as a researcher you can play a facilitating role in assisting farmers to better interpret results, and by treating farmers' impressions as sources of data. Regardless of the division of duties between you and the farmers, it is extremely important that both parties understand their rights and responsibilities (Table 1).

Table 1. Guidelines for successful collaboration between farmers belonging to self-help groups and researchers conducting on-farm studies

While doing research you should

- Involve cooperating groups and farmers in an earlier stage of research planning
- Rely upon simplified experimental designs and relatively few treatments and explain which treatments are intended as candidate improved technologies
- Establish a clear timetable and division of responsibility for field operations, data collection and record keeping
- Interpret their research findings into terms understandable by client farmers, particularly their costs and returns
- Be prepared to modestly compensate collaborators for their efforts and harvest removal
- Encourage farmers to conduct their own satellite experiments adjacent to the field trials.

You should not

- Perform unplanned on-farm field operations without the knowledge and consent of collaborators
- Fail to keep appointments or rearrange schedules without consulting collaborators
- Ignore collaborators' impressions of different management practices, particularly unrealistic reliance upon additional labour, land or expenses
- Exclude acknowledgement of community groups and key individuals in your publications.

Collaborating farmers should

- Make their own observations concerning field trials and express them at group meetings and to research partners
- Organise local field days that demonstrate the tested technologies to their communities
- Make a genuine effort to understand the scientific basis for treatment selection and sampling procedures so that promising results can become adapted into farm practice.

Collaborating farmers should not

- Falsify data collection records, disguise experimental failures, or exaggerate claims for compensation
- Remove crop harvests without the knowledge and agreement of research partners
- Expect researchers to engage in lengthy social interactions during intensive field campaigns.

You must not dominate the research process, and should take time to explain your intentions and approaches to farmers. Establishing regular consultation and firm timetables, and relying upon simple experimental designs with understandable treatment combinations are important means to this end (Box 1). Hiring family members to assist in routine measurements is one possible reward mechanism and you could offer a small compensation for the use of the land. Don't intrude too much and keep your social interactions with farmers to a respectful minimum.

Box 1. On-farm miscommunication

- Patty's MSc research involved large field experiments on three farms. She would arrive at irregular intervals, deride farmers for lateness of field operations, refuse to consider claims for compensation and argue with fellow students and technicians during data collection. During her defense, she acknowledged the assistance by 'the farmers' without referring to them by name. Three years later she received a PhD scholarship and sought to work in the same general locations but experienced difficulty in securing collaborating farmers!
- Bill and his team of field technicians were experts in installing on-farm trials, completing as many as 10 per day. They would arrive, mark the plot boundaries, apply pre-packaged inputs, plant the seeds, label the plots, thank the farmer, Cornelius, and be gone in a matter of minutes. Cornelius established an independent satellite experiment by carefully marking the plots in string and planting along a marked 10-m line, just as the researchers did. But there was no improvement in crop performance because nobody had bothered to explain which inputs were being examined and why!
- A team of researchers scouting for new field sites chanced across a farmer burning brush next to a slightly chlorotic stand of groundnuts. They observed satisfactory root nodulation and concluded that the groundnut suffered calcium deficiency. They carefully demonstrated how to apply wood ash to the groundnut pegs and then recommended that the farmer do the same. He replied "Why should I waste this wood ash on my neighbour's groundnuts?" Because no obvious boundary existed, the researchers had assumed a contiguous landholding!

Advantages of working through local farmers' organisations

Projects designed to achieve agricultural impacts almost always involve a stage of on-farm research. It is common to select collaborators from a list of farmers obtained from local authorities. Where possible, work with self-help groups. Self-help groups are formed as a means to access information and to assess new technologies. Groups of neighbouring farmers share common concerns and it is reasonable that they organise themselves for collective action. They share information, learn new technologies and pool resources to acquire inputs or to market surpluses. Farmers who belong to self-help groups are often enthusiastic and capable collaborators.

Among the advantages of working with local groups is that it is easier to assemble farmers to explain the goals of a research project and to identify collaborators. Training in experiment installation, measurement and record keeping can be organised more easily through the officers of a local self-help group, whose keenest members can be recruited as trainers. Identifying one farmer as a local coordinator tends to invoke less rivalry when all of the collaborators belong to the same self-help group, especially when the appointment is made in a participatory manner. It is easier to establish experimental schedules and to adjust them when working with groups of farmers. During experiments, peer pressure among group members will ensure that tasks are performed correctly and on time, such pressure does not exist among independently recruited farmers. Similarly, the rights and responsibilities of collaborating farmers are more easily established and enforced. Farmers within groups will tend to voice their opinions more openly and to be bolder in challenging your actions and highlighting your misconceptions. Local self-help groups are in a better position than you are to organise farmer field days to promote research findings. They often have important contacts among neighbouring groups and local authorities that will ensure these events are well attended. An example of a very successful self-help group in rural Kenya, the St. Mark's Women's Group, is presented in Box 2.

Box 2. St. Mark's Women's Group, Amagoro, Teso, Kenya

Teso lies to the south of Mount Elgon in Western Kenya. It has infertile sandy soil and until recently was primarily used for grazing. The conversion to sedentary agriculture resulted from increased population and establishment of land titles but was accelerated by an epidemic of East Coast fever, a viral disorder that decimated the local cattle population. The St. Mark's Women's Group was started by 30 church members in 1998 as an outgrowth of a prayer group. Its original goals were poverty alleviation and improved child nutrition. The group has five elected officials; a Chairperson, Vice-chairperson, Secretary, Vice-secretary and Treasurer who are elected for 3-year terms. The membership in 2003 was 52 and the group is locally recognised as an effective and equitable community-based organisation, partly because of its widely attended field days and its successful efforts in processing and marketing traditional crops.

The group's primary collaborator is the Sustainable Agriculture Centre for Research Extension and Development in Africa (SACRED-Africa) that initiated a local outreach project in partnership with St. Mark's and other local organisations in Teso in 1999. Relying upon participatory methods for problem identification and a simple adaptive research process, progress was made in the areas of composting, soil fertility management, tree seedling establishment, integrated pest management, crop diversity, marketing farm surpluses and gender roles in agriculture. The St. Mark's group also serves as one of seven co-operators in the Best-Bet Network, a group that evaluates alternative land management recommendations side-by-side on 140 farms in Western Kenya. Exposure to different maize–legume intercropping technologies has demonstrated to members how to raise yields from less than 2700 kg/ha to over 4200 kg/ha, increasing net returns by US$200 per crop. In the process, members developed new skills in recordkeeping and fertilizer use, increasing their experimental successes from 70–87% within a single year.

After 5 years of operations, several impacts from the group are evident. Their rapid bulking and broad distribution of cassava resistant to the mosaic virus promoted food security within the group and among neighbouring farmers. When most other cassava in their district was failing, this group had established over 240 ha of cassava throughout the area. The adoption of a maize–lablab relay fallow has demonstrated that sustainable field cropping can be achieved on the worst of N-deficient sands. Traditional green vegetables and small grains that were previously considered a home gardening activity now have established markets. But the benefits from the group's activities extend beyond technical adoption because its members now view agriculture in a more holistic and positive manner.

Members are able to diagnose new problems as they arise and to better apply past lessons to emerging situations. The underlying mechanisms for the degradation of agricultural resources are now better understood, as are the relationships between various conservation measures. As Jenipher Etiang', the group's Chairperson, stated "We discovered that we had many resources at our disposal that we were not using well and the relationship between the problems that we were having and our present and past actions. It was a turning point in our lives." The group is frequently visited by members of other organisations from Kenya and neighbouring countries, by officers from the local Ministry of Agriculture and by local politicians who attend field days to make modest donations. Members assist one another with medical and funeral expenses and through small loans because they know their neighbours can now generate income from farming. Even domestic lives have improved, as is evident from Jenifer's comment "Women no longer bother husbands for money to buy salt, sugar or tea leaves and this has improved our family relationships."

How to navigate the research and development continuum

Along the research and development continuum (Figure 2), 'upstream' theory and basic research is translated into potentially useful technologies that are then applied under field conditions. Next, these candidate technologies undergo 'downstream' adjustments based upon the needs of potential users and their site-specific conditions become captured into

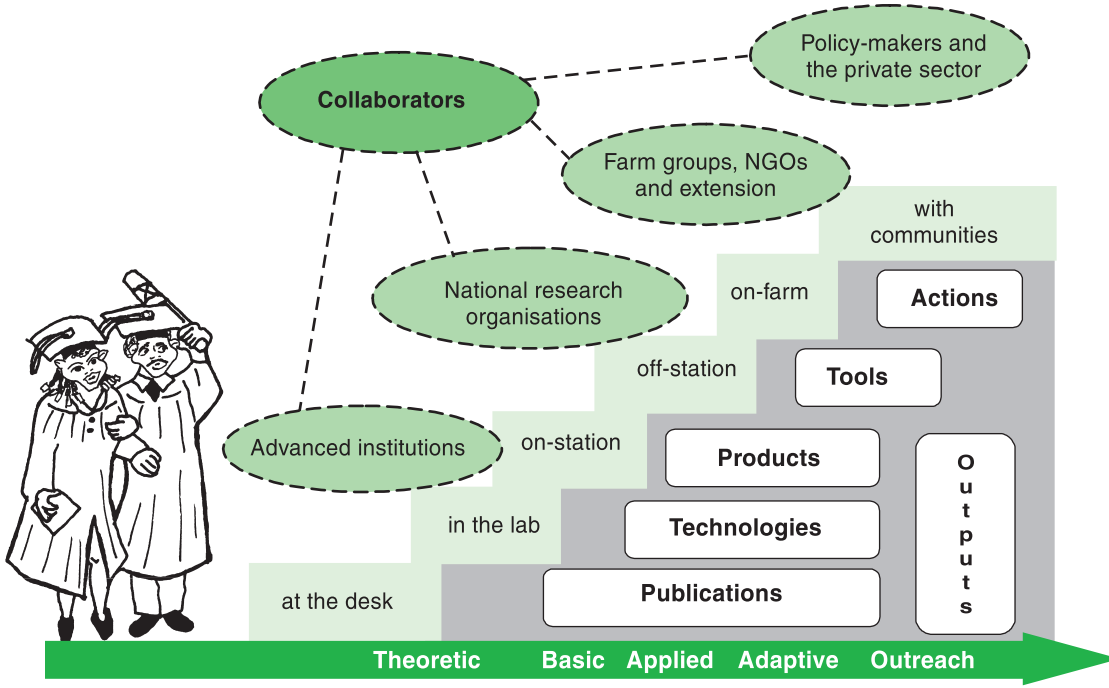


Figure 2. Research intended to achieve impacts through collective action is conducted in a series of settings and with changing sets of cooperators, leading to a sequence of more widely distributed research products

products that are tested under a wider range of conditions, and are then offered to communities as a possible solution to common problems. This process requires several years at best, and while relatively few candidate technologies are likely to become widely adopted by society, actions and choices taken by scientists as they escort research products along the continuum can greatly affect the fate of their innovations.

While the process appears straightforward, navigating the research and development continuum requires teamwork, vision and persistence. Innovators must select the appropriate setting and collaborators, both of which change as their innovations undergo testing and become refined. Theoretical and basic research leading to new ideas, is performed at the scientist's desk and in the laboratory, and is best facilitated through collaboration with leading scientists from advanced institutions. On-station studies translate these ideas into candidate technologies, with emphasis on better understanding of the underlying mechanisms that govern their effects.

When studies are moved away from the research station, different collaborators are needed with expertise in packaging technologies and examining their cost-effectiveness. If these technical packages offer promise, they can be scaled up. You must remember that farmers will innovate and adapt your technology while trying it out. Accept this – they know the reality of their situation better than you. If you choose your research setting and collaborators wisely as you escort your innovations or your contribution to an innovation,

'downstream' you are much more likely to achieve impacts than someone who does not. Make sure that you have solid well tested technologies to pass on.

The case of staggered intercropping (MBILI) in Western Kenya presents an interesting example of movement along the research and development continuum. The farmers' main enterprise, maize–bean intercropping, was performing poorly, primarily because of inadequate nutrient supply to the maize and a severe pest-and-disease syndrome on the beans. Researchers had examined a wide range of solutions over many years, including mineral nutrient replenishment, short-term improved fallows, green manure and cover cropping, breeding for stress, pest and disease tolerance and detailed integrated pest management (IPM) strategies but none of these interventions were reaching farmers, partly because they overestimated farmers' land, labour and ability to invest. A simpler solution was required, one that involved reconfiguration of farmer-available resources.

By simply staggering the 75-cm maize rows into alternating 50-cm and 100-cm rows (Figure 3), and orienting the rows in an East–West direction when possible, substantial improvement was achieved. This adjustment allowed for the inclusion of additional, higher-value legumes such as groundnut and green gram into the intercropping system, crops the farmers already knew but only grew as occasional monocrops. These legumes fixed more symbiotic nitrogen, resulting in strong residual benefits to maize, and, when grown as a

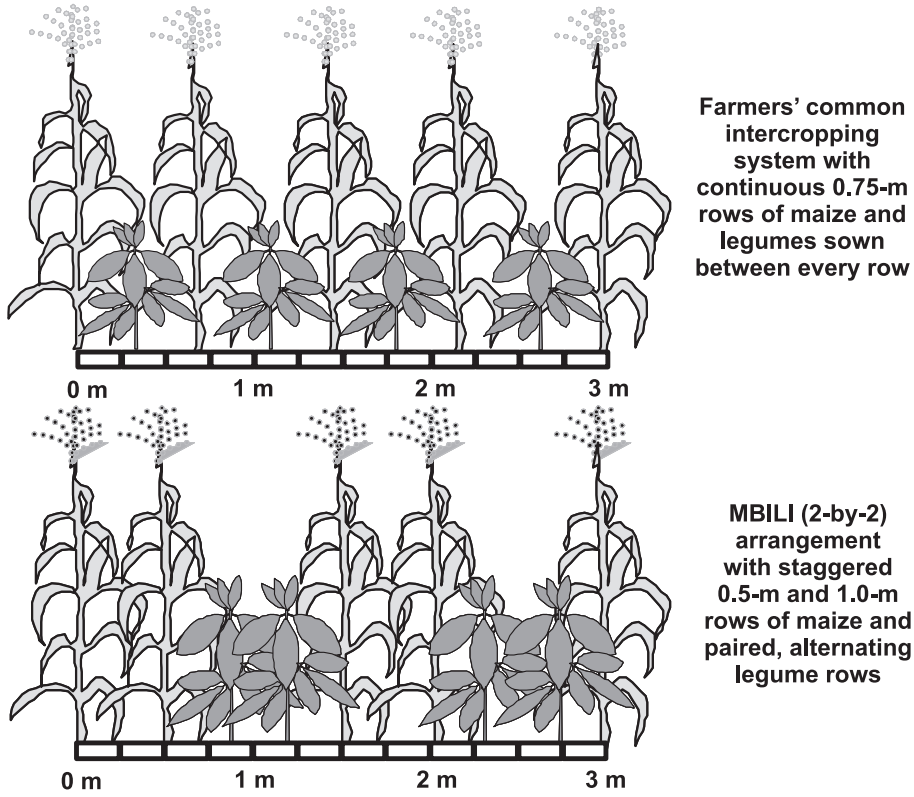


Figure 3. The MBILI staggered maize–legume intercropping system that improves maize and legume production and provides better market opportunites in Western Kenya

maize–legume intercrop rotation (maize–groundnut, maize–green gram, maize–bean), greatly reduced the incidence of legume pests and diseases.

This MBILI intercropping adjustment was first proposed for Western Kenya by a university scientist in 1999 based upon an understanding of current farmers' problems and the volumes of literature on intercropping, relay and strip-cropping. MBILI was field tested at a farmer field school later that year, and then expanded to eight farms in 2000. In 2001, it was tested on 32 additional farms by a local NGO and featured at several agricultural shows and farmers field days. In 2002, it was included as one of eight candidate intercropping technologies for testing on 140 farms over 2 years by a research network, where it emerged as the most cost-effective management system. In 2003, MBILI was featured in a regional farming magazine and formal collaboration was established with officers from the Ministry of Agriculture, allowing the practice to be further promoted by extension agents. Only 5 years after its inception, many of the poorest farmers in Western Kenya credit MBILI for their escape from hunger, while better resource-endowed farmers rely upon it to produce greater crop surpluses for market. The progress of MBILI along the research and development continuum serves as an example of how rapidly a new technology can reach its intended clients when different partners within the agricultural community all play their respective roles, and when that technology matches farmers' needs and resources (see Box 3).

Box 3. Two perspectives on MBILI's benefits

Agronomic A baseline study of 107 farms in Western Kenya revealed intercrop yields of 1197 kg maize and 192 kg beans/ha, offering a net return of US$72/ha. Introduction of the MBILI intercropping package, involving row adjustment, substitution of groundnuts for beans and modest fertilizer application (31 kg N and 20 kg P/ha) resulted in 2431 kg maize and 360 kg groundnut/ha. The MBILI package required additional investment of US$63/ha, but increased returns by US$183.

Personal "I am a housewife with 6 children. I plant MBILI on my farm and I have found the system very paying. When I used to plant maize and groundnuts using conventional methods I could get 5 bags (250 kg) of maize and 1 bag (33 kg) of groundnuts from 0.2 hectares of my land. Under MBILI planting, I got 12 bags (600 kg) of maize and three bags (100 kg) of groundnuts which was a record yield for me. The rows in MBILI receive enough sunlight and it reduces wastage of land..."

Purity Nalianya, Chililila Woman's Group, Bungoma, Western Kenya

From project outputs to farm impacts

Dissemination and outreach strategies are at the other end of the research and development continuum. From the social perspective, science exists to provide useful solutions to human difficulties, a goal that requires that the research community be linked to the public. In developing nations science is largely confined to academia, and society has yet to recognise a substantial improvement through investments in research. Donor investment in applied research is usually linked to such pressing social concerns as food security or public health, and important scientific findings are expected to become translated into flexible tools for development. Thus, dissemination and community outreach (Figure 4) are natural conclusions of a successful project.

Within the context of agricultural research, the progression from on-station to off-station and to on-farm research proceeds in a stepwise manner. You must understand the mechanisms, ranges and suitability of a new technology, so that you can then identify opportunities, options and potential impacts (Figure 4). Many farmers consider all technologies tested on-

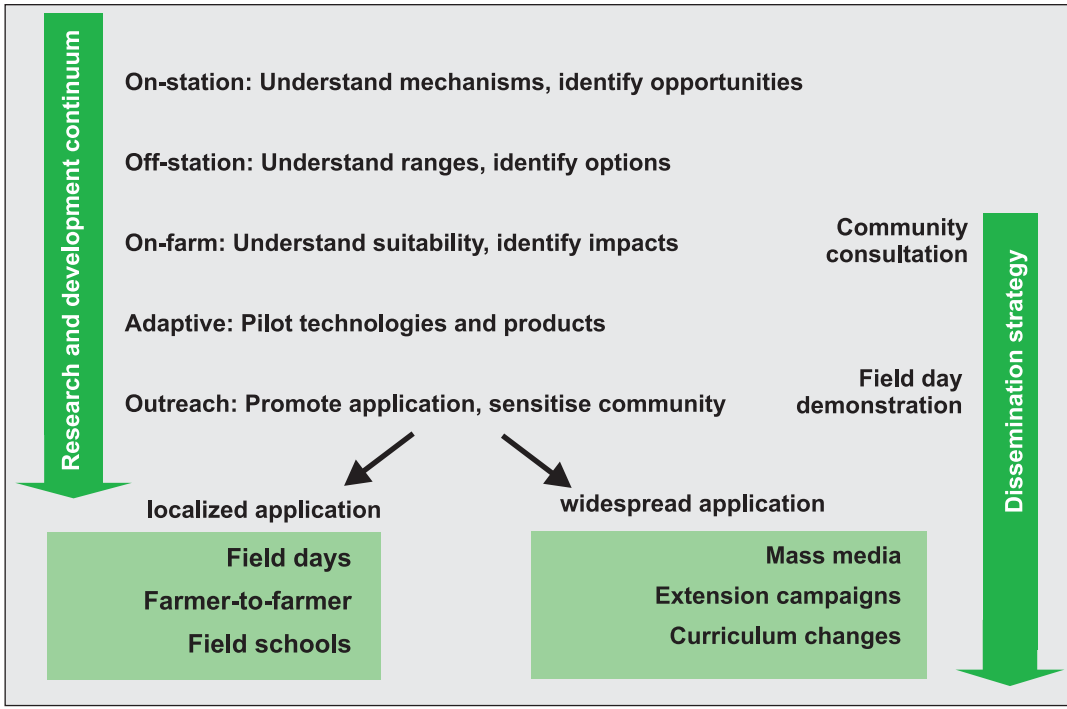


Figure 4. As the research and development continuum proceeds downstream, it interacts with different possible dissemination and community outreach strategies. Innovators are encouraged to escort technologies beyond their experimental stages in order to achieve greater impacts from their research

farm to be 'recommended', so you must make it clear to farmers that you are refining or testing a technology and that it is not a recommendation. As research becomes more participatory and demand-driven, dissemination moves further 'upstream', a phenomenon that requires you as a researcher to be more responsible and conservative about the technologies you might propose as candidate solutions to farmers' problems. The risk of miscommunication is reduced as farmers increasingly recognise their roles as full partners in adaptive research.

One useful approach to on-farm adaptive research is to test current recommendations and various 'best bet' technologies side-by-side across a range of cropping conditions, because many competing 'recommendations' are developed in relative isolation from one another. For example, the effects of applying composts are seldom tested against mineral fertilizers, or fallow systems are compared to one another but not to direct soil amelioration. You should welcome the opportunity to test your candidate solution alongside others. The fusion of alternative management practices represents an exciting avenue of research, particularly in partnership with farmers empowered to combine and manage different recommendations as they see fit. If you treat farmers' planning and reactions as useful information if will be an important step in realising fuller partnership with them during your adaptive research.

During project planning you should devote funds to the promotion of your findings. This can be done through farmers' field days, or the facilitation of adjacent farmer-to-farmer

training, particularly through local extension agents and nearby self-help groups. Widespread application is effected through mass media campaigns, exhibits in regional or national agricultural shows, designing extension campaigns, and inducing curriculum changes within public school systems. It is generally difficult to plan and budget beyond localised outreach at the onset of a research project but you should try to liaise with senior extensionists, educators and journalists in order to popularise your findings to wider audiences. Table 2 identifies different outreach options, indicative costs and likely beneficiaries.

Table 2. Returns to US$1000 investment in various dissemination options

Option	Audience		Unit cost (US$)
Field day attended by	100	participants	10.00
	500	participants	2.00
	1000	participants	1.00
Printed media prepared and distributed	2000	copies	0.50
later each copy read by nine more farmers	20000	readers	0.05
Video documentary prepared and broadcast	50000	viewers	0.02
Video documentary taped and distributed	100	recipients	10.00
later seen by 99 additional viewers	10000	viewers	0.10
Field school initiated with	25	members	40.00
Initiated with	50	members	20.00
and each member trains 9 farmers	500	trainees	2.00

Pitfalls you should avoid

Intense disciplinarity

Agricultural science is not a single discipline, but rather the sum of numerous sub-disciplines. These pursuits include agronomy, animal husbandry and nutrition, crop improvement, economics, food science, horticulture, pest and disease management, post-harvest handling, rural sociology, soil science and many other fields. Modern society is complex, and this is especially true within science. Indeed, most of the greatest scientific discoveries result from several years, or even decades, of intense, highly specialised, often obsessive study. But this model for scientific achievement is less applicable within the more-applied disciplines such as agriculture. Agricultural science still involves discovery, but within an iterative, problem-solving context. **Support for agricultural science is society's insurance against malnutrition and famine.** Most of agricultural science starts not with theory, but in the field, where plant production is failing. This situation is especially true in Africa, where the continent's capacity to feed its people is failing.

Even at the undergraduate level, young agriculturalists are expected to declare an area of specialisation. Graduate candidates specialise further, often leading to detailed knowledge within a sub-sub-discipline, and little else. This situation is most severe in universities where graduate studies do not include coursework. **Do not let your research vision be narrowed by disciplinary blinkers.**

I recall a farm visit in the Central Kenyan Highlands accompanied by a noted virologist. This farm was extremely diversified, and included a number of different vegetables intended for Nairobi markets. After discussing crops and markets with the host farmer, and touring the fields, the virologist confided that she did not enjoy the visit because the crops were all healthy and none displayed symptoms of viral disorders. At the time I sympathised, and

promised to better direct future field visits, but afterwards I recognised a perverse logic. The absence of pest and disease is not random, or the result of good fortune, but rather nested into farm practices and the farmer's skills and experience. Even a famous virologist should be prepared to learn something from a farm where viral disorders are controlled. This analogy may be extended to soil fertility specialists and the lack of nutrient deficiency symptoms, economists and strong markets, entomologists and harmful insects, agroforesters and trees and all other agricultural specialists. It is naïve to assume that farm productivity is necessarily restricted by factors related to your chosen sub-discipline, and this becomes more so as you specialise further. When agricultural scientists behave like the blind men attempting to describe an elephant, then they are practicing precise, and most likely inaccurate, disciplinarity.

Survey-mania

Too many talented scientists focus upon describing problems that are already known, rather than exploring possible solutions. As a field researcher you should conduct your own 'participatory, diagnostic survey' at an early phase of every investigation. Concise survey instruments consisting of less than 20 short questions that are based upon important research questions are a useful first step. Many farmers grow weary and wary of answering questions about family members, land tenure, income and education, so your survey should be short and conform to the task at hand.

Over-delegation

Delegation is a responsibility in a research setting, it entails the optimal use of available time, funds and staff to ensure scientific quality and meet project goals and it requires that delegated tasks be closely supervised. Responsible delegation breeds scientific teamwork and mutual satisfaction, irresponsible delegation leads to division and inferior science. For example, I once visited an agricultural research station and noted a large, vigourous stand of an indigenous legume that was being examined elsewhere as a candidate for land restoration efforts. Some controversy surrounded the nodulation of this legume, so I asked a station scientist if I might borrow a shovel and conduct an impromptu investigation. He agreed to help, and consulted the Chief Technician. After about one hour, a stranger arrived to deliver my 'bag of soil'. When I asked where the soil came from, he could not say. Evidently, the Chief Technician consulted the Laboratory Technician who informed the Field Technician who instructed the Field Labourer who put some soil in a bag for reasons not understood. Obviously, my intentions were mistaken in the process. This 'tradition' of over-delegation, where scientists and senior technicians avoid 'unnecessary' field labour and where important tasks are performed by unqualified casual workers, poses a serious hazard to quality research.

Compulsive home-area focus

Many young agricultural scientists in Africa feel compelled to conduct studies in their home areas. Clearly, advantage exists for these studies. They have an intuitive understanding of production constraints, are able to communicate with the poorest farmers in the most local dialects and have ready access to field sites. During field visits, workers are often able to economise on accommodation. Moreover, working within your home area fulfils a social obligation to return the benefits of education to your family and immediate community. All of these factors offer clear advantages in terms of research position and motivation.

But a suite of disadvantages also exists. Your home area may be remote, and may suffer from similar constraints to a closer more easily accessible location. You may not have the expertise to address the constraint that exists in your home area. Furthermore, social obligations can become confounded with research strategies in a compromising manner. Devote yourself to good science in the place your work can have most impact (Box 4).

Box 4. Where will your work have impact?

Mary receives an advanced degree in plant pathology overseas, finds employment in an African public university and returns home intent upon 'proving' herself. She has specialised in bacterial diseases of a crop that is not widely gown in her home area, but nonetheless she bases her research project upon it. After several years, she has produced a research publication but failed to impact upon farmers lives. Next she employs her skills within an interdisciplinary team active in another agroecological zone where the crop is very important and within one year is assisting farmers to better understand their production problems and improve their yields. Where, and with whom should she have initiated her research?

Conclusion

Well-trained scientists practice credible research within their immediate sub-discipline almost by instinct.

As practicing agriculturalists in Africa, given the continent's persistent problems of under- and malnutrition, resource degradation and rural stagnation, identifying important questions requires that we look no farther than into the lands, crops and practices of the poorest farmers, particularly into their main food production enterprises. Escorting communities from failing subsistence farming to mixed, market-oriented agriculture is a major responsibility of the agricultural research community, and if you cannot identify your particular role within this key transformation perhaps you should rethink your longer-term research interests. Let us not merely identify the farmers' problems, but work together to solve them. Let us not be dazzled by proliferating agendas and research fads, but rather focus upon the basic needs of the poor and their abilities to secure better lives. Let us not work as individuals on those problems that comfortably address our disciplinary bias, but work together with other specialists and generalists to ensure that food security and better rural livelihoods result from our combined efforts. This process requires patience, vision and teamwork, and its completion is not likely to be repaid in riches, but rather rewarded through personal satisfaction and social wellbeing.

Resource material and references

Appendix 2. Innovation, Problem Solving and Operational Research Strategies. Paul L. Woomer. PowerPoint on CD.

Appendix 3. Designing Research Around Client Needs. Paul L. Woomer. PowerPoint on CD.

Abate, T. and Ampofo, J.K.O. 1996. Bean pests in Africa. *Annual Review of Entomology* 14: 45–73.

Amadalo, B., Jama, B., Niag, A., Noordin, Q., Nyasimi, M., Place, F., Franzel, S. and Beniest, J. 2003. *Improved Fallows for Western Kenya: An Extension Guideline.* World Agroforestry Centre (ICRAF). Nairobi, Kenya. 48 pp.

Booth, W.C., Colomb, G.C. and Williams, J.M. 1995. *The Craft of Research.* The University of Chicago Press, Chicago, USA. 294 pp.

Carr, S.J. 1997. A Green Revolution frustrated: Lessons from the Malawi experience. *African Crop Science Journal* 5: 93–98.

Carr, S.J. 2003. More people more soil degradation; the Malawi experience. *African Crop Science Conference proceedings, Vol.* 6. (In press).

Chambers, R., Pacey, A. and Thrupp, L.A. 1989. *Farmer First: Farmer Innovation and Agricultural Research.* Intermediate Technology Publications, London, UK. 219 pp.

Den Biggilaar, C. 1991. Farming systems development: Synthesizing indigenous and scientific knowledge systems. *Agriculture and Human Values* 8: 25–36.

Eicher, C.K. 1999. *Institutions and the African Farmer.* Economics Program, CIMMYT, Third Distinguished Economist Lecture (15 January, 1999). Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), Mexico DF, Mexico. 64 pp.

Food and Agriculture Organization of the United Nations (FAO). 2002. FAO *Yearbook* 2001: *Production.* Vol. 55. FAO, Rome, Italy.

Harrison, P. 1996. *The Greening of Africa: Breaking through the Battle for Land and Food.* Academy Science Publishers, Nairobi, Kenya. 380 pp.

Lacy, W.B. 1996. Research, extension, and user partnerships: Models for collaboration and strategies for change. *Agriculture and Human Values* 13: 33–41.

Lynam, J.K. and Blackie, M.J. 1994. Building effective agricultural research capacity: The African challenge. In: *Agricultural Technology: Policy Issues for the International Community,* Anderson, J.R. (Ed.), pp. 106–134. CAB International, Wallingford, UK.

Misbahulmunir, M.Y., Sammons, D.J. and Weil, R.R. 1989. Corn–peanut performance in relation to component crop relative planting dates. *Agronomy Journal* 81: 184–189.

Mureithi, J.G., Gachene, C.K., Muyekho, F.N., Onyango, M., Mose, L. and Magenya, O. 2002. *Participatory Technology Development for Soil Management by Smallholders in Kenya.* KARI Legume Network Project, Kenya Agricultural Research Institute, Nairobi, Kenya. 551 pp.

Nicholson, S.E. 2001. Climatic and environmental change in Africa during the past two centuries. *Climate Research* 17: 123–144.

Norman, D.W., Francis, C.A. and Henrich, G.M. 1994. Providing relevant education and training for sub-Saharan African agricultural scientists: foundation for a sustainable future. *Journal of Sustainable Agriculture* 4(3): 79–90.

Omare, M.N. and Woomer, P.L. 2002. Innovations in organic resource management: Experiences from Kenya's Forum for Organic Resource Management and Agricultural Technologies. *Outlook on Agriculture* 31: 235–242.

Patel, B.K. and Woomer, P.L. 2000. Strengthening agricultural education in Africa: The approach of the Forum for Agricultural Resource Husbandry. *Journal of Sustainable Agriculture* 16(3): 53–74.

Sagan, C. 1996. *The Demon-Haunted World: Science as a Candle in the Dark.* Ballantine Books, New York, USA. 457 pp.

Saint, W.S. 1992. *Universities in Africa: Strategies for Stabilization and Revitalization.* World Bank Technical Paper No. 194. Africa Technical Department Series. World Bank, Washington DC, USA. 140 pp.

Smaling, E.M.A., Nandwa, S.M. and Janssen, B.H. 1997. In: *Replenishing Soil Fertility in Africa.* Bursch, R.J. Sanchez, P.A. and Calhoon, F. (Eds.), pp. 47–61. Soil Science Society of America (SSSA) Special Publication No. 51. Madison, Wisconsin, USA.

Squires, V.R., Glenn, E.P. and Ayoub, A.T. 1998. *Combating Global Climate Change by Combating Land Degradation*. United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Terrent, J. and Poerbo, H. 1986. Strengthening community-based technology management systems. In: *Community Management, Asian Experience and Perspectives*. Korten, D.C. (Ed.), pp. 172–182. Kumarian Press, West Hartford, Connecticut, USA.

Tungani, J.O., Mukhwana, E.J. and Woomer, P.L. 2002. MBILI is Number 1: A *Handbook for Innovative Maize–Legume Intercropping*. Sustainable Agriculture Centre for Research Extension and Development in Africa (SACRED)-Africa, Bungoma, Kenya. 20 pp.

Vedeld, T. 2000. Village politics: Heterogeneity, leadership and collective action. *The Journal of Development Studies* 36: 105–134.

Wahua, T.A.T., Babalola, O. and Aken'ova, M.E. 1981. Intercropping morphologically different types of maize and cowpeas: LER and growth attributes of associated cowpeas. *Experimental Agriculture* 17: 407–413.

Woomer, P.L, Bekunda, M.A., Karanja, N.K., Moorehouse, T. and Okalebo, J.R. 1998. Agricultural resource management by smallhold farmers in East Africa. *Nature and Resources* 34(4): 22–33.

Woomer, P.L., Mukhwana, E.J. and Lynam, J.K. 2002. On-farm research and operational strategies in soil fertility management. In: *Integrated Plant Nutrient Management in Sub-Saharan Africa: From Concept to Practice*. Vanlauwe, B., Diels, J., Sanginga, N. and Merckx, R.. (Eds.), pp. 313–331. CABI Publishing, Wallingford, UK.

Woomer, P.L., Musyoka, M.W. and Mukhwana, E.J. 2003. *Best Bet: Maize–Legume Intercropping Technologies and Summary of 2002 Network Findings*. Sustainable Agriculture Centre for Research Extension and Development in Africa (SACRED)-Africa, Nairobi, Kenya. 18 pp.

Woomer, P.L., Omare, M.N. and Mukhwana, E.J. 2003. The Operations of Rural Self-Help Groups. In: *Organic Resource Management in Kenya: Perspectives and Guidelines*. Savala, C.E.N., Omare, M.N. and Woomer P.L. (Eds.), pp. 131–145. FORMAT, Nairobi, Kenya.

2.4 Development and management of projects

Bharati K. Patel

- **Projects provide a framework for a piece of research**
- **The logical framework matrix is commonly used in project design**
- **You will always be a part of a research project and a research team**
- **Be a good team member**
- **A large research undertaking can be divided into smaller projects**

> *'The success or failure of the many community projects and farmer associations that are being formed in Africa will depend on the availability of profitable technology for small-scale farmers. This situation harkens to some of the hard choices that Asian political leaders made in the 1960s to build agricultural knowledge triangles. Will African political leaders make the same hard choices in building strong national agricultural science bases or will they continue to rely on bottom-up, quick-fix projects and a gaggle of food aid subscriptions? Only time will tell.'*
>
> **Carl K. Eicher (2003)**
> Agriculture in the Global Economy

As a graduate student you will first need to write a research proposal that will be approved by a research committee before you can do your research project. Your main aim is to get a degree and thus your project should be 'do-able' in the timeframe available. Projects and proposals are closely linked and have common features. Smaller discrete projects can be developed from a large proposal or small proposals for funding can be developed from a large project.

This chapter deals with how a project is developed and managed. A project has many facets and provides a framework for a piece of research or work. It usually involves other persons, which implies partnerships and interactions with colleagues, peers, students or clients. A project is only a part of a larger agenda. Everyone involved in a project is important and has a role to play and it is essential that all those involved in a particular project are committed to it and share a common vision. Throughout your research career you will be involved with projects and will be a part of a team.

Most agencies and organisations today utilise a project design approach based on some version of a **logical framework matrix (LFM) and a work breakdown structure (WBS)** of project activities. The LFM and WBS facilitate not only project design but also progress reporting and evaluation. The LFM is a one or two-page overview of a project which summarises its design information. The WBS is a one-page graphical presentation of the project which links the goal, purpose and outputs to specific project activities.

Logical framework matrix (LFM)

Begin by preparing the LFM as shown in Table 1. On the vertical axis (first column) of the LFM **Goal** refers to the broad programme or sector goal to which the project is expected to contribute. It represents a development objective.

Table 1. Logical framework matrix (LFM) for project design

Narrative summary	Objectively verifiable indicators	Means of verification	Critical assumptions (beyond the control of the project team)
Goal The reason for the project, the desired end toward which the efforts are directed (*e.g., to raise farm yields*)	Conditions which will indicate that the goal has been achieved (*e.g., higher yields in farmers fields*)	The way that goal achievement can be objectively verified (*e.g., seed sale records, government yield statistics*)	Assumptions which must be met if purpose is to result in achievement of the goals (*e.g., effective seed systems exist*)
Purpose The anticipated benefit if the project is completed successful and the outputs are actually utilised (*e.g., improved varieties released by* NARS)	The signs which will indicate that the purpose is achieved (*e.g.,* NARS *release at least three varieties*)	The way that purpose achievement can be objectively verified (*e.g., official varietal release documents*)	Assumptions which must be met if outputs are to result in achievement of the purpose (*e.g.,* NARS *skilled and funded to effectively test and release varieties*)
Outputs The specific kind of results that are expected from good management of the project inputs (*e.g., improved elite lines*)	The tangible form in which the outputs can be observed (*e.g., breeder's advanced germplasm collection*)	The way these outputs can be objectively verified (*e.g., yield trial results*)	Assumptions which must be met if Inputs are to result in achievement of the outputs (*e.g., useful genetic variation exists*)
Inputs Resources for activities necessary to produce the outputs (*e.g., basic germplasm*)	The tangible form in which the Inputs can be observed (*e.g.,* 1000 *new accessions used*)	The way these inputs can be objectively verified (*e.g., field books and plantings*)	Assumptions which must be met if Inputs are to be attained (*e.g., importation of exotic germplasm is allowed by national authorities*)

Source: ICRISAT, Guidelines for proposal/project development (personal communication)

Purpose is the immediate objective that describes the intended impact of the project on the direct beneficiaries, but is beyond the direct control of the project team since it relies on how the beneficiaries will make use of the project outputs. A project should only have one immediate objective or purpose.

Outputs are the specific kinds of results that can be expected from good management of the project inputs and activities. The project team should be held accountable for the production of the outputs.

Inputs are the resources (funds, personnel and goods) that are needed for the production of the outputs.

Activities are not listed in the LFM since they are provided in the work breakdown structure (WBS).

On the horizontal axis of the LFM, **indicators** are parameters, preferably those that can be quantified, which verify the achievement of the goal, purpose and outputs. Indicators provide a basis for monitoring and evaluation, they should define attainment in terms of target group (for whom), type of output (what), quantity (how much), quality (how good), time (by when) and location (where).

Means of verification should specify both the instrument for measuring the indicator and the sources of information necessary to use the indicators (e.g., questionnaires and structured interviews, the results of which are found in ministry statistical reports, project technical and financial progress reports).

Critical assumptions are the events or conditions over which the project team have little control but which must be assumed to exist if the inputs are to be applied, the outputs delivered, and the objectives achieved. These external factors determine the risks of the project. They clarify and set the limits of responsibility for the project management. Projects may be unsuccessful because:

- Unreasonable assumptions were made during the design phase
- Reasonable assumptions do not hold up
- Inputs are poorly managed.

The identification and clear expression of the assumptions are therefore extremely important in the evaluation process.

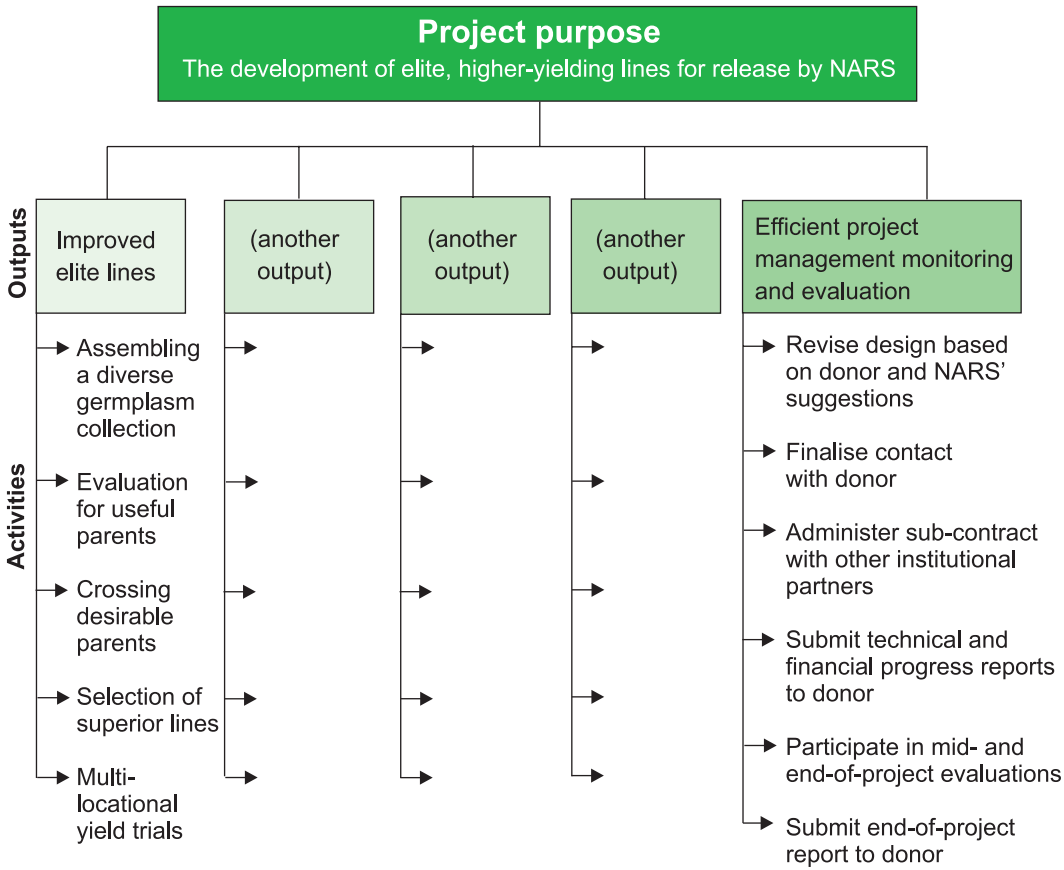


Figure 1. Example of a work breakdown structure (WBS) linking project activities to outputs

Work breakdown structure (WBS)

After completing the LFM, the next task is to prepare the work breakdown structure (WBS).

The WBS is a graphical diagram which groups project activities around specific outputs. The outputs of the WBS (Figure 1) provide the link to the LFM.

Activities identified in the WBS serve as the basis for:

- Project monitoring
- Preparing both technical and financial progress reports to the donor
- Providing the framework for mid-term and/or end-of-project evaluations.

The following brief descriptions of two projects provide insights into how projects can be developed and managed. One project is 10 years old and the other has just completed its second year. They differ in scale, scope, approach, conceptualisation and implementation.

Cowpea Improvement Project, Makerere University, 1993–2003

Starting point (Phase 0)

In 1992, during a needs assessment by the National Agricultural Research Organisation (NARO-Uganda) and Makerere University researchers identified cowpea (*Vigna unguiculata*) as a key legume crop supporting livelihood of about 30% of the Ugandan population (Professor Adipala Ekwamu, personal communication, 20 October 2003). Strikingly, no research was being done on cowpea. A multidisciplinary team was subsequently formed to develop a research agenda for this important crop of the semi-arid regions of Uganda. The starting point was clearly to conduct a baseline study (survey) to:

- Establish the status of the crop (its importance in relation to other crops)
- Gather production statistics
- Identify and categorise the available germplasm
- Identify production constraints (social and biological)
- Establish the competitiveness of this crop vis-a-vis other crops grown by the farmers.

A proposal was submitted to the Rockefeller Foundation's Forum on Agricultural Resource Husbandry Programme, which agreed to support it. This initial phase (Phase 0) established that a research agenda would be formulated with defined deliverables (outputs and indicators) and the steps (based on available information) to be followed in subsequent years.

Phase I Diagnostic survey 1993–95

A national baseline survey helped to set the priorities and define the future research agenda. A multidisciplinary team that included staff from the University, NARO, and the Extension Service further agreed to oversee the research agenda even though the project was housed at the University. Seven MSc students were recruited to implement the baseline survey. A structural questionnaire was developed, pre-tested and used to obtain information from various stakeholder groups. Secondary data was also collected. After data collection and analysis, additional field visits were made. The biological science students' field visits were made over a period of two seasons to verify and quantify biological information provided by surveyed farmers. The outcome of this phase helped to identify the most pressing problems faced by the farmers, and the researchable issues, and to establish benchmarks for future research for development (R&D) for cowpea.

Phase II On-station trials and socio-economic studies 1995–97

The key issue that emerged in Phase I was poor yields (<200 kg/ha). These were mainly due to pests, and to a lesser degree to diseases, weeds, a narrow germplasm base (7 cultivars/

varieties), and poor agronomic practices. The team also considered that more-detailed analysis of market competitiveness and the underlying marketing issues was needed. Five MSc students were recruited for this phase. On-station trials were conducted within the University and at NARO field stations in the cowpea-growing agroecological zone. This phase marked the beginning of efforts to develop technologies to address some of the key constraints identified in Phase I.

Phase III On-farm verification trials 1998–2000

The promising technologies identified in Phase II were tested in farmers' fields but were managed by the research students. Efforts were made to integrate some of the technologies, principally, to develop integrated pest management (IPM) technologies, since pests had been identified as key constraints. Various options such as time of planting, host resistance, chemical control, spacing, weeding frequency and market preferences were studied. These trials resulted in a basket of options that farmers could potentially use to improve the productivity of their cowpeas. They targeted different farmer groups and market demands, and involved four MSc students.

Phase IV Dissemination of IPM options, 2000–02

This phase involved refinement and dissemination of the IPM options developed in Phase III. A farmer field school approach was used involving 6 farmer groups (each group consisting of 20–30 farmers). The farmers conducted season-long evaluations of the different options. Pre-tests were conducted to establish baseline knowledge and background of the participating farmers and at the end of the second year, post-tests were done to establish the acquisition of knowledge and changes in practices. Based on this phase, strategies for scaling up were developed in partnership with farmer groups and district extension officials. Three students were involved in this stage, during which other partners, such as the Integrated Pest Management / Collaborative Research Support Program of the United States Agency for International Development (USAID) (IPM/CRSP) were incorporated into the research team and helped to co-fund the study. After 10 years of study three improved varieties were finally identified and recommended to the Ugandan National Variety Release Committee.

Phase V Scaling up dissemination of IPM options, 2003

In order to reach more farmers in all regions the Makerere University Cowpea Improvement Project has now joined up with a number of partners to support dissemination and adoption. Different district extension departments are now engaged in dissemination of such technologies and programmes as I@mak.com (Innovations at Makerere Committee), IPM/CRSP and the National Agricultural Research Organisation–Department for International Development) (UK) (NARO–DFID) are now supporting the scaling up activities. The farmer field schools have been expanded to cover six districts based on earlier experience. Three graduate students are currently involved in scaling-up. A proposal for further scaling up has been prepared for funding.

Summary

10 years of phased studies led to the development of technologies that are now being adopted nationally. It has also strengthened linkages and partnerships and produced graduate students that are highly practical and more responsive to society's needs. Throughout the phases a **total of 22 graduate students** have been trained in various disciplines (see Table 2)

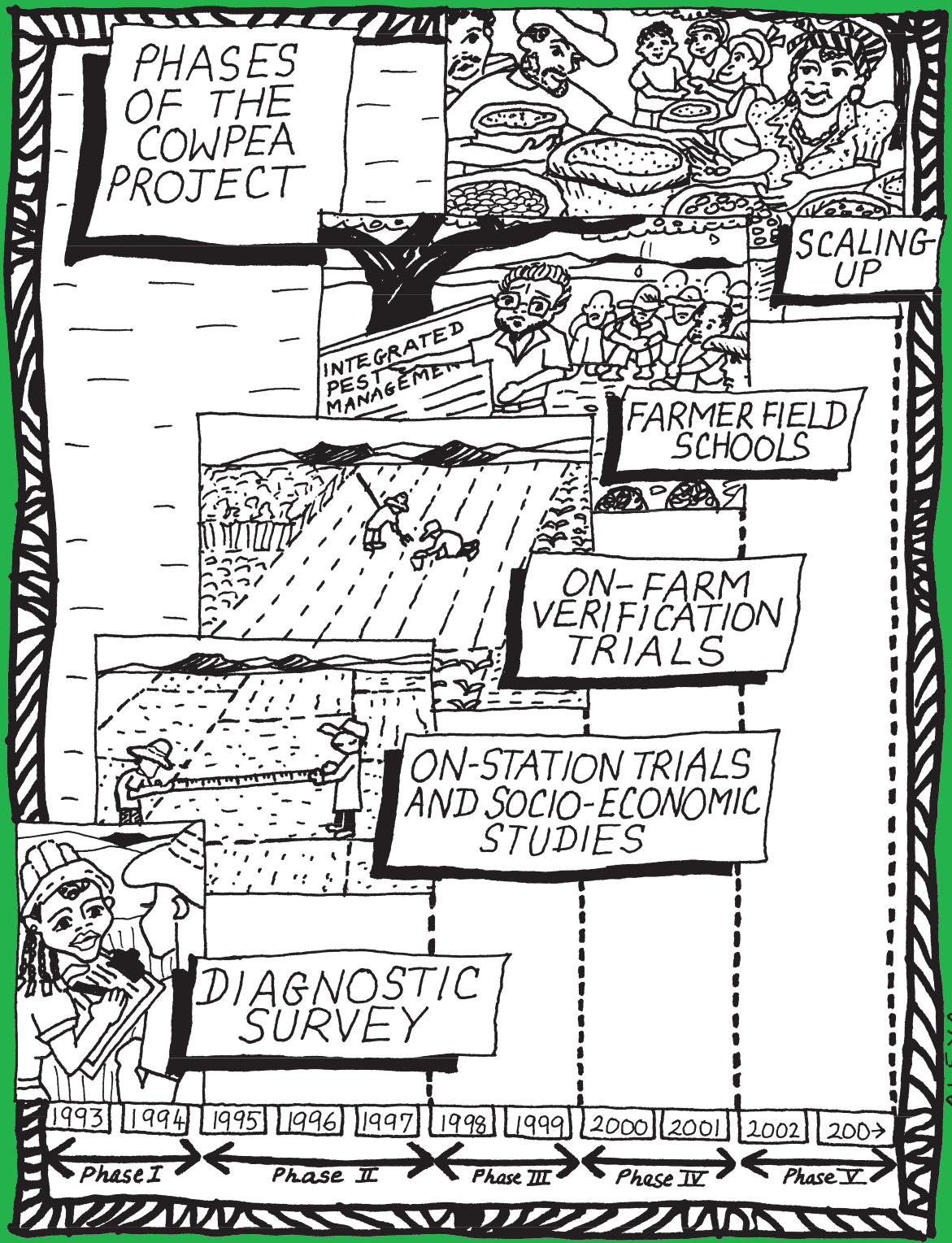

PHASES OF THE COWPEA PROJECT
SCALING UP
INTEGRATED PEST MANAGEMENT
FARMER FIELD SCHOOLS
ON-FARM VERIFICATION TRIALS
ON-STATION TRIALS AND SOCIO-ECONOMIC STUDIES
DIAGNOSTIC SURVEY
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
200→
Phase I
Phase II
Phase III
Phase IV
Phase V
ALEYA

Table 2. Graduate students trained during the cowpea improvement project

Discipline	Number of students per phase				
	I	II	III	IV	V
Agricultural economics	2	1			
Entomology	1	1	2	1	1
Plant pathology	2	1			
Agronomy	2	1	1	1	1
Weed science		1			
Social sciences			1		
Extension				1	1
Total students	7	5	4	3	3

and the project has to date produced 46 scientific publications (30 journal articles and 16 proceedings publications). Extension brochures have also been produced.

Consortium for scaling up options for increased farm productivity in Western Kenya (COSOFAP)

Why was a consortium needed?

COSOFAP (2003) reported that: 'Because there was an identified need – a glaring one – to reach more people, more quickly and more lastingly'. COSOFAP also highlighted the following farmer from Soso village who said: "If you work with 3 or 4 farmers in our village, we do not see anything tangible, the whole village needs to be involved if we are to prosper".

Many development workers in Western Kenya felt that a joint effort would be the best way forward, and thus COSOFAP was born out of a stakeholders meeting held in 2000. It currently has over 70 members and more are expected to join. The Consortium is made up of the Ministry of Agriculture and Rural Development Extension Branch, research institutions both local [Kenya Agricultural Research Institute (KARI), Kenya Forestry Research Institute (KEFRI)] and international [World Agroforestry Centre (ICRAF), Tropical Soil Biology and Fertility (TSBF)], national and local non-governmental organisations (NGOs), community-based organisations (CBOs), the Swedish-supported Regional Land Management Unit (RELMA), private companies, and most important of all – farmers' representatives.

COSOFAP's vision is to alleviate poverty among the resource-poor farmers in Western Kenya; its mission is to increase productivity through increased access to technologies through better delivery mechanisms and its purpose is to do this via better networking among the development partners. Figure 3a shows the structure of COSOFAP and 3b its interactive learning sites.

Phase I

The first thing that the Consortium did was to set up a temporary functional secretariat. Next it established management structures and developed governance rules that could function and apply at the regional and sub-regional levels. The region was divided into three sub-regions and three sub-regional coordinating committees were formed to efficiently manage the whole region. The secretariat also prepared a directory of partners, identified learning sites and prepared training and extension notes. A website was developed. Other secretariat duties included proposal preparation for resource mobilisation.

Together with the farmers many activities were identified for support, these included:

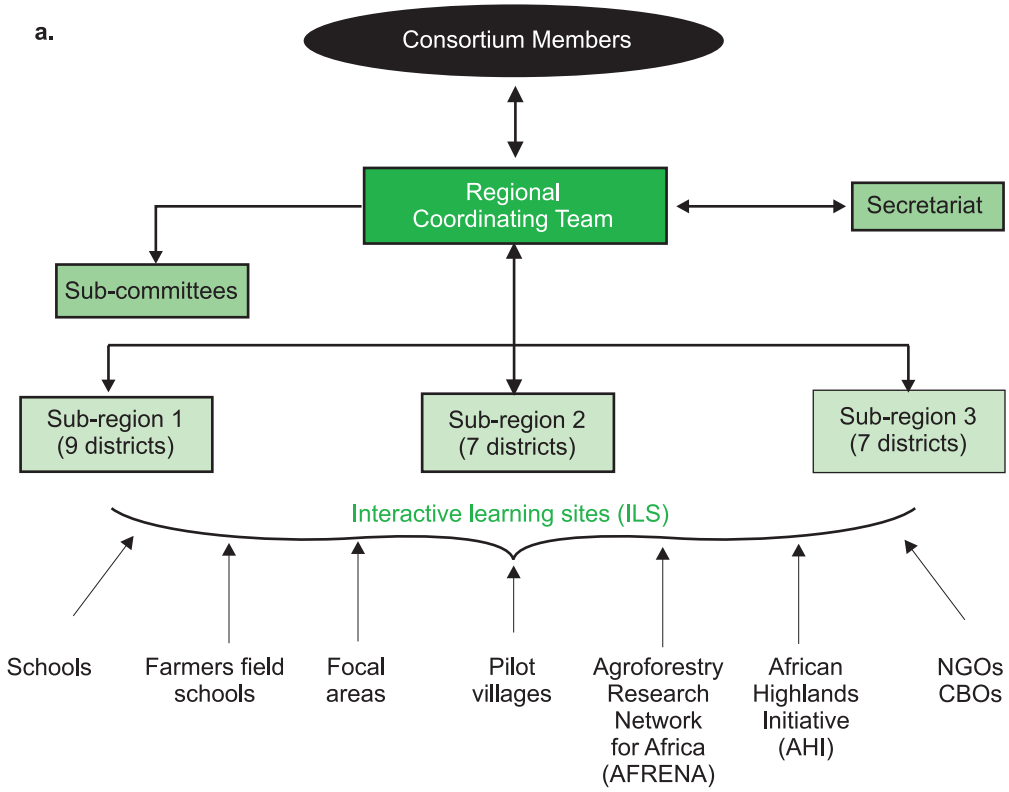


Figure 3a. Structure of the Western Kenya Consortium of Partners (COSOFAP)

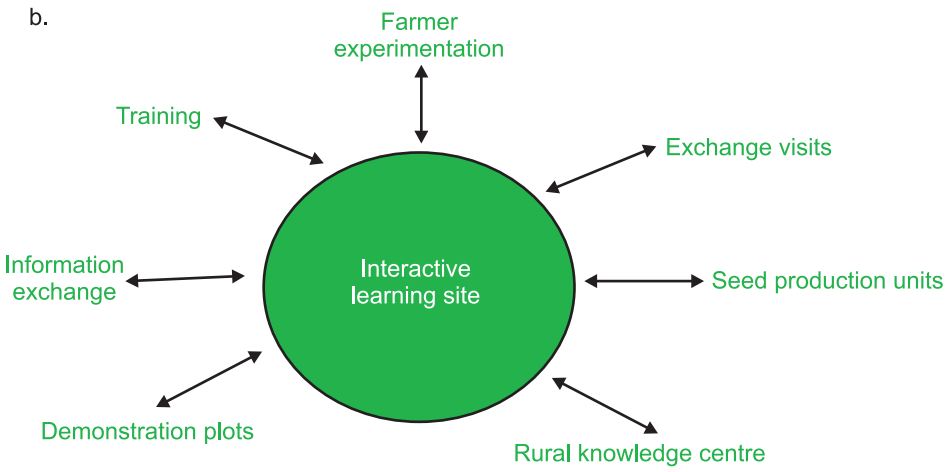


Figure 3b. Interactive learning sites of COSOFAP partners

- Training in soil fertility options
- Grafting of trees
- Poultry and beekeeping
- Exchange visits, field days and training at interactive learning sites (ILS), germplasm distribution.

At the end of the first year what lessons had been learned?

The Consortium learned that much can be achieved in a fairly short time if there is buy-in from all the players at an early stage. That input and commitment from decision makers is essential. That partnership appraisal is also needed to identify the critical and willing partners. That it is better to start small and then grow because there is a need to scale up both options and processes. That it pays to involve all stakeholders from the conceptual stage to the action phase and that it is necessary to keep everyone well informed. In order to do this more meetings are required during the start-up phase of a project. That it is best to develop monitoring and evaluation procedures together with the farmers as soon as possible, and that these should be immediately instituted. All inputs should be in place in time and in adequate quantities.

The Consortium also learned that the expectations were high and varied – some stakeholders viewed COSOFAP as a donor! Management and coordination of partnerships require special attention such that no one can exert undue influence. COSOFAP found that the administrative load was very heavy for a part-time officer and that fundraising is not easy! Grassroot organisations tended to make direct demands rather than following the designated channels. The need to identify recommendation domains became evident as did the need for decision-support tools.

Insights and learning from Cowpea and COSOFAP Projects

The two projects were selected as models because of their differences. But similarities abound as well, see Table 3.

The University-based cowpea project provided many additional learning opportunities for students:

- The area of research was defined prior to selection of students to secure funding, so they had to fit into an identified project and developed their sub-research projects around a given topic
- Students were involved in real problem-solving research
- Different disciplines worked together sharing experiences and knowledge during the whole crop chain from production constraints to markets
- Students were exposed to several participatory approaches
- Students were supervised by specialists in their field of research, and were required to seek the help of the Biometrician in the design of their experiments to ensure continuity
- Successive batches of students followed a progression along the Research Continuum
- Students interacted with scientists from NARS, the extension department, and farmers
- After 2 years of research students published papers in reputable journals, attended meetings, and presented their research data via posters or presentations
- Students also learned how to arrange and manage meetings.

Table 3. Comparison of two projects to highlight similarities and differences

Cowpea	COSOFAP
Goal Improve the livelihood of the cowpea-growing farmers	**Goal** Reduce the poverty level of the resource-poor farmers in Western Kenya
Purpose Through research develop technologies for increased productivity of the crop approach	**Purpose** Reach more farmers through a co-ordinated effort via the Consortium
Outputs Initially graduate training and then farmers in the scaling up phase through a farmer field school	**Outputs** Farmer training from the start of the project using the interactive learning sites
Development of a database	Development of management and operational structure
On-station and on-farm research	Setting up of interactive learning sites
Publications and posters	Training pamphlets
Multidisciplinary team work – 3 public institutions – different faculty members and students working together setting research agenda	Multidisciplinary teams working together on jointly identified priorities and setting work agenda
Joint production of reports	Joint report prepared by regional teams and secretariat
Farmer involvement	Farmer empowerment
Papers presented at scientific meetings	Pamphlets and other training materials prepared for farmers
Continuity and networking	Improved networking in the whole Province
Transparency in process management and resource use	Transparency in management, resource acquisition and use
Strengthened scientific collaboration and interaction	Strengthened the community
Participatory management	Participatory management
Inputs Funding resources available from donor in blocks of 2 years because tied to MSc training	**Inputs** Some resources available; funding to be sought through proposals
Students available for training – supervisory expertise available	Expertise available for most identified activities
Financial management – applications for funds by one faculty member; budget development involved everyone including students. A good example of transparency and learning by doing.	Finances managed by sub-regional teams and secretariat
Clear division of duties – who does what and when	Clear definition of roles and duties

How to survive your graduate years and beyond.....

It is always useful to find out as much as possible about the institution, faculty, department and the supervisor prior to embarking on your graduate work. If you are not careful you could have a miserable time and not achieve your academic or intellectual goals. Students within the faculty/ department and ex-graduate students can be a good source of information that could help you to avoid or navigate the hurdles that might crop up along the way. Remember:

- Everyone has a reputation and their own way of working in an institution
- Each institution has its own culture and networks
- Work ethics vary.

Things do not always go as smoothly as you wish. So what do you do when problems crop up? You may have a falling out with your main supervisor – he or she may not provide the guidance and supervision you need; funding problems frequently crop up; you may not feel so motivated as when you started.....

Honesty is the best policy – sometimes it is not possible to apply this rule fully when you are a student, but it is possible to find a solution through other means. Try to discuss the problem or issue with the concerned person. If you do not get any positive results then you have to look for an alternative approach. You could approach the Dean of the faculty or Department Chair if the problem persists, or most faculties usually have a student representative who can take up an issue with management, and who could try to resolve things within the department.

The point is that you are there to get a degree and training, and it is the duty of the institution to provide the best possible education but you also have responsibilities and duties. You do not have to put up with an inadequate supervisor or a poor research project, but you must weigh up the costs before taking a decision or stand.

Always try to keep the communication channels open with your main supervisor and your research committee whose members you can also approach for help. Keep them well informed, meet them as a team as often as possible so that when the project appears to be off track, you can get a consensus opinion and devise a joint way forward. If you see people individually you might get diverse opinions and advise, and end up more confused than ever.

Be open, ask questions and seek clarification when you do not understand a view point or instruction... and Good Luck!

Resource material and references

Appendix 2. Innovation, Problem Solving and Operational Research Strategies. Paul L. Woomer. PowerPoint on CD.

Appendix 3. Designing Research Around Client Needs. Paul L. Woomer. PowerPoint on CD.

Conway, G. 1997. *The Doubly Green Revolution.* Penguin Classics, UK. 335 pp.

Eicher, C.K. 2003. Agriculture in the global economy. In: *Hunger: 13th Annual Report of the State of World Hunger.* Prepared for the World Resources Institute (WRI), Washington DC, USA. 164 pp.

Kaner, S., Lind, L., Toldi, C., Fisk, S. and Berger, D. 1998. *Facilitators Guide to Participatory Decision Making.* New Society Publishers, Canada.

Lacy, W.B. 1996. Research, extension and user partnerships: models for collaboration and strategies for change. *Agriculture and Human Values* 13: 33–41.

Milton, S. 2003. Systems Thinking–Putting Agricultural Programmes in an Ecological Context. Curriculum Development and Transformation in Rural Development and Natural Resource Management. FORUM *Working Document Number* 7, pp. 58–65.

Quereish, N. and Njui, A. 2003. *Consortium for Scaling-up Options for Increased Farm Productivity in Western Kenya* (COSOFAP), First Year Project Report. Prepared for The Rockefeller Foundation, New York, USA.

Senge, P.M. 1994. *The Fifth Discipline: The Art and Practice of the Learning Organisation.* Doubleday Dell Publishing Group, New York, USA. 423 pp.

Part 3
How to approach academic research

This part of the book is designed to help you to get started, select your topic and develop and write up your thesis in a way that meets academic requirements. All academic research is primarily directed toward a better understanding of our world. As a graduate student your research is also required to give you practical experience in doing research and to test your ability as a future academician. Graduate research work, particularly in Africa, can make a significant contribution to producers, entrepreneurs, communities and/or policy-makers and development agencies.

Your objective is to obtain your qualification. If your research is funded outside the university, then the sponsors will require that your research contributes to their project objectives. If your work is applied, then those with whom you will be researching or working will expect your research to contribute to their own productivity or development agenda. This can place you, the student, in a difficult situation. The requirements of the project are likely to be made explicit to you. You need to be aware of the requirements for your academic thesis. You can then take steps to balance this with what you are asked to do for your project. The most important thing is to be very clear with the funding agency what you are required to deliver for them. This way they cannot keep changing the goal posts. It also means that you can be sure to adapt your research from the start so that it is able both to achieve the required funding objectives and your personal objective of obtaining a higher degree. The first three chapters of this part provide guidelines on your objective of obtaining a qualification and guidance on initiating, developing and writing an academic thesis. Chapter 3.4 complements the research proposal chapter with specific recommendations for a research grant proposal.

Kay Muir-Leresche


Making it HAPPEN
SILENCE
zzz
SEEK & THOU SHAL FIND
CLICK!
ALEYA

3.1 The first steps – literature reviews and references

Kay Muir-Leresche

- **What research would fascinate you and what are you good at?**
- **Consider the problems that need to be solved – use your everyday experience to help you**
- **Look for projects working in this area which you could join**
- **Carry out a preliminary literature scan and Internet search**
- **Narrow down the broad topic to the specific area you would like to research**

'Every man is a borrower and a mimic ... and literature a quotation.'

Ralph Waldo Emerson (1860)
Society and Solitude

The first steps

1. Carefully assess your strengths and weaknesses. Consider first in which subjects you are strongest and which most fascinate you. Remember that you will have to maintain your interest and enthusiasm for the topic for a long time – often many years. Enjoying and having a good grasp of the subject area you work in is important. Then consider whether you would be better working with abstract concepts emphasising theory and mathematical models (basic research), or if you would be better working more closely with people in a practical and development, or policy-oriented way (applied research). You do not need to decide anything at this stage. You just need to have a realistic view of what you can do and where your interests lie. You will be most effective if you are able to be passionate about your research so it is very important to chose interesting topics and an approach which suits your personality and abilities.
2. When you have thought of your strengths and interests, you need to think about the world in which you live. In your own opinion, and based on your experiences, what do you think needs to be researched? Ask yourself such questions as:
   - Is there a particular soil type that appears to be uneconomic for a particular crop or in a certain area?
   - Are farmers' decisions relating to resource use leading to degradation?
   - When you were studying biochemistry, the only examples used were analysing samples from another continent – would it be interesting to run similar tests on local soil?
   - Does goat manure appear to be more economic than cow manure in improving the productivity of soils for growing maize?
   - Are the currently used physical measurements of soil structure relevant in a particular situation?

   These sample questions are from different disciplines but are all directed at considering the productivity of soil in one particular area. It is you who decides what the most interesting research needs might be in the particular topic and area you are considering. A few students will focus on basic research, but most African graduate students will be primarily focused on addressing their

research to real-world problems. Your own life experience can be an important contributor to your understanding of issues and problems:

- What problems do your parents face on the farm?
- What products or services are not meeting your needs as a consumer?
- Which government policies are making it difficult for your uncle to establish a business or for your cousin to market the commodities she grows?

These and other questions could all be inspiration for the starting point of your research. Your observations of the world – even simply that some farmers get better results than others – can all lead you to problems to research as you consider why. You will then use theory as a central component to solve the problems, even in applied research.

Your starting point could even come from a news report or from a crisis the country is going through, or from a change in government policy. Reading literature, journals, Internet articles, books and even your studies will provide most of you with ideas for applied research. A literature search and your own laboratory experience are often the main source of inspiration if you are more interested in basic or theoretical research.

3. When you have some idea of your field or fields of interest, approach your university lecturers and find out if there is an on-going project in this area which you may be able to join when you carry out your research. It is useful to indicate your interest early.

   Do not make an approach to them, even informally until you have briefly looked at some literature so that you are able to talk with some confidence on the topic when they question your interest in the research.

   Look outside the university as well. Research goes on in many different organisations – national, regional, international and even some commercial. Many have schemes for attaching students from universities, and often have better-funded projects that can help support students.

   If you are prepared to finance your own research then you will have more control over what you research and the approach you use and you can go directly to a more-detailed literature search. If you have already been recruited to a project, then your choice of field and approach to be used may be prescribed for you, but the emphasis you place on different aspects will still be up to you.

4. Once you have some idea of the topics you will investigate, carry out a preliminary search of the literature. If you have access to the Internet that is a good place to start. If your university does not provide good Internet access then you might have to invest a bit of your own money in using a public Internet access point ('cyber café'). If you do not have Internet access, then go to your libraries and search by subject matter. There are some journals which provide abstracts of recent publications in particular fields. Also go to relevant journals and glance through the article titles, occasionally stopping to look at abstracts. Many African agriculture faculties and libraries have access to CD-ROM literature databases, like the Essential Electronic Agriculture Library (TEEAL) which is a full text collection of core journals in agriculture and related fields. TEEAL is compiled by Cornell University. It is most useful, particularly as you can scan and print the abstracts, and only print a few of the most relevant articles. Given the high cost of printing, it is not advisable to print much when you carry out your initial exploration of the literature.
5. After you have looked at some of the literature relating to the topic of your interest, you should be in a position to begin considering exactly on which area you are going to focus

and to start to narrow this area to a researchable problem. Now go and visit lecturers, research funders, stakeholders and other persons involved in the work you are interested in pursuing. Discuss with them your ideas and what you hope to achieve. You can then begin to put together your research proposal. This will require you to consult the literature in more depth and to start looking at the theoretical literature and the data collection and analytical methods that may be appropriate for what you want to achieve.

Research is an on-going process and your thesis will represent one cycle. It will not be the end of research into the topic. One of the purposes of academic enquiry is to develop further questions for research. (Figure 1).

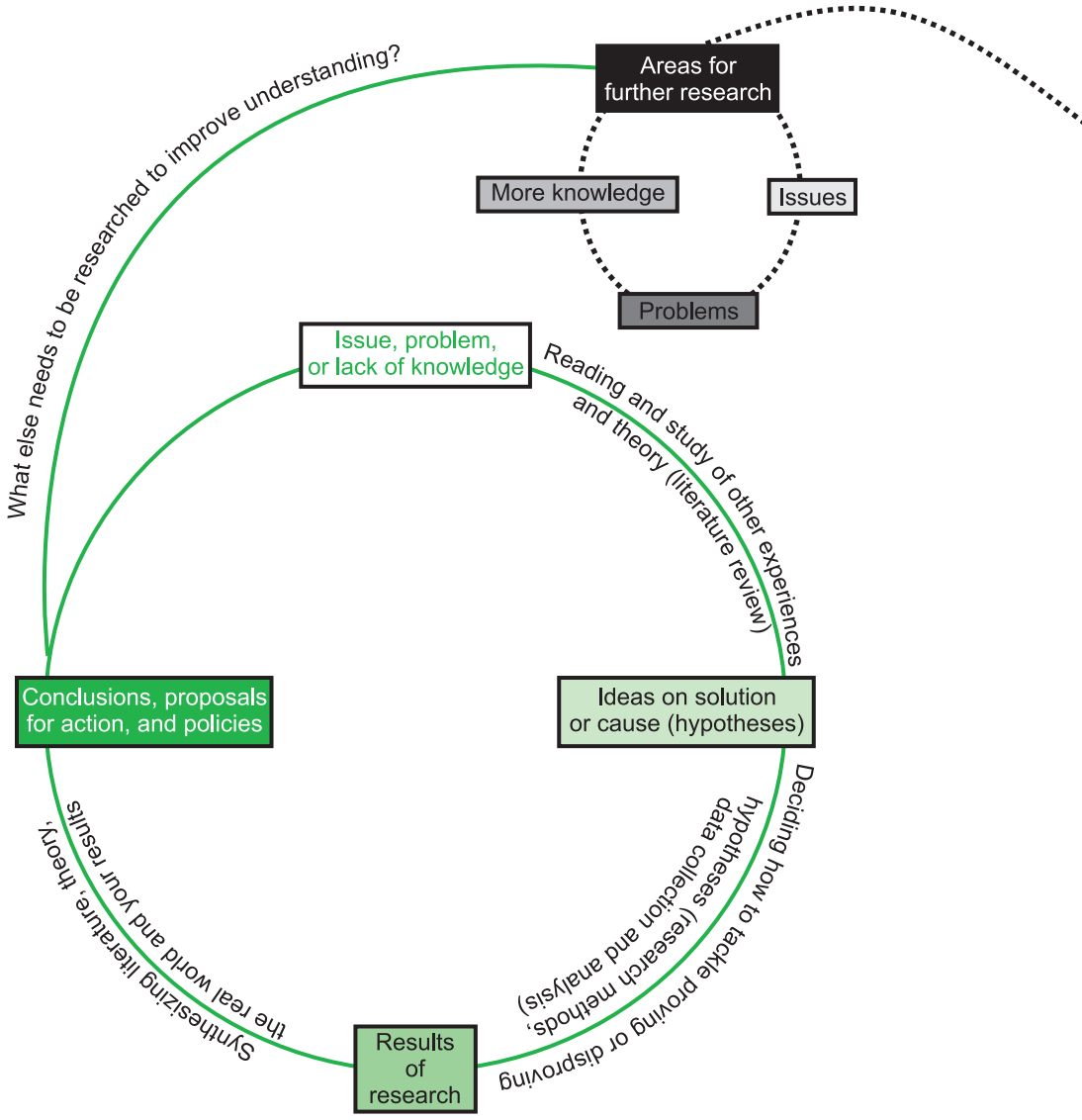


Figure 1. The cycle of research

The purpose of research is to increase knowledge. The scientific process starts with a problem that needs to be addressed. After reading and consultations, you should be able to come up with some ideas of cause and effect and to present the issues to be researched as one, or a series of hypotheses. You will collect data in the form of experiments, or surveys, or literature and secondary data sources. This data will then be analysed and interpreted and, where appropriate, presented as recommendations and areas for further research. Your conclusions will be based both on analysis of the data on theoretical principles and the literature review. With the new questions posed by your research, the cycle will begin again.

Your literature review

- Identify earlier work in your field – avoid reinventing the wheel
- Use the literature to show how your research will contribute to greater understanding of the subject
- Synthesise and summarise the earlier studies in a way that links together and highlights and resolves conflicts between different approaches
- Be sure that your review is critical and keeps showing the reader its relevance to your study.

It is a tragic waste of our precious human resources to continually re-invent the wheel.

Literature review

Purpose

Reviewing literature takes up considerable time for all academics – even those involved in the most theoretical, mathematical or practical research projects. It is particularly important to those addressing descriptive or policy issues. One of the main reasons that reviewing literature is so important is to avoid your spending long hours investigating something that has already been investigated! Re-investigation is only appropriate if you consider the previous research process inadequate, or if a different research method or new technology could produce different results.

For both masters and doctoral theses you will need to demonstrate your understanding of and competence in the research process, research techniques, interpretation and presentation. Your work must contribute to the body of knowledge but only doctoral theses have to demonstrate that the research constitutes an original investigation or testing of ideas or, if it is predominantly descriptive research, that it is in an unexplored area.

In order to demonstrate this you will need to provide a review of the literature to show you are not re-inventing the wheel. You will also require the literature to describe the problem you are researching and to explain why you consider it worthy of research. You will need a review of the theoretical literature in order to provide for the logic behind your hypotheses and for the interpretation of your results. You will need to use literature as evidence to support many of your statements, both theoretical and empirical, during the course of writing your entire thesis.

A thorough understanding of the literature is an essential component of graduate studies.

All dissertations, including honours theses, must demonstrate your ability to make critical use of literature and to provide a clear link between the literature reviewed and the research being undertaken. You must not review conflicting texts without highlighting the conflicts and interpreting them in relation to your own thesis.

Your literature review must avoid simply summarising available texts.

All graduate students need to ground their research in an explicit theoretical or conceptual framework, even when it is based on problem-solving or policy-oriented applied research. You will need to include a specific section related to those theoretical principles which underlie your assumptions and which inform your analysis and conclusions.

For your review of theoretical literature, it will be useful to scan old notes from relevant courses and then do the additional readings you may have skipped at the time.

Doing the review

In the first place you will need to make a preliminary review of the literature to provide you with the inspiration you need when developing your research topic and your research proposal. Then you will need a thorough review of the literature on the problem you are addressing. This will normally, but not always, be presented in a literature review chapter of your thesis.

The literature review chapter presents the views of other authors on the problem and issues your research addresses. Your opinions should be kept out of this chapter except where you critique what a particular author is saying. You are also required to show the reader how the literature you are reviewing relates to your research. This must be a well thought-out review of the literature. You use it like building blocks to show what other research has been carried out in the field and to review the theoretical principles which form the basis for the hypotheses you are postulating and/or any principles you may actually be testing in your research. You need to show:

- What other studies have been done, what their findings are and how they relate to what you propose to research. You need to report the results of others' findings and provide a critical review of these and of the methods which were used
- What theory has to say about the relationships you are investigating in the problem you are researching
- That you are familiar with the literature (not that you have seen it all!) and that you are able to understand and interpret the work you are reviewing. You need to make a particular effort to access current literature.

Links between each reviewed author and the research problem, and those between the reviewed authors must be made explicit.

It may be appropriate to include an analytical model which summarises the theoretical framework.

Many students are afraid of models. Don't be! A model is just an abstraction of reality. We build models to make it easier for us to deal with a very complicated world. A model can be descriptive – when you describe the real world, but do not include everything; schematic – when you produce an illustration which simplifies the relationships; or you can develop mathematical models. Mathematical models are the most useful when you need to make predictions, whereas descriptive and schematic models are useful when trying to understand the world better. Mathematical models are also very useful in establishing which variables are important in a system and how they are linked. See **Chapter 4.8** for a detailed discussion of models.

The literature review provides the validation of your research. It also provides legitimacy to your approach to data collection, analytical techniques and to your interpretation. It

should be an interesting synthesis of available literature which will make it clear to your examiners why you are undertaking this research and why you have chosen a particular approach. It will also lead them towards an understanding of your interpretation of the results and of your recommendations to producers, or policy-makers. The literature review will also inform them about areas for further research which are such an important component in graduate research. Most importantly it shows readers that you are not repeating earlier work.

Two common problems to avoid

1. Taking a literature review from another paper and giving the impression that you have yourself looked at the articles referenced
2. Plagiarism through copying large sections from other authors or published abstracts.

What is literature?

Literature is really just information that has been presented by other individuals or institutions. It includes text books, journal articles, graduate theses, working papers, occasional papers and briefings, Internet articles and data sets. It also includes unpublished reports, documents in files, pamphlets, draft research and notes. Published literature is that which it is possible for other readers to access. 'Grey' literature is that which is only available directly from the author or institution who produced it and is not available for public orders. Text books from reputable publishing houses and journal articles will normally have more credibility than unpublished reports, or pamphlets. This is because the published work will have been reviewed by peers and the data collection and analytical techniques will have been open to scrutiny. Unpublished work may be based on poor data or analysis or may even be deliberately biased to a particular outcome. When you are using literature to provide evidence for some of your assertions you need to keep this in mind.

Don't be fooled – not all published journal articles are based on sound data or evidence. If the results or conclusions are not logical, carefully question the author's assumptions, data and/or analytical methods.

Be warned!

In my own experience, I published data from very dubious records by District Administrators on estimated crop areas and yields in communal farming areas. I placed caveats everywhere warning people not to use the data which was only included as a matter of historical record since there was no other data available between 1890 and 1960. The supply response studies I did using the data were not included in my thesis because of the unreliability of the data. Some 10 years later I saw an article in the American Journal of Agricultural Economics, estimating supply response using my data with no acknowledgement of the problems that existed with that data!

You need to be aware that even the most respected publishers and journals may publish material that is false – the review process is not infallible. You must always look at what is presented critically and assess the source of secondary data and the method of primary data collection carefully. For the most part you can assume that information from published sources is reliable – but keep a look out for errors. You need to be critical.

You need to be particularly critical of information coming from vested interests – farmers associations, government departments, or private companies. It is often very good informa-

tion but you need to assess it for bias. For the social sciences grey literature is widely used, but you have to be constantly aware of the need to assess its validity.

Literature is central to providing evidence for your choice of topic, your hypotheses, and the interpretation of your results. It also informs the methods you use to collect and analyse data. An effective review of literature provides your examiners with evidence that you understand your topic. Do not overlook its importance.

How to go about a literature search

Where to look

1. Look at the materials that have been recommended to you in reading lists for your courses. These are usually the easiest to obtain. These articles and books will in turn include references to which you can go for more depth. If your library does not have the text you need to access, you can ask your librarian to access it from a larger library. This was common practice until the 1980s when, in most of Africa, paper and postage became too expensive and so for several decades the inter-library loan facilities were not used very much. However, now with Internet and scanning facilities it has become easier for your librarian to arrange for you to access the material you need by using electronic transfers.
2. If you have Internet access this is probably the most useful way to get access to literature and some suggestions on how to access the information you need is included at the end of this chapter.
3. Use the subject index in your library to go to the shelves and see what is easily available in your area. Increasingly our university libraries have very little modern information, but quite often the old information they do have can be most informative. Many of the studies that were carried out in Europe, Japan, India and North America in the 1950s–1970s can be very relevant to what you want to do. The experiments and analyses reported were relevant to their particular natural and social conditions, but there are others which can usefully provide guidelines for undertaking similar investigations in Africa.
4. Go to the journal section in your library and scan the article titles to see which ones may be relevant to your work.
5. Use some of the journals and CD systems available which provide abstracts (and sometimes the entire article) of recent research. A list of some of these sources is provided at the end of **Chapter 3.1**.
6. Go to government offices, farmers' organisations, NGOs, research organisations and the information libraries of various international agencies and embassy services. Some government departments have a surprisingly good collection of material that is not available elsewhere. Note that in some African countries national and international agricultural research organizations have been in existence for a very long time [the Kenya Agricultural Research Institute (KARI) in Kenya are celebrating their centenary]. Of course some information they hold becomes out-of-date but much is still relevant.

How to look

1. You should learn how to scan very quickly through books, articles and papers in such a way that you are able to see if they are likely to be useful. You need to look at the abstract first and if it does not appear to be relevant put it aside. This should take you no more

than a few minutes for each book or article. If you are looking through a publication of abstracts then use the Table of Contents to find the relevant sections and then glance down the page and only stop to read the abstract if the title seems relevant. You may miss some relevant material in this way but you have to learn to make a trade-off between time available and the depth of your hunt for literature.

2. If it appears that the publication may be useful then turn to the Table of Contents and if that also looks useful then make a note of the author and title.
3. Next, turn to the conclusion and scan that. If it still seems relevant make a few very brief notes from the abstract and conclusion and be sure to fully complete the reference note with publisher and date and place of publication. Then put it aside to check out (if it is in a library) so that you can read and make notes at leisure. If it cannot be taken home, then make a quick review of the rest of the document, paying particular attention to the results and make a note of the data collection method and the analytical techniques. If there are any really interesting assumptions or conclusions, make a note of these and perhaps even copy out a quote. This should not take you more than 15 minutes per book or article. If it seems that the publication is essential to your research then see if you can persuade the holder to let you borrow it, or at least to photocopy some pages or arrange to come back when you have more time.

Get a hardback notebook and when you go somewhere head the page with the name of library/office and the date. Use the book for your references and your notes. One of the most difficult things is retracing where you found the information you are using. Be sure to enter these regularly in your computer in case you lose your book! Then back up the computer as well.

Constructing your review chapter

The type of research you are undertaking, and your discipline, will affect how your literature review is constructed. In some cases the literature review may form an introductory section to several chapters and not stand alone. In others you may actually have two full literature review chapters, one related to description and history and another related to theory and research methods. Whatever the form your literature review takes it must at some point include the following aspects:

- An overview of the subject, issue or theory under consideration, along with the objectives of the literature review
- A categorisation of the literature into those items that are in support of a particular position, those against, and those offering alternative theses entirely
- Explanation of how each work is similar to and/or how it varies from the others
- Conclusions as to which pieces are best considered in their argument, are most convincing of their opinions, and make the greatest contribution to the understanding and development of their area of research.

In assessing each piece, consideration should be given to:

- Provenance – What are the author's credentials? Are the author's arguments supported by evidence (primary historical material, case studies, narratives, statistics, recent scientific findings)?
- Objectivity – Is the author's perspective even-handed or prejudicial? Is contrary data considered or is certain pertinent information ignored to prove the author's point?

- Persuasiveness – Which of the author's theses are most/least convincing?
- Value – Are the author's arguments and conclusions convincing? Does the work ultimately contribute in any significant way to an understanding of the subject?
  (for more details see Lyons, 2003)

The most important factor in a literature review is that you continually link what you are reviewing to your research. You must show your reader why you are including this work and how it helps to develop your thesis. You need to make these links as explicit as possible.

Helpful hints in writing a review

You need to ensure that your literature review is not just a jumble of different summaries – you need it to tell a story. The best approach in most cases is to separate the literature into different themes:

- Historical and descriptive – or what research has already been done on this topic
- Methodological – how other studies collected data and analysed it. Here is where you look at various data collection and analytical methods including those you are **not** going to use and say why they are not right for your research. In some theses this section can also go before the chapter you write on data collection and/or in some cases before the analysis chapter
- Results, interpretations and controversy – here you discuss the major points these writers were making and how your research fits in. You can assess weaknesses of the earlier research and contribute to the discourse.

Remember

- Use literature as evidence to back up what you are saying
- Be selective
- Summarise the key points made in your own words – don't use too many quotations
- Be careful when paraphrasing – you must represent the opinions and information accurately.

Referencing, citations and bibliographies

It is essential that you always acknowledge the source of what you are saying. **Plagiarism and falsifying research data are totally unacceptable in academic circles.** Either of these crimes will result in your losing employment, funding, and credibility, and lead to expulsion from your degree course or to failure. **Plagiarism is defined as stealing the writings or ideas of another.** It occurs when you are using work that you do not acknowledge, even if you have put those ideas into your own words. You are expected to use other people's ideas and even on occasion their words, but you must always acknowledge that you are using them. There are many different styles of providing the sources of your information, but all systems involve citing the author in the text where you use the ideas (either in brackets or in a footnote). In addition you must provide the full reference to the citation – usually in a reference list at the end but sometimes by providing the information in footnotes throughout the text. The detailed references must provide all the information needed for your reader to access the original source.

Evidence and acknowledgement are the heart of academic research

All written work must include the sources of information you have used. These should be the main sources you have consulted in writing your report or dissertation, i.e., those that you cited in the body of your thesis. Your reference list does not include everything you might have looked at. In some academic writing a full **bibliography** is given at the end of the publication that includes most of the documents consulted, even if they are not cited in the text. More commonly a **reference list** is used and this includes only cited work.

Why do you need to provide citations and references?

- To provide evidence – the most important part of contributing to humanity's store of knowledge is to be sure that the contribution is valid (within the limits of what is known at the time). As an academic you should never make unsupported assertions. Evidence and support come from:
  - empirical facts which you obtain by carrying out experiments or collecting data which 'prove' that this is a reflection of the real world
  - theoretical principles (and in some cases you may need to show how these were derived or why they are valid)
  - literature – what other people have found out. You need to say where you got this information from – hence citations and references
  - allowing your readers to check what was said and to ensure that you have interpreted it correctly
  - allowing your readers to discover more information and read more deeply on the topic.

Providing citations and references is what separates academic research from political rhetoric, or religious dogma, or uninformed opinion. It is one of the most important parts of your research and your literature review and the references you provide may be the most useful contribution of your research to academic enquiry.

A **bibliography** or **reference list** gives all the work you have cited in alphabetical order by author's surname, or institutional (corporate) name, or by title where no name is given and is usually situated at the end of the main body of your work, but before the appendices. There are many different styles of referencing and you can chose to use any system, even a numbers system, provided you are consistent. Check with your university regulations to ensure that the system you use is appropriate. A slightly adapted version of the Harvard system is the one used in this book that follows the style of the African Crop Science Society Journal.

In the text you should include the author or editors surname in brackets after the presentation of her/his ideas or a direct quotation (e.g., Rukuni and Eicher). It is also common to include the date with the surname/s (e.g., Rukuni and Eicher, 1994) but this is only essential when you have more than one publication by the same author/editors. If you have more than one by the same author in the same year, then you also use alphabetical letters (e.g., Rukuni and Eicher, 1994b) to distinguish them.

It is only for quotations (using the other author's words) or where you want to provide your reader with direct access to the source, that you include the page numbers in your citation in the text. When you quote directly from another work you must indicate this with quotation marks and then beneath where it appears in your text, insert the author/editor name and the page number(s) of the original text. This will correspond to the name/s as they

appear in the alphabetical sequence of citations in your bibliography or reference list. Generally textural quotations should correspond precisely to the original in wording, spelling, capitalisation and punctuation. With short quotations incorporate passages of not more than four lines directly into your text, identified by quotation marks, e.g., Ojwang (1994) 'The natural cycles of biodiversity are affected where there is habitat destruction,.....monoculture crops or forest plantations.'

With longer quotations (two or more sentences or more than four lines) set the quotation off from your text and indent from the left margin.

> 'We have three principal means: observation of nature, reflection, and experiment. Observation gathers the facts, reflection combines them, and experiment verifies the results of the combination. It is essential that the observation of nature be assiduous, the reflection be profound, and that experimentation be exact. Rarely does one see these abilities in combination. And so, creative geniuses are not common.'
>
> (Diderot, 1753)

The reference list

You should find out if you are required to follow a particular system of referencing from your university and search for a detailed description of that system. When you are publishing journal articles you will need to check and see what system is used by that journal. The elements are the same in all reference lists but they may use a different order and different punctuation. The Royal Agricultural College Library has compiled a comprehensive description of the Harvard System also known as the Author–Year or Name–Date system. It gives very detailed and useful information on how to reference and the website details are included in the reference list to this chapter. Modified extracts of their website information, using African examples are provided below.

Main elements of a reference list – how to prepare a citation

Author

- Surname first, followed by initial(s)
- Where more than one author, list them with 'and' before the last one. (When citing in the text if there are more than three, put first named followed by... *et al.* (meaning 'and the rest'. But all their names must appear in the Reference List at the end).
- If they are editors, put ed. or eds. in brackets after the name(s).
- Corporate authors: where initials are commonly used, e.g., FAO (Food and Agriculture Organization of the United Nations), make sure that somewhere in your paper, (perhaps as a separate appendix) you have a list of acronyms giving their full expansions.

Title

- Must be in *italics*
- Capital letter for the first word only, or second word if the first is an article.
- Take the wording from the title-page of the book (not the cover as it may differ).
- A colon precedes the sub-title. (Always include sub-titles because they often give extra useful information.)

Books: Personal author

Surname, initial(s). (Year) *Title: sub-title.* Edition (if more than one). Publisher. Place of Publication

Venkatesan, V. (1994) *Seed Systems in Sub-Saharan Africa: Issues and Options.* World Bank, Washington DC, USA.

Books: Corporate author

Name of Organisation. (Year) *Title*. Publisher. (add Series and number if appropriate)

ISSER (Institute of Statistical, Social and Economic Research). (1994) *The State of the Ghanaian Economy* Legon: University of Ghana, Accra, Ghana.

Chapter in book

Cite the author(s) of the chapter, use the word In: to indicate where that chapter is, then give the title of the book in italics and editor name(s) publishing details and lastly the page numbers in the book.

Ondiege, P. (1996) Land tenure and soil conservation. In: C. Juma and J.B. Ojwang (Eds) *In Land We Trust: Environment, Private Property and Constitutional Change* Initiatives Publishers, Nairobi, Kenya, and Zed Books, London, UK. pp. 117–142.

Conference proceedings

A paper in a collection of conference proceedings is cited in similar fashion:

Boardman, J. (1995) Soil erosion and its impacts. In: *Soil erosion and land use: towards a sustainable policy: proceedings of the seventh Professional Environmental Seminar, February 1995, Cambridge.* B. Evans (Ed). Cambridge Environmental Initiative: 37–53.

Journal articles

Author(s). (Year) Title of article. *Title of journal.* Volume (part number): page nos

Borlaug., N.E. and Dowswell C.R. (1995) Mobilising Science and Technology to get Agriculture moving in Africa. *Development Policy Review* 13(2): 115–129.

Unpublished dissertations or theses

Sakala, W. (1994) Crop Management Interventions in Traditional Maize–Pigeonpea Intercropping Systems in Malawi, unpublished M.Sc. thesis, Bunda College of Agriculture, University of Malawi, Lilongwe, Malawi.

Personal communication

Sukume, C. (2003 Sept 20) Conversation about the importance of tenure to investment in production. University of Zimbabwe, Harare, Zimbabwe. [Note, usually only cited in the text, not in the reference list.]

Internet

Author. (Year) *Title.* [online]. Edition. Publisher. Available from: URL
[Date accessed]

Environment Agency. (2002) *Fisheries action plans* [online]. Environment Agency. Available from: www.environment-agency.gov.uk/subjects/fish [Date accessed: 30.9.02]

It is worth keeping copies of key Internet pages on your computer as they can disappear.

The term **Publisher** is used to cover the organisation responsible for maintaining the site on the Internet (corporate author). If it is not immediately obvious, delete sections of the URL one by one, going higher up the chain of the Internet address to find out who created the website.

Electronic journal articles

Author (Year) Title of article. *Journal title*. [online or CD-ROM] volume (issue), pagination. Available from: URL. [Date accessed]

Horesh, R. (2002 Sept) Better than Kyoto: climate stability bonds. *Economic Affairs*. [online]. 22(3):48-52 Available from: www.iea.org.uk [Date accessed 30.9.02]

E-mail communications

Discussion lists generate e-mail messages which are sent directly to the subscriber. References to these messages should be treated in a similar fashion to journal references. Use the list name in place of the journal title and the subject line of the message in place of the article title. After 'Available from', use the e-mail address of the list administrator or URL of the archive.

Author (Year, month, day). Subject of message. *Discussion list* [online]. Available from: list e-mail address [Date accessed]

Ladley, L. (2001 Feb 27) Customer feedback: summary of responses. *Lis-link* [online]. Available from: www.jiscmail.ac.uk. [Date accessed: 30.9.02]

Searching the Internet

The purpose of this section, that was compiled by ***Liliosa Maveneka***, is to provide you with a simplified overview on how to use the Internet to obtain information and to provide a guide to some of the agriculture–related databases which you can access through the Web.

The Web (or WWW) is a collection of documents, resources, Internet sources or websites that can be accessed on the Internet via a Webbrowser. Microsoft Internet Explorer is a popular multimedia browser. **Search engines** are the primary tools that are generally used to search for information from the Internet.

Search engines

Search engines are of two main types. Some have robotic software that crawl all over the Internet looking for webpages and indexing them in their databases. They index any type of webpage.

Other search engines have human indexers who index web pages. These are generally better than robotic search engines because their websites are checked for their quality. Their search programmes give the entries found in order of relevance.

General search engines:

Google	http://www.google.com/
Alltheweb	http://www.alltheweb.com/
AltaVista	http://www.altavista.com/
HotBot	http://www.hotbot.com/
WiseNut	http://www.wisenut.com/

Meta-search engines:

Dogpile	http://www.dogpile.com/
Iboogie	http://www.iboogie.tv/
Metacrawler	http://www.metacrawler.com/
Profusion	http://www.profusion.com/
Infogrid	http://www.infogrid.com/

Meta-search engines search different engines at the same time and then present results to the user

Some of the more serious academic research engines are, AltaVista and ENCARTA.

Directories, also known as subject directories, group websites by subject and make it easier to select appropriate information. Directories are indexed by subject specialists and therefore have superior quality websites. However search engines are more up-to-date than subject directories.

Examples of directories are:

Yahoo	http://www.yahoo.com/
Pinakes	http://www.pinakes.com/

Searching techniques

Most people have problems because of the overwhelming amount of information available on the Internet. After you have determined a suitable search engine, directory or database, you will find the following strategies useful.

1. Define the key information you are looking for and come up with key terms. You may also use the 'help' function found on the engine.
2. If you have multiple key terms use Boolean operators to specify the search action and limit the list of hits to an acceptable and relevant number. The **Boolean operators AND, OR** and **NOT** specify relations between search terms:
   AND to indicate certain terms to appear on a page simultaneously,
   NOT to indicate that certain terms should certainly not occur on a page,
   OR expands the search to contain either of the words.
3. Use phrase searching to get highly relevant results. Phrases help to refine the search.
4. If you are unsuccessful in your first search, use alternative search terms.
5. Try to formulate as many search terms as possible.
6. Try a different search engine or database.

Searching requires time but is not stressful.

Example: Searching for literature on writing a research proposal

- Double click on the **Internet Explorer** icon
- Click **Search**. A search engine/ directory comes up
- Click **Find a Web page**. Write the word **Google** and click on **search**.
- One of the sites in the search results is **Google**. Clicking this makes the google engine active
- Enter the word **AltaVista** and click on **google search**
- Click on the search result **AltaVista** and this search engine becomes active
- Enter words **writing research proposals** and click **Find**
- AltaVista gives the option to focus the search term. Focus on **proposal writing**
- Looking through results one of the results (as at 26/08/2003)
  Reid A, Proposal Writing – A Practical Writing Guide. The website is given as
  http://members.dca.net/areid/proposal.htm

Useful websites/databases on agriculture and related sciences

- AGRIFOR – The UK's gateway to high-quality Internet resources in agriculture, food and forestry
  http://agrifor.ac.uk/

- African Journals Online AJOL – for African-published journals in the sciences
  http://www.inasp.info/ajol/
- EBSCO – provides access to academic search in social sciences and other areas as well as access to economic journals (Library to register – updated daily via EBSCO host)
- Institute of Development Studies, Sussex, UK
  http://www.ids.ac.uk/
- Consultative Group on International Agricultural Research (Provides information on all the 16 centres in the Group)
  http://www.cgiar.org
- International Network for the Availability of Scientific Publications, UK
  http://www.inasp.info/ajol/links.html e-mail inasp@inasp.info
- Food and Agriculture Organization of the United Nations
  http://www.fao.org/
- World Bank
  http://www.worldbank.org/

Resource material and references

Appendix 5. Stapleton, P., Youdeowei, A., Mukanyange, J. and van Houten, H. 1995. *Scientific Writing for Agricultural Research Scientists*. WARDA/CTA, Ede, The Netherlands. On CD.

Appendix 6. Publication as an Output of Science. Adipala Ekwamu. PowerPoint on CD.

Appendix 7. The Art and Ups and Downs of Scientific Publication. Adipala Ekwamu. PowerPoint on CD.

Appendix 8. Presentations and Style – Tips on Photography and Writing. Eric McGaw. On CD.

Boling, E. 1997. *Research Writing: Literature Review*, University of Indiana, USA.
Available from: http://education.indiana.edu/~istcore/r519/lit.html [30/07/2003]

Coghlan, L. 2000. *Referencing*. Portsmouth University, Portsmouth, UK.
Available from: www.pbs.port.ac.uk/~coglan/bus102/ref.pdf [30/07/2003]

Cooper, H. 1998. *Synthesizing Research: A Guide for Literature Reviews*. Sage Publications, Thousand Acres, California, USA.

Daniel, H. and Fisher, E. 1999. *Enjoy Writing Your Science Thesis or Dissertation*. Imperial College, London, UK.

Galvan, J.L. 1999. *Writing Literature Reviews*. Pyrczak Publishing, Los Angeles, USA.

International Network for the Availability of Scientific Publications (INASP). 2003.
http://www/inasp.info/ajol/links.html

Kung, H.T. 1987. *Useful Things to Know about PhD Thesis Research*, prepared for 'What is Research' Immigration Course. Computer Science Department, Carnegie University, USA.
Available from: http://www.eecs.harvard.edu/~htk/thesis.htm [30/07/03]

Lyons, K. 2003. *How to Write a Literature Review*. University of California, USA.
Available from: http://library.ucsc.edu/ref/howto/literaturereview.html [30/07/2003]

Macauley, P. 2001. *The Literature Review*, Deakin University. Geelong, Victoria, Australia.

Available from: http://www.deakin.edu.au/library/findout/research/litrev.html [15/10/2001]

Mouton, Johann. 2001. *How to Succeed in Your Master's and Doctoral Studies: A South African Guide and Resource Book*. Van Schaik Publishers, Pretoria, South Africa. 119 pp.

Ojwang, J.B. 1994. National domestication of the Convention on Biological Diversity. Chapter 16, In: *Biodiplomacy: Genetic Resources and International Relations*, Vicente Sanches and Calestous Juma (Eds.). African Centre for Technology Studies (ACTS), Nairobi, Kenya.

Royal Agricultural College Library Services. 2003. *Bibliographic References – The Harvard System*. Royal Agricultural College, Cirencester, UK.
Available from: http://www.royalagcol.ac.uk/library/referencing.htm [30/07/2003]

Rukuni, M. and Eicher, C. (Eds.) 1994. *Zimbabwe's Agricultural Revolution*. University of Zimbabwe Publications, Harare, Zimbabwe.

Saint Louis University. 1998. *A Student's Guide to Research with the* WWW. Saint Louis University, St. Louis, Missouri, USA.
Available from: http://www.slu.edu/departments/english/research [21/08/2003]

Sullivan, D. and Sherman, C. (Eds.) 2001. *Web Searching Tips*. Search Engine Watch.
Available from: http://searchenginewatch.com/facts/article.php/ [21/08/2003]

Taylor, D. and Proctor, M. 2001. *The Literature Review: A Few Tips on Conducting It*. University of Toronto, Toronto, Canada.
Available from: www.toronto.ca/writing/litrev.html (30/07/2003)

Tilburg University. 2003. *Searching the World Wide Web: A Basic Tutorial*. Tilburg University, New Zealand.
Available from: http://www.tilburguniversity.nl/services/library/instruction/www/onlinecourse/introduction.html [21/08/2003]

University of Zimbabwe Libraries. 2002. *Dissertation and Thesis Writing*: Online Resources, University of Zimbabwe, Harare, Zimbabwe.
Available from: http://www.uz.ac.zw/library/resources.html

3.2 Your research proposal

Kay Muir-Leresche

- **Planning research requires you to reduce and organise information**
- **What you can achieve is constrained by your time, skills, contacts, physical and financial resources**
- **Do not overstate what you will research - rather understate and achieve more**
- **You will be judged on how rigourously you approach the hypotheses and objectives you specify**
- **Continually involve your supervisor in the development of your research proposal**
- **Objectives should be simply and clearly stated and make it clear to the reader what you want to achieve by solving the problem**
- **A hypothesis is a statement of what you think is true based on available evidence. Your research will then prove or disprove this hypothesis**
- **You must provide the rationale for your hypotheses and you must be sure you have the resources to test them**

'Extraneous information and ideas are eliminated as foreign matter might be filtered in a funnel'

Andrew and Hildebrand (1982)

This chapter is directed towards the requirements for an academic degree. But it is important to keep in mind that if you are involved in a larger project that this will have demands of its own. **Chapter 3.4** covers the development of project proposals to obtain grant funding and it complements this chapter.

Where you are part of a project you may find yourself caught in the middle when trying to reconcile your thesis requirements with those for the project. Your research will be just one component of the larger project. This means that you will need to adapt your research to fit in with the requirements of the project.

Study the grant proposal and project documentation before you begin to refine your research proposal. Do not rely on what someone else says is needed. When you have done this, then carry out the steps outlined in **Chapter 3.1** before going on to develop your research proposal.

Getting started

You have decided on the area you want to research, you have gathered information on the topic and you have held discussions with prospective supervisors – you have established what you want to do. Now you need to work on your research proposal and you need to clearly define your research. In due course this research proposal will form the basis for the introduction to your thesis.

Your primary task is to narrow down and clearly specify what you hope to achieve. You need to specify the problem or issue you are addressing in your research. You need to show why this is an important topic. You can specify the problem in a broad context at first but then you will need to narrow this down to exactly what you will be researching and show how this will contribute. Planning research requires that you reduce a large volume of information to manageable proportions. Each part of your research proposal should be designed to make what you are researching clearer to your reader (and yourself!). To follow Andrew and Hildebrand's model, you start of with the wide section of the funnel and the general setting, this narrows to problems faced, then specifically to the problem you address and then to the hypotheses you will test, your objectives in testing them and the questions you will pose to

gather the information. You need to keep filtering out surplus and less directly relevant information to make the orientation precise. The constraint is the narrow part of the neck of the bottle into which the filter must fit. This bottleneck is the resources available to you – time, skills, contacts, and the physical and financial resources for the research.

The research proposal is primarily an exercise in cutting back. For an academic thesis you can do more than you indicate, but do not state that you are going to do more than you are able to achieve.

What does this mean? It means that less is more. You should limit what you set out to achieve to the bare minimum required by your supervisor. If you achieve more in the course of the research that will be good and it will give you more information to back up your conclusions and to develop areas for further research. However, if you state that you are going to test many hypotheses, or one very complicated hypothesis, or achieve multiple objectives, and your thesis does not make a full and thorough attempt to address these, then an examiner could deem you to have failed. You will be judged on whether you make an acceptable attempt to carry out the research on those hypotheses and objectives you state you are addressing. This means that you should show a thorough understanding of the various approaches to the research as well as providing a thorough theoretical review, analysis and well structured testing of your hypotheses. It is extremely important that you remember that when determining your academic research **less is more.** Be precise about what you will achieve, limit it to fit your resources and then be sure that you are very rigourous in your academic enquiry.

Always limit what you say you are going to do. If you say you are going 'to discover why some small-scale farmers are successful and others are not' then you will be judged on whether you succeed in achieving this objective. Rather say your objective is 'to discover some of the reasons why some smallholders are more effective at x,y z than others'. That is far more realistic.

If you need to incorporate additional research in order to meet the requirements of other stakeholders (the communities/farmers with whom you are working, the funding agency and others) then provide them with a supplementary proposal. This should detail those aspects that you will include but which are not being included in the academic research proposal. The aspects covered in your academic proposal will receive a more academic and theoretical approach than those included in the supplementary proposal. **The requirements of a research report to stakeholders are different from the requirements of a thesis.** The former is more interested in your findings and in ensuring that the research process used is valid and that the findings are legitimate. In addition to these criteria, your thesis needs to show your examiners that you understand the theoretical concepts, are aware of the available research and analytical tools and of the literature. A thesis proposal must indicate to the academic committee how you will address these issues, whereas a research proposal to prospective funders or clients needs to be more explicit about how your project meets their needs. In rural development you also need to show how you will include affected communities in the research process and how they will benefit.

The research proposal for your thesis is a vital component of your research and can take up to a quarter of the time allocated to the thesis. Specifying the problem clearly is essential to avoid gathering the wrong information and/or using the wrong research tools and analyti-

cal methods and then having to start again, or to base conclusions on inadequate evidence.

If you include the context in which your research will operate you may find that this will help you to limit what you are planning to achieve. If you are explicit about the geographic, social, and economic bounds of the problem and solution you can avoid the trap of producing a grandiose but unachievable proposal.

You need to continually involve your supervisor and other lecturers in your research proposal phase. In many ways this is the most important time of your research. It is also the time when you are likely to interact most closely with your supervisor and is a good time to really get to know her/him.

The rush to the field

Getting out and being active is what most people want to do. If you really have to start before the proposal is ready, use your early fieldwork to refine the proposal. Use rapid rural appraisal to gain an overview, informally pilot some approaches, and pretest your questionnaires. Avoid starting to collect data before you have a research proposal accepted by both your academic committee and, if appropriate, those funding your research.

The research proposal

Setting the stage

You need to provide an introduction that gives the background to the topic, explains your rationale for choosing this problem and briefly includes a review of some of the other work carried out on the subject. You should avoid giving a detailed review of agriculture in that region – rather just highlight the elements most relevant to your research and provide references. However, you do need to provide the general background for the particular research problem you will address.

Example

Smallholder farmers in Africa (or in x country, or in y region) have very low yields and low incomes/poor health, etc. (provide references). The poor soil fertility and the impact of pesticide residues negatively affect productivity (references) and contribute to unsustainable production systems and a degrading environment (references).

This is a key part of your research proposal but you should avoid providing detailed information. It is more important for you to extract the essential elements and then to provide references indicating where information can be found. The length of this section depends on the type of problem you are addressing and on whether you will include a brief literature review after providing the statement of the research problem. You will need to get guidance from your own university on their limits and requirements. Some universities require you to have both a long and a short proposal. The long proposal would include a comprehensive literature review. However most academic committees when deciding on the merits of your research proposal will use a short proposal and will not want the introduction and literature review to be more than one or two pages.

Start off with as much of a background as will help you to set the stage. Then go ahead in specifying the problem and developing hypotheses and research questions. After this is done go back and cut the introduction to the required length, making sure what you leave in is directly relevant to your proposed research.

If you are applying for an independent research grant then you will need to have a long proposal with a detailed literature review to provide background to the short proposal. If, however, you are applying to be part of an existing or proposed project then your own proposal does not need to be so long. It does, however, need to be very clear on how it fits in with the project. What will your research contribute? How will it meet some of the specific objectives of the project? Will it address any already established hypotheses? If not, how do your hypotheses add value to the project?

The research problem

Your clear statement of the research problem can be in a section on its own or it can fit into the end of the Introduction. This is your opportunity to clearly indicate which component you will address from the general issue/problem outlined in your introduction. You need to use it to show how this aspect fits in to the general subject area and you can also use the section to show why addressing this particular aspect is important – to academic enquiry, to your client population, or to society in general.

At the end of this section you need a paragraph which briefly and clearly defines the research problem you are addressing.

Example

Pesticides and chemical fertilizers are expensive and frequently unobtainable. Some small-holders in region x have been successful in increasing incomes and maintaining soil fertility by using an integrated pest management scheme and crop rotation. However other farmers have been less successful. This study is particularly concerned with the problems of soil type (or distance to market; or access to draft to ensure good timing; or access to manure; or crops included in the rotation; etc) on successfully using IPM and crop rotation to increase income and sustainability.

It is important that your research problem statement includes the specific aspect that you will be considering. The first three sentences would be inadequate as the statement of your research problem. They need the final qualifying statement that will clearly indicate what you are going to address.

Literature review

In short proposals this may be included in the Introduction. In academic proposals it is important as it provides evidence to the academic committee approving your research that you understand the context of your research and what other work has been done in this area. The information provided in **Chapter 3.1** is relevant here, although, obviously the proposal will not provide a detailed analysis of the literature. In the proposal, the Literature Review is a brief summary of the most important information, highlighting its relevance to your choice of topic.

Objectives

What is the purpose of your research? What do you hope to achieve? In answer to these questions you will develop objectives for your research. Note that there is no particular order in which the objectives, hypotheses and research questions must be presented. Each school of thought will have its own approach and you must consult with your supervisor to see

whether you can choose how you frame your proposal or if you must follow a fixed format. The objectives are also a way of identifying your clients, defining the limits of the research and describing the expected outputs in a clear and succinct way. It is useful to crystallise your objectives before you finalise your hypotheses, even if in the research proposal you put the objectives after the hypotheses.

The objectives need to be simply and clearly stated. They need to include both the general objectives related to stakeholder welfare and the specific objectives of the type of approach you will use and the aspects you will emphasise.

Objectives based on the above research problem statement:

1. To assist smallholders to improve livelihoods/ reduce health risks, etc.
2. To contribute to improved sustainability of the environment by isolating those factors that reduce the adoption/success of using IPM and crop rotations.
3. To use xyz baseline study to differentiate between farmers' adopting/successfully using the recommended technology and those who are less successful or non-adopters. If you are doing a doctorate, or a masters which is part of a larger study, then you could be involved in the baseline study. If you are doing the masters on your own it is too ambitious for you to carry out a statistically valid baseline study without available secondary data in the time limit. You could only do this if you worked in a team with other masters students on a collaborative research project.
4. To collect detailed information on the soils (availability of draft, access to market or whatever) of selected farms in the differentiated groups from the baseline study area.
5. To analyse the information and determine if the type of soil (whatever) affects adoption/ success.
6. If time is available (otherwise put in areas needing further research) – to conduct experiments varying the recommendations according to your preliminary findings. (This is usually applicable to doctoral rather than masters theses).
7. To provide recommendations to farmers/ technical agencies/policy-makers based on the outcome of this research.

Some parts of the above objectives are moving towards methods and are not strictly objectives in that they address more how to solve the problem than what the problem is. However, it can be useful to include an indication of method to help clarify it for yourself and your readers. But do not go into any details on the method part – the objective should be directed at what you will achieve by solving the problem – not how to solve it.

You will need to include some justification and background for these objectives, unless earlier sections have made the logic apparent.

Hypotheses

A **hypothesis** reflects what you think is true but which still needs to be proved. It is a supposition or a provisional explanation of something. Students are often overwhelmed when asked to present their hypotheses. In fact it is simple: A hypothesis is a statement of what you think is true based on available evidence. Your research will then set out to prove or disprove the validity of this hypothesis.

This is something you do every day. In countries with shortages a person might hypothesise that flour/sugar/fuel is more easily available in the low-density suburbs. They will then test this hypothesis by going there and trying to find the commodities. Another person may

hypothesise that these commodities are more easily available in the poor suburbs and go there to find out. One researcher may hypothesise that these commodities are more easily available in the wealthy suburbs because people are able to afford the very high prices. Another researcher may hypothesise that they are more easily available in the poor suburbs because illegal exchanges are more easily facilitated in the open, informal markets.

It does not matter which researcher or individual is correct. That is the task of the research – to gather evidence and then to prove or disprove the hypothesis. What you do need to do when presenting your hypothesis is to make it clear what basis you have for presenting it. In the above example the two researchers will go on to test:

- Whether the commodities are more common in one area or another
- Whether the reason for this is the one provided in the hypothesis.

You need to show the logic of the hypothesis. When it is simple it can be incorporated into the hypothesis as above. In other cases the rationale needs to be included in the hypothesis section, unless the introduction or literature review make it obvious.

The 'why' part of the hypothesis is critical in most studies, and too often neglected. I see too many pointless hypotheses like 'Farmers vary in their willingness to adopt...' Of course they do! Such studies usually have finding out 'why or how' as the real objectives, but if their reasons are not hypothesised it is impossible to set up relevant methods, in particular to know what to measure.

In addition to providing the rationale for your hypotheses you must be sure that the hypothesis(es) you propose to test are manageable. Will you have the resources (time, money or skills) to test them, and are they in fact testable? Do not concern yourself with whether your hypothesis is likely to be proved correct. The purpose of research is to determine if the hypothesis is true and your research is just as valuable even if you prove that, against your expectations, it is actually not true.

It may help to specify a general hypothesis that drives your research. This may be one underlying hypothesis that you are not necessarily planning to test, for example,

'That farmers with the same physical resources will not always achieve the same results.' This is more of a tautology, but it could be useful to articulate it and provide the overview of factors which affect this before going on to specify the particular hypothesis you will assess.

'Farmers who are risk-averse will have lower gross margins over time'. In order to test this hypothesis you will need to be able to access time-series data. You would need to take into consideration that the period covered by the series is not exceptional, i.e., that there were not an abnormal number of drought years or greater or fewer policy upheavals etc. This is a testable hypothesis. However if you are not intending to test it, but to use it as an assumption underpinning much of the other research, then you need to discuss it in detail and provide the logic in your use of it in this way. You can then go on and present the specific hypotheses you will be testing:

'Farmers who do not have reliable access to remittances will be more risk-averse'. You can then go on and give your rationale 'These farmers cannot afford to risk the failure of basic food crops and are less able to experiment with production methods and commodities until these are proven to be as reliable as the traditional systems. Thus even if they have the same soils and inputs they will be less successful than farmers who are more food-secure because they are unable to risk growing unfamiliar commodities or using unproven production technologies.'

A **null hypothesis** presents your supposition in such a way that you would expect it to be disproved. The null hypothesis posits that there has been no change or difference. If there has been a change the null hypothesis is rejected which indicates that the alternative hypothesis is accepted. Null hypotheses are the usual form in statistical analysis where tests of significance are set up so that one first assumes no change or difference. In statistical analysis the onus of the proof rests with the hypothesis of change. It sometimes makes sense to present null hypotheses even when not using statistical analysis, but this is not usual.

Example of a null hypothesis

'The inclusion of legumes in the crop rotation will not affect maize yield'.
If the analysis shows that it does affect yield then the null hypothesis is rejected and the alternative hypothesis: 'That the inclusion of legumes does affect yield' is accepted. The problem is that it is always easy to 'fail to reject the null hypothesis' simply by doing a poor study. Thus the statistical concept of null hypothesis may be useful sometimes, but it does not help design an effective study. However the concept of 'null models' in ecology is important and under-used. The idea is that the consequences of 'no effect' may not be as simple as you think.

More often in applied research we know the null hypothesis of 'no effect of legume' must be false but are actually interested in things like 'Is it large enough to be of use to farmers?' So it would be better to change the hypothesis to reflect what is needed.

In applied research a hypothesis should also be useful, i.e., it should take you further in the problem-solving or remove a critical knowledge gap or blockage.

Formulating and testing hypotheses is the essence of scientific activity whether the field of study is in the natural sciences, social sciences or even the arts. The hypothesis is a theoretical proposition that can be right or wrong, true or false. It differs from a tautology which is self-evident and is always true.

A hypothesis will normally consider how an independent variable or concept is affected by a dependent variable or concept, it indicates that x is related to y, or x causes y. 'Access to supplementary legume feeds during the dry season will improve milk yield'. It can help if you put your hypothesis into a small illustrative model:

You do not necessarily do this in your proposal or thesis but it is a good way to see if you are specifying a testable hypothesis. And it also helps to identify methods, for example, by avoiding the effects of confounders. If you find three things pointing to 'milk yield', you have to have methods that will separate their effects.

The research process involves examining your subject area, finding a specific problem to address, formulating hypotheses, testing them against facts, and then either accepting or rejecting the hypothesis – or more frequently reformulating, amending and retesting in a continuous exploration. Formulating hypothesis is therefore an essential component of your academic research. **The key hypotheses form the core of your research and you should be sure that they are clearly specified.** During the course of your research you may formulate and test many sub-hypotheses in the body of your thesis that you are not including in either your research proposal or the introduction to the main body of your thesis. What you need for the proposal are the major hypotheses that are to be tested in order to assist in addressing your research problem.

Research questions

You have established:

- What you are going to research (the research problem)
- Why you are going to undertake the work (objectives)
- What you are going to test (hypotheses).

Now you articulate what you need to find out in order to be able to carry out this research – the research questions. The questions you pose will also affect the research methods you use to obtain the data for your analysis. They are discipline-specific.

If you are an animal scientist you may be most concerned with comparing milk yield for cows/goats with and without leguminous supplementary feed. If you are a crop scientist you will want to consider the impact on the yields of other crops grown in the rotation, whereas a soil scientist will be particularly concerned with the impact on soil fertility. If you are an economist you will want to assess all the benefits and costs involved for the farmer of including legumes in the crop rotation and you will need the results from all the other disciplines to determine the benefits. A sociologist or anthropologist will want to consider the effect of the changed rotation on social relationships – does it reduce or increase the income of women, or affect the nutritional status of children.

The research questions will help you to determine the required research methods and analytical approach.

Research methods and analytical framework

Although you may not be in a position to provide the exact research approach you intend to use, your research proposal must provide your approval committee with an indication of what approach you intend to pursue. You need to show them that you understand the requirements of different approaches and that you will be in a position to test the hypotheses specified, or to meet the objectives.

You should include an overview of the research and analytical techniques which may be applicable, and if you know, indicate which you will probably use.

Budget and timeline

In some universities the academic committee is not involved in how you will finance your studies. They judge the proposal only on its academic feasibility. At other universities they do need to know that your project is sustainable and a budget is required.

If you are applying for a research grant from the university or as part of a project, then the budget is critical. You need to be sure that you provide enough information to justify your requests. You also need to ensure that you cover all the expenses you will face. You are unlikely to be awarded further funds during the process of the research.

Take your budget to someone who has carried out a similar project and ask her/him to check that you have everything covered. Also be sure to discuss it with your supervisor.

It is important that you think carefully about the time you expect to take. With a time-limited dissertation and with funded research, you will have to stick closely to this timeline. If you are doing a thesis with a flexible timeframe, it is also important to stick to your timeline. Many theses are abandoned because they have dragged on for too long. If there had been more rigid time requirements, this may not have happened.

Well done – you now have a workable research proposal. You are much further down the road towards getting your MSc, MPhil or PhD! Your supervisor is happy with the proposal and the funders have accepted it. Now is the time for you to go into the field. Do not necessarily wait for formal academic committee approval. One of the biggest problems you might face are the long delays in getting proposals approved and theses examined. In some universities this can be delayed by cancelled meetings, strikes and committee members away on consultancies. If the committee return the proposal with requests for changes you can make them as required. The problem will come if they want you to change the data to be collected after you have already started.

See if you can get someone (other than your supervisor) who is on the academic committee to provide comments on your proposal before you go into the field. With two different perspectives accepting it, you should not have to make big changes.

Resource material and references

Appendix 1. The Craft of Research. Paul L. Woomer. PowerPoint on CD.

Appendix 5. Stapleton, P., Youdeowei, A., Mukanyange, J. and van Houten, H. 1995. *Scientific Writing for Agricultural Research Scientists*. WARDA/CTA, Ede, The Netherlands. On CD.

Appendix 6. Publication as an Output of Science. Adipala Ekwamu. PowerPoint on CD.

Appendix 7. The Art and Ups and Downs of Scientific Publication. Adipala Ekwamu. PowerPoint on CD.

Appendix 8. Presentations and Style – Tips on Photography and Writing. Eric McGaw. On CD.

Andrew, C.O. and Hildebrand, P.E. 1982. *Planning and Conducting Applied Agricultural Research*. pp. 14–33. Westview Press Inc., Colorado, USA.

Dixon, J., Bouma, M. and Atkinson, K. 1987. A *Handbook of Social Science Research*. Oxford University Press, Oxford, UK.

Greenfield, T. 2002. Writing the thesis. In: *Research Methods: Guidance for Postgraduates*, Greenfield, T. (Ed.), pp. 307–316. Second edition, Arnold Publishers, London, UK.

Ronald, M. and Bernauer, T. 1998. Empirical research on international environmental policy: Designing qualitative case studies. *Journal of Environment and Development* Vol 7: 4–31.

3.3 Writing your thesis[1]

Kay Muir-Leresche

- **You must make the essential components of your work readable by a broad audience**
- **Be logical and consistent in your arguments**
- **Be rigourous in your approach and do not make unsupported statements**
- **Be aware of your bias and avoid allowing it to influence your work**
- **Be aware of which approach you are using for each hypothesis. Use historical analysis, literature reviews and case studies for deductive reasoning. Use statistically valid samples and experiments for inductive generalisation**
- **Writing a thesis needs 'soul' time. Be sure to allow yourself the space to be creative**
- **Set yourself deadlines and be strict in enforcing them**
- **Remember your work is only one imperfect step towards the transformation of rural areas**

'A poorly written thesis can result in failure of otherwise excellent research. A well-written thesis cannot rescue poor research but it can help a marginal thesis pass.'

Derived from **Stan Taylor (1996)**

Introduction

Your thesis is where you bring together all your work and make it intelligible to your peers. It is very important that you make every effort to present your research professionally. Do not throw it all together and hope that the value of your research will enable you to pass.

You should produce a thesis which is clear, concise and both comprehensive and comprehensible. Any person who understands their topic well enough is able to provide a clear explanation. The analysis and the proofs contained in the thesis may only be clear to a specialist in that area but your interpretation of them and your rationale for using a particular approach need to be as simple as possible. This is particularly relevant for work in rural development where problems are not discipline-specific and people from other disciplines must understand your research.

Avoid using **jargon** where possible. Your examiners are more likely to be impressed if you can simplify what you are writing so that it is clearly understood. Jargon is often open to the dictates of fashion and your work will stand the test of time better if you can avoid using it. It should be distinguished from technical language. Jargon is language characterised by pretentious syntax, vocabulary or meaning. **Technical language** uses words or phrases that have special meanings in a specialised subject; such language is useful provided the special meanings are defined explicitly.

Your thesis will be available from your university library for others to read, even if you do not publish it as a book or in journal articles. It reflects on your university, your faculty and in particular on you and your department. You need to produce a high-quality thesis because it will affect your reputation.

1. Common practice uses thesis and dissertation interchangeably but they are different. A **dissertation** is a formal written discourse on a subject, whereas a **thesis** sets out to provide original research to prove or disprove a particular argument. A thesis is normally submitted for a doctorate and a dissertation for undergraduate and taught masters degrees. The advice given in this book for theses, applies equally to dissertations.

The structure

You need to set out the thesis so that your reader is able to follow a logical path. This path outlines:

- Why you undertook to do the research (the research problem) and how it fits into a wider research and development strategy
- What work had gone before (literature review)
- How you collected the information, and the information collected (research methods and data tables or historical information)
- How you analysed the information (analytical tools)
- What the results were (results of analysis)
- What these results mean in terms of your hypotheses and objectives (interpretation and conclusion)
- What they mean for policy
- What actions can be taken
- What further work would contribute to better systems.

Stan Taylor (1996) uses the analogy of an explorer producing a guidebook to clarify your role as a researcher writing a thesis, or dissertation. As the author of the guidebook you need to explain:

- Your starting point and why you decided to embark on the journey
- How you decided to undertake the journey
- The route you followed and the discoveries you made on the way
- How, in the light of the above, you redrew the route
- Where you arrived at the end of your journey
- How it differed from your starting point
- Where you go from here.

This logical progression is normally achieved by following a fairly well laid-out structure. The structure of the main body of the thesis will vary, and will be subject to the specific requirements and norms of your own university. Whatever the structure all the following elements need to be incorporated into your thesis.

Title

A title should be as brief as possible but should still indicate precisely what is covered. It may be useful to provide a sub-title which places the research into its precise geographic, social or other niche.

The title page of your thesis should include the Title (and sub-title if used), your full name, the name of the degree to be awarded, your Department, Faculty and University and the month and year submitted for examination.

Abstract

Think of your abstract as your explanation to an aunt of what your research is about, what you discovered, and what it means. It is very important that you do not use the abstract as an introduction. It must give a synopsis of your most important results as well as indicating why the research is important and what its implications are. The abstract needs to either explain or avoid technical terms. If, for example, your results include a domestic resource cost (DRC) ratio, then say: The DRC of ..... indicates that there is (or is not) a comparative advantage in producing x.

The abstract should be no longer than one page of single-spaced text.

Acknowledgements and dedication

You do not need to include a dedication but you may like to. Alternatively you can include your dedication in the acknowledgements. The acknowledgements should highlight your supervisor(s) role and those of any other mentor who has assisted you. You can use the acknowledgements to indicate where part of your thesis may be particularly beholden to someone else, e.g., if you used someone to develop or help you develop a mathematical model. Keep this section as brief as you can and avoid a long list of names that includes everyone to whom you spoke.

Acronyms, abbreviations and glossary of terms

An acronym is a word formed by the initial leters of other words, such as ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). An abbreviation may be formed by the initial letters of words or in some other way but it does not create a new word, such as UN. If you use very specific terms, or vernacular terminology they should be explained in a glossary.

Where you put this list differs, and you should check your faculty regulations. If you have a choice, it is more useful to your readers if it is near the front of the thesis.

Table of contents

In a Table of Contents you should use roman numerals for all pages leading up to the Introduction. It does not matter where you put page numbers, unless your University requires them to be placed in a particular place. In the table of contents first list all those pages with Roman numerals, then go on to provide a comprehensive list of each chapter including all the headings and sub-headings with the relevant page numbers.

Provide lists of all tables, illustrations and appendices and indicate the page numbers for each one.

The body of the thesis

Within the body of the thesis the Introduction will be based on your research proposal, taking into account the adaptations you have made along the way. This is where your reader learns what led you to undertake this research (not your personal path – but the literature and evidence of problems that led you to decide on the research), the objectives of the research and the hypotheses you will be testing. You can also use it to explain any circumstances that are peculiar to the situation you address or which made the research more or less difficult. Look at **Chapters 3.2** and **3.4** for input on hypotheses and objectives.

The literature review may be a separate chapter on its own, it may be only part of the introduction and part of the research methods chapter, or it could form more than one chapter and be part of other chapters. (See **Chapter 3.1** for more details on accessing and using literature).

Research methods and data presentation may be contained in one or more separate chapters. For some theses gathering the data is a major component of the contribution and presenting the data collected is an important component of your work. Refer to **Part 4** for information on how to present data, and on selecting the data presented. You need to be sure to provide an overview of which research methods are available and why you chose the particular method you did. You should also, show why you chose to collect those variables, the sites selected, time periods and any other important factors. Your examiners will be

unimpressed if you just went out and collected everything that was available. An important part of the process is to know what to collect. You waste both your time and that of the communities involved in the data collection if you collect more than you need for your specific objectives and hypotheses.

The analytical techniques that are possible (with more detail on those used) can be put in front of the results in a chapter covering both analysis and results, or they can be in separate chapters. If your thesis is very involved in establishing effective models or in finding the best analytical techniques, then this may cover several chapters. If you are using a widely accepted methodology, then a simple introduction in front of the analysis and results chapter is fine.

In most cases it is best to present your results simply and clearly giving only a brief explanation of what they mean but without providing discussion and interpretation. However, for some research it may be appropriate to include some discussion with the results and they may be incorporated into several chapters leading to the overall conclusions.

The best way is to present the results tables is with a sentence or two below each one simply explaining what it means without going into discussion of the implications. These explanations are to show the examiner that you understand the results and to allow people from other disciplines some understanding of what the results mean.

The discussion of the results can be a separate section at the end of the presentation of the results or be in a chapter on their own. This discussion can be used particularly to provide input from your results to the different options relating to the problem and it is here that you would make recommendations arising from your research.

Your conclusion should not be too long. It should highlight your objectives and your hypotheses again and show how your thesis has addressed them. You should then summarise the discussion of the results, presenting them as implications and policy recommendations. For many theses, the most valuable contribution will come from your recommendations on areas for further research. This is a component that is often tagged on at the end with little thought. It should be given much more attention. You should not only indicate what needs to be done but, if you have the information, you should indicate how it should be done.

Throughout your work you should keep making a note of where you are frustrated because you don't have access to certain information. Whenever a villager or anyone asks you what your research shows should happen with respect to x, and in fact there is more work that needs to be done for you to answer the question, then note it down. When you come to consider the areas for further research you then select from these notes those you consider the most important and most interesting.

References

Every thesis must include a comprehensive list of all the references cited in the text. Examiners are very particular about references because it is a hallmark of academic work that the reader is able to follow up on what is being presented. Every reference cited must be included and the references must be presented in the style required by your university. Refer to **Chapter 3.1** for more information on reference lists and bibliographies.

Appendices and footnotes

Appendices and footnotes are very useful because they provide you with the opportunity to present information which may be of interest, but which, if included in the body of the text,

would divert attention from the main topic. Appendices allow you to present information both as data and analyses which are relevant to the topic but outside the direct purpose of your research. However you should not simply include all the data you collected or all the analyses. You should only include information in an appendix if it is relevant to your thesis and if it would be useful to a reader. If you include too many appendices it will seem that you are unable to discern what is relevant. It may also make your thesis too heavy to carry!

Footnotes are very useful in providing some additional information but if you have too many of them then again it will appear that you are unable to select what is important, and they can also affect the readability of your work.

Presentation and style

Modern technology has made it easy for work to be well presented. You need to ensure that you are consistent in the way you present headings, tables and other information. This consistency is also important in the use of fonts, bold, spacing, bullets and other format issues.

You must follow the style required by your university for titles on tables, figures and illustrations; for headings and sub-headings and indentations.

For a discussion of style you should refer to *Scientific Writing for Agricultural Research Scientists* by Stapleton *et al.*, the full text of which is available as **Appendix 5** on the CD, as are several more helpful appendices. You can also consult Greenfield (Chapter 37, 2002) and Levy (Chapters 38 and 39, 2002). There is no one acceptable style but in general a formal, impersonal style is normal for theses and dissertations. It is interesting to note that Greenfield (page 312) argues strongly for using the pronoun, 'I' and a more personal approach. Levy on the other hand argues for a more formal and impersonal style (page 319). This contradiction reflects the different schools of thought and highlights the need for you to make your own choices. These choices are constrained by the requirements of your university.

Before you start to finally write up your thesis, you should look up the regulations at your institution. You should format your chapters to match these requirements when you first start drafting your chapters.

Your university will normally require you to present your thesis in a very specific way. It is useful to format your chapters correctly from the start. This will save you time. It can be very difficult to adjust your layout to new margins or to redo all the headings to meet university regulations.

Also check on your supervisor's preferences beforehand! You can ask your supervisor about format issues, but I suggest you read some of your supervisor's work (in fact the work of all the members of your advisory board if you have one) to be sure that you understand the style he or she prefers. You can choose to have a different style but then you should be prepared to defend it.

Writing

The approach you use

When you come to writing up your work it is important that you understand what underlies the logic of your arguments. You need to know where it is appropriate to rely on different approaches. Most theses will include an element of each of these approaches for different

aspects, but one form of reasoning should provide the driving logic for the thesis and be the main focus for your 'guide book'.

You need to understand whether you are relying on **deductive reasoning** – this is where you derive your hypotheses from theory and is sometimes referred to as **conceptual reasoning.** It will be most applicable to theses where you are going from the general to the particular. This is the approach popularised by Karl Popper (1934, English version, 1977) for the social sciences and is normally followed by the testing of these hypotheses using historical analysis, literature reviews, or through the testing and collection of case study and sample data.

Inductive generalisations are used when you go out and collect specific information (from samples) and then apply the results to a broader population. This is the most common method of testing hypotheses in the natural sciences. In order for the specific to be valid for generalisation to a population, the sample will have to be statistically valid. **Case studies** are useful in providing a fuller understanding of a particular situation but can seldom be extrapolated to a valid generalisation.

Retroductive reasoning is a less-common research approach than deductive reasoning and is most relevant to developing and shaping theory. It is appropriate when the situation appears to be different from what we would expect theory to predict. It is where you gather empirical data and then develop hypotheses (make inferences) based on the information collected.

In the writing of your thesis you need to be sure that everything you claim is justified so that anyone challenging your results cannot fault you on the logic of your approach but only challenge the data you may be using.

Common fallacies of scientific reasoning (derived from Mouton, 2001)

Unsupported generalisations

Unsupported genrealisations present a very common trap and you need to be extra careful to avoid them – economists and other social scientists are particularly vulnerable. You must have evidence to support claims. Every time you state something is ... check to see if you have included your basis for saying it is so! Try and avoid 'all' or 'every' unless you are sure there are no exceptions.

Appeals based on authority

It is not always enough to claim that your evidence derives from the opinion of another 'expert'. If the source is internationally recognised as an expert you may get away with it. However it is better to get more than one source to support what you are saying or to use other evidence as well.

Impressing by large numbers (bandwagon)

Remember that all numbers are relative and that you need to put the data into context. Even where statistical analysis bears out the results you would like, it is useful to put it into the context of findings of similar research elsewhere.

Affirming the consequent (*post hoc* fallacy) otherwise known as illogical reasoning

You are probably aware of the requirements for statistical validity and may not fall into this trap but you need to be very careful when linking cause and effect. Just because when you harvested pearl millet, the clouds came over does not mean that millet-harvesting causes overcast conditions! If something appears illogical to you, then very carefully check how the researcher has linked cause and effect and what evidence they have for that link.

False analogy

False analogies are most frequently found when making comparisons. Because some things are similar it doesn't follow that all are, for example, given that Mozambique and Zimbabwe are both African and both developing it does not necessarily follow that they are the same country.

Circular reasoning

Circular reasoning happens when you try to prove a point by returning to the point itself.

Ad hominem reasoning (attacking the person)

Ad hominem reasoning occurs when you attack the credibility of the person instead of addressing the issues and attacking the argument.

Non-sequitur reasoning

This is where the reasoning is not logical and does not actually follow, e.g., it is a *non-sequitur* that: 'violence in films has a bad effect on children and so people should not see violent films.' The finding refers to children so you cannot make the conclusion for adults.

Red herring argument

A red hering argument in what happens when you bring in a side issue with no real relevance to your research. It only serves to distract the reader from looking for the proof that should be presented.

Some tips on writing up

Writing up your research is one of the most difficult tasks you will face. This is particularly true for those who are more used to practical work either in the field or the laboratory. It can also be the least-interesting aspect of the thesis because you now know what you found and it is tiresome to have to spend as much time writing it up for others as you spent in finding out the answers. You should avoid thinking in this way as it will affect how you write. Rather consider it an equal challenge to make what you know accessible; to prove to the world that you are capable. By making your work accessible you can make a difference to the world. If you do not take up this challenge then what you have found out will be as useful to the world as playing with a puzzle.

Another problem, even if you do see the written work as important, is that you may face writer's block. This is a problem almost all writer's face at one time or another. A suggestion is that you first give yourself a few days of total space to allow time for your subconscious to work. If that still doesn't help then just force yourself to write whatever it is as a letter to your grandparents or a cousin in the rural areas. In this way you make yourself simplify the problem and do not feel overwhelmed by the need to meet some outside standard. Once you have the basic concepts down, it is much easier to translate them into the more formal and detailed style required for your thesis. Try it – it really does work and it can help your thesis!

You also need to keep in mind that every person operates differently. For some it is important to stick to the routine of writing a certain number of pages each day regardless of how slowly. For others, the subconscious is always important and it may be necessary to give your mind time free from distractions that will then give you the chance to be much more productive when you do write. I am one of the latter and if I am producing original writing, I normally need time with no distractions pottering in my garden and reading light novels

before I can really be effective. But such periods need some limits or they become simple indulgence.

Writing a thesis requires 'soul time'. You must recognise that you need to be able to dedicate all of yourself when you are writing your first draft. It is difficult to be creative and innovative and to really assess the implications of your results if you are not totally focussed on your research. You need to be aware of this and block out time completely away from other work and family duties in order to produce something really worthwhile. When you are feeling stressed or overworked, or when you have writer's block, then edit what you have already written. Design tables and figures and improve the style and presentation. These things allow your subconscious to continue to work and help you to overcome your block.

When you are in the process of writing, get up at frequent intervals – go for a short walk, stretch, or go and get a cup of tea. Avoid interaction with others so that when you come back and sit down you will find your mind has already arranged what you are going to say.

You need to be sure that you give yourself strict deadlines. With an MSc this is normally done for you and you are forced to complete. However for research degrees and doctorates, supervisors tend to leave you to determine your pace for yourself. There is a very real danger that if the project with which you are working finishes before you hand in your thesis, that you will never complete your degree. You really have to set yourself very strict deadlines and you cannot take on other consultancies or work, no matter how pressing your financial needs, if it means that you won't complete. You have to be very strict with yourself. If you leave your research for more than a year, rural development progresses so fast that you may find what you were working on has already been overtaken.

No matter how badly written it is imperative to produce a first draft promptly. It is much easier to rewrite and to see where you have gone wrong once you have it down on paper.

Another really important point is to remember that no matter how long you work on your research and on your thesis,

it is NOT possible to produce the perfect research, and it is not possible for your research to solve all the problems.

You have to draw the line and you have to accept that your work is not necessarily going to win a Nobel prize or transform rural areas or solve food security. Your work is only one imperfect step towards that goal. Provided it makes that step honestly and boldly and to the best of your ability, you can do no more.

After you have reviewed the literature in some depth and done your fieldwork and while you are in the labourious process of entering, or supervising the entry of your data, you should write your entire thesis. It will give you a needed break from entering numbers or working with your experiments. Before you have analysed the data and even before collecting all the data, write your thesis. In the results chapter you can put in what you think the results will be. It also helps to even outline the conclusion and fill in what you expect to find with respect to your hypotheses. This will assist when, almost inevitably, your results are different. You can then look for the explanations and see why the results differ from theory.

Although you will significantly change what you have written, even for the introduction, literature and methods chapters it will really help you to have the overall thesis structure in place. You will be writing it while you are living it, and this can also help you to chart a clearer course. You won't find when you get to the end that you have left out some vital component because by writing it first you will have identified what needs to be in place. Best

of all, you can avoid the tension created when all the research is complete and you now have to write. This is advice that is seldom followed – but if you take it, you will find completing your postgraduate degree much more likely, and more fun.

Resource material and references

Appendix 1. The Craft of Research. Paul L. Woomer. PowerPoint on CD.

Appendix 5. Stapleton, P., Youdeowei, A., Mukanyange, J. and van Houten, H. 1995. *Scientific Writing for Agricultural Research Scientists*. WARDA/CTA, Ede, The Netherlands. On CD.

Appendix 6. Publication as an Output of Science. Adipala Ekwamu. PowerPoint on CD.

Appendix 7. The Art and Ups and Downs of Scientific Publication. Adipala Ekwamu. PowerPoint on CD.

Appendix 8. Presentations and Style – Tips on Photography and Writing. Eric McGaw. On CD.

Anson, C.M. and Schwegler, R.A. 2000. *The Longman Handbook for Writers and Readers*. Second edition. Longman, New York, USA.

Daniel, H. and Fisher, E. 1999. *Enjoy Writing Your Science Thesis or Dissertation*. Imperial College, London, UK.

Greenfield, T. 2002. Writing the thesis. In: *Research Methods: Guidance for Postgraduates*. Second edition. Greenfield, T. (Ed.), pp. 307–316. Arnold, London, UK.

Jones, R., Bizzaro, P. and Selfe, C. 1997. *The Harcourt Brace Guide to Writing in the Disciplines*. Harcourt Brace, New York, USA.

Kung, H.T. 1987. *Useful Things to Know About PhD Thesis Research*, prepared for 'What is Research' Immigration Course. Computer Science Department, Carnegie University, USA.
Available from: http://www.eecs.harvard.edu/~htk/thesis.htm [30/07/03]

Levy, P. 2002. Presenting your research: reports and talks. In: *Research Methods: Guidance for Postgraduates*. Second edition, Greenfield, T. (Ed.), pp. 317–333. Arnold, London, UK.

Mouton, J. 2001. *How to Succeed in Your Master's and Doctoral Studies: A South African Guide and Resource Book*. p. 119. Van Schaik Publishers, Pretoria, South Africa.

Popper, Karl, 1977. *The Philosophy of the Logic of Scientific Discovery*. (Originally published 1934 by Springer in German.) Routledge Publishers, New York, USA.

Taylor, S. 2002. Managing your PhD. In: *Research Methods: Guidance for Postgraduates*. Second edition. Greenfield, T. (Ed.), pp. 13–27. Arnold, London, UK.

Tham, M. 2001. *Writing Research Theses or Dissertations – Guidelines and Tips*. University of Newcastle-upon-Tyne, UK. Available from: http://lorien.ncl.ac.uk/mingDept/Tips [30/07/03]

University of Zimbabwe Libraries. 2002. *Dissertation and Thesis Writing: Online Resources*. University of Zimbabwe, Harare, Zimbabwe. Available from: http://www.uz.ac.zw/library/resources.html

3.4 Preparing a grant proposal

Paul L. Woomer

- **Some donors require specific formats but all include similar elements**
- **Proposed research methods must be cited and be suitable to test the stated hypotheses**
- **Highlight the expected impact of the research on beneficiaries**
- **Indicate how you will communicate results**
- **Keep what you say simple, clear and easy for a non-specialist to follow**
- **Get background information on your donors and be sure to direct grant proposals to the appropriate organisations**
- **You can apply to more than one donor – but only accept funds from one donor unless there is explicit approval for multiple donor funding**
- **Remember to always acknowledge donors when publishing**

'A proposal doesn't succeed. It's the project that succeeds. A good communication process is important, including calls, writing, and follow up.'

Joseph H. Cruikshank (1993)
The Clark Foundation

Introduction

Over the past several years, I have had the opportunity to familiarise myself with grantsmanship in a variety of ways including having several research grants awarded by different donors, by assisting other scientists to develop research proposals and by acting as a technical reviewer for the donor community. If you are an enthusiastic scientist with burning ideas and little experience in preparing research proposals for the international donor community, I offer the following advice on proposal format and considerations. The proposal format is generalised and stresses continuity between proposal components. Remember that some donors require very specific formats while others prefer to evaluate a proposal, in part, by its very composition.

Rember too that whatever the format, you proposal should be as clear and well writen as you can make it. Consult Stapleton *et al.* (1995) **Appendix 5** and other appendices on the CD for useful guidance.

Proposal format

A simple, short proposal is often best. One format that has been very successful in the past follows:

Title page. The title page includes the proposal title, principal investigator, co-operating investigators, complete contact details of principal investigator, proposal duration, funds requested, and a brief scientific summary (1 page). The summary should not be more than half a page, start with a one-sentence description of an agricultural or natural resource problem, how you plan to approach the problem, the time required to do so and the funds that are requested.

Introduction, justification and literature review. A clear statement of the problem and a state-of-the-art review of the research topic is necessary to convince donors that the proposed research is original and meaningful. This is the best place to introduce any conceptual or mathematical models upon which your proposed research is based. Any reference citations you include must be of the latest published work in the field. This is an area where access to computer-based bibliographic software is often extremely im-

portant because claims that a certain topic remains poorly understood must be substantiated through strong and current citation. In most cases, 2–3 pages of tightly worded introduction are sufficient, followed by a one-page justification and a comprehensive yet concise literature review (3–8 pages). It is important to include either original or properly cited conceptual diagrams and syntheses tables in the literature review.

Objectives. State a general and a few more specific objectives of the proposed research. These objectives must be well worded (and short). The objectives will lead to the working hypotheses of your proposal (0.5 page).

Hypotheses. The statement of a clear general, global hypothesis and a few specific (working) hypotheses is essential to a strong scientific proposal. What do you intend to prove or disprove? State these very carefully because this sets the standard by which the success of your research progress will eventually be judged. Many donors prefer research proposals that are hypothesis-based and most reviewers pay particular attention to the clarity of stated working hypotheses. You must avoid tautological statements and those that containing jargon in your hypotheses Social scientists often prefer to pose 'Research Questions' rather than hypotheses. You should be able to state your hypotheses in half a page.

Research approach. This section is similar to 'Materials and Methods' except that special effort must be placed upon how the approach you are proposing is suitable to test your previously stated hypotheses. You need not go into exact methodological detail but all proposed research methods must be cited in this section usually within 2–4 pages. This section can be sub-divided into:

General experimental approach and site characteristics. Does your research strategy fall into discrete phases? Examples of different phases are farmer survey, glasshouse, and field investigations. A description of the proposed research site, or sites if you are comparing two or more, should be included in this section.

Treatments and their rationale. Which treatments will be compared to test specific hypotheses?

Experimental design. This sub-section should specify an exact experimental design or key treatment contrasts, identify sample populations and, whenever possible, include a diagram that identifies treatments, plot sizes and the number of replicates.

Measurements. Which measurements need be taken to prove your hypotheses, how often will you take them?

Analysis of results. How will the experiments mentioned in the above section be analysed, what facilities are available to you for state-of-the-art analyses (co-operators, computer facilities, software)?

Research outputs and impacts. What do you anticipate the key accomplishments of this research topic to be and how will these be popularised? Include such activities as scholarly publications, popular publications, student degrees and agricultural field days (0.5–1 page). Research outputs are often well expressed as research products. What are these products, who are their likely beneficiaries, how might these be disseminated and what are their likely impacts on immediate clients and society as a whole? Remember that applied science exists to offer society solutions to its concerns! (1–2 pages, often presented as a numbered list of complete statements).

Timeframe and logistics. What will be done when? How will different components of the research project interact and complement one another? The time frame is best displayed as a table or figure. The logistics indicates to whom the funds will be dispersed and how

equipment will be purchased and acquired. Many donors require specific details on how funds will be administered within a given organisation, including whether or not principal investigators serve as signatories and if funds intended for hard currency purchases are first converted into local currency upon release (1 page).

Budget and budget notes. This is a simple table with which most scientists are certainly familiar. What funds are required for general budget items by year? These should be sub-totalled by year and item in US$ or the hard currency specified by donor, e.g., £ Sterling or Euros, and also, if you choose in local currency. Typical items include Equipment, Supplies, Technical Support, Travel (local and international), Student stipends, Communication, Office supplies and Miscellaneous. Details of these items should be included as footnotes (1 page).

Literature cited or references. Place these in the format of an international journal within your discipline but do not abbreviate journal titles (See Chapter 3....?) (1–3 pages is usually sufficient). Be aware that many technical reviewers will evaluate your literature by conducting a literature key word search using bibliographic software and will compare the recovered references to those listed in your Literature Cited.

As you can see, an acceptable proposal may be as short as 12 pages in length but will clearly specify why the research is important, what will be tested, how it will be tested, what measurements will be made, how data will be compiled and analysed, who is likely to benefit from the research, when it will be completed and what funds are required. The above is to some extent a general guideline that has proven effective in the past but is subject to modification depending on your preferences and grantsmanship style. As we are now well into the personal computer revolution, donors expect potential grantees to be computer literate and to prepare their proposals with word processing and graphics software. The overall appearance of a proposal is indicative to donors of an applicant's ability to later publish their research findings. Incorrectly spelled words, inconsistent heading and sub-heading structure, poorly constructed tables and improperly cited references are liabilities to an otherwise strong proposal. Additional information on proposal formats is available from Stapleton *et al.* (1995, **Appendix 5**). The process of identifying and refining a research topic, and the transition from preparing an outline, writing a first draft and completing a final draft are described by Baugh (1995).

Funding level. Well written research proposals in the area of agricultural resource management that seek between US$15,000 to US$30,000 per year for 3 years are frequently funded. Feel free to ask for less ($45,000) but be reluctant to ask for more ($90,000) especially if the grant is your first proposal to a particular donor. Given the expense of field experimentation and costs of technician and field labour, this level of funding is able to keep a research team very busy and to partially re-equip a laboratory as well.

Timeframe. Whenever possible the completion of a research proposal should be a fairly rapid process. Very few donors will consider funding a single research project for longer than 3 years and many prefer a 2-year duration. This time frame allows donors to assess research progress and then encourage successful grantees to submit an extension study. Also, remember donor's funding cycles. In general, donors begin to exhaust their funds by mid-year but it is never too early to submit something for the following year. Many donors have well established technical review procedures that require several weeks or months to complete. Whenever possible, ask the donor when is the best time of year to submit your proposal (and then do it!). Sometimes life is full of surprises and a donor may offer seed money on the spot to test the feasibility of a research proposal, especially one that is as near the cutting-edge

of current thinking on a topic. Do not hesitate to accept these funds at this point even though the offered funds are less than you have requested. Offers of seed money may signal that the donor is very interested in your proposal and wants to see how successfully you can initiate it.

Continuity between proposal elements

The key to a successful grant proposal is continuity between proposal sections. The objectives must be few and clearly stated and in turn lead to well worded working hypotheses. These hypotheses must be stated in such a way that the experimental design and important measurements are obvious to the reader. If more than one experiment is being proposed within a single grant proposal, these different experiments must be easily distinguishable from one another (sometimes a donor may be interested in funding only part of the proposal). When writing your grant, you must be prepared to anticipate different experimental outcomes and identify the potential significance of these research outcomes upon outputs and impacts within the proposal itself, rather than later when experimentation is completed. Keep-It-Simple-Scientist (KISS): remember that often a donor may not be a specialist in your field of science but is generally interested in the impacts of many areas of science on agricultural development, food security, environmental awareness or curriculum development.

Avoid proposal drift

Sometimes people's thinking and ideas change or further develop during the proposal writing process. This must not be considered undesirable because it is a fundamental part of the learning process. What is undesirable, however, is when these changes are reflected in the finished proposal. Every next section of a proposal must be a sound reflection upon the parts preceding it. One all-too-common example of 'proposal drift' is to add an unexplained experiment or set of treatments when the proposal reaches the Experimental Design section without returning to the Introduction, Objectives and Hypotheses sections to reinforce the necessity of that experiment. Beware, sometimes research activities are included seemingly as an afterthought. One sure way to not be funded is to confuse the donor representative who reads your proposal!

Emphasise the role of students

One of the advantages of university-based research is the potential to involve students within research programmes. The enthusiasm, commitment and cost effectiveness of graduate students in conducting research is well known to donors, and some donor programmes require student involvement. In this regard, proposal authors are encouraged to identify their candidate students and specific research topics within a proposal. At the same time, investigators must not give the impression that they are imposing tightly prescribed research programmes but rather have opportunity for creative input. What is more, authors must be careful not to appear as delegators of responsibility to co-operators and students, but rather they must provide scientific leadership and maintain their own responsibilities to the project as a whole (Patel and Woomer, 2000). If you know your research could fit into a large project, be sure to get involved in writing your bit of the proposal.

Paragraph and section structures

One of the keys to successful scientific writing is your ability to adhere to sound paragraph structure. **Paragraphs** are the units through which concepts are presented and logical arguments constructed. Many paragraphs should consist of a single **claim** in the opening sentence, followed by **evidence** in support of that claim in the next few sentences and conclude

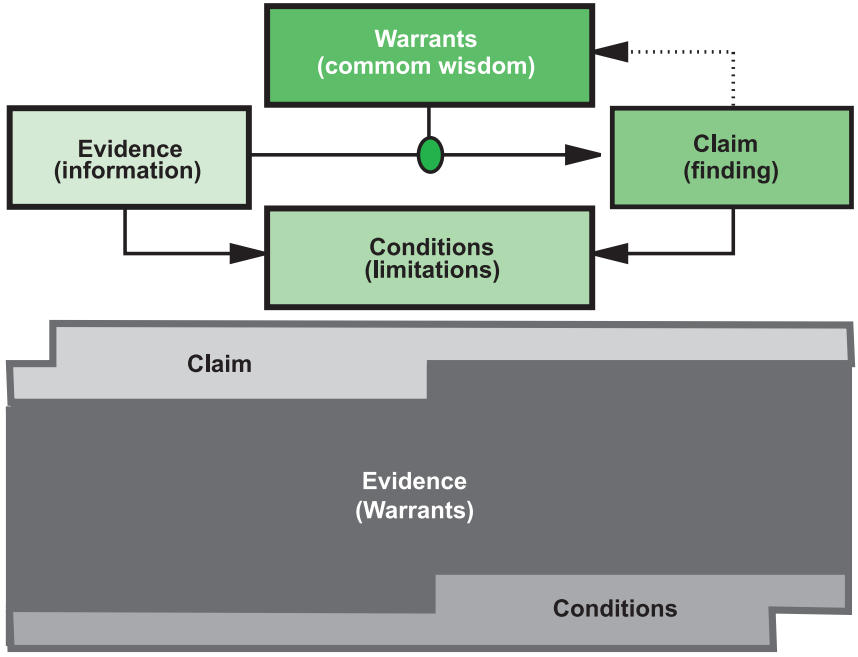


Figure 1. Constructing logical arguments as paragraphs requires claims, evidence and conditions

with a sentence that places conditions or limitations upon that claim (Figure 1). This structure is particularly important in the Introduction, Justification and Literature Review sections as well as in the Discussion section of scientific papers. Further information on establishing claims and supporting them with evidence is provided by Booth *et al.* (1995).

It is also important to maintain a consistent hierarchy of section, sub-section and sub-sub-section headings throughout the proposal. For example,

Sections centred, bold capitalised

Sub-sections bold, left justified

Sub-sub-sections bold italics, left justified is often used.

It is reasonable to structure the headings and sub-headings in the same way as those of a leading scientific journal within your area of interest.

Tables, figures and conceptual diagrams

Every proposal should include tables, figures and conceptual diagrams. These tools demonstrate an ability to compile and synthesise diverse sources of information and to prepare publication-quality material. Conceptual diagrams are best designed as graphic presentations of working hypotheses that identify likely mechanisms and how they might be elucidated. In many cases, quality graphics greatly reduce the need for lengthy text explanations when 'one picture is worth a thousand words'.

Additional documentation

The submitted proposal should be accompanied by a short covering letter, letters of institutional support, and a brief description of the investigators' qualifications. When possible, the

covering letter should identify the title of the proposal and the specific donor programme to which the proposal is submitted. You must indicate your willingness to provide additional information to the donor in the future but the letter must not go into detailed explanation of the proposal's intention or methods.

Letters of institutional support

Such letters from a high-ranking member of the principal investigator's organisation are usually a prerequisite for processing an applicant's proposal. The letter of institutional support should mention the proposal by title and principal investigator by name and express commitment to accommodate the project. It is not usually necessary to include a full resume of all investigators with a proposal, but each investigator should prepare a 1 or 2-page profile of their qualification with emphasis on their educational and professional backgrounds, publications and previous experience in grant administration. You must not overwhelm a donor with enclosures or attachments accompanying a proposal because these could distract from the strengths of the proposal itself.

Know your donors

While it is not possible for most scientists to know every donor representative personally or to be assured that an individual proposal will appear attractive to a donor organisation, it is possible to target a proposal to a given donor. Many donor organisations maintain home pages on the Internet that describe their aims and programmes. Some post their Instructions to Authors and Application Forms over the Internet as well. You can gain an insight by examining the Acknowledgements sections of recent publications because the donor organisation and its specific programme that funded an investigation are usually identified there. Most donors 'specialise' in areas of food security, natural resource management, privatisation/liberalisation, forestry, environmental conservation and in specific commodities or agroecological zones and it is important to learn which topics are funded by which organisation. Such knowledge is gained through experience, as there is no single source and donor priorities change with time.

Emphasise substance, not superficial structure

Be aware that many donors rely on experienced technical reviewers to evaluate incoming proposals and that these reviewers are expected to comment on the feasibility, relevance and potential impacts of the proposed research. Some proposals highlight structure that is the administrative mechanisms through which a project is managed, rather than scientific substance and these proposals tend to be negatively reviewed. Avoid establishing 'management committees' for a project, the principal investigator should assume responsibility for completion of activities once the project is awarded. Also, be careful not to reflect top-down administrative and client attitudes in work plan diagrams, but instead emphasise interactions between research partners and stakeholders. Highlight the quality of your research experience rather than the size of your parent organisation. The proposal should reflect your stature as a developing scientist, not your ambitions to become a technocrat. Also, you must remember that donor representatives are by necessity generalists and that grant submitters will usually possess much greater knowledge of their individual subject area. Take care to explain the scientific approach and key measurements in understandable terms, and to rely upon the references you cite to represent extremely technical details.

Avoid disciplinary jargon and excessive abbreviation as this will be interpreted as an inability to communicate with the wider scientific community.

Grantee ethics

As a proposal writer you must be fully aware of the ethics surrounding proposal writing and research (see Booth *et al.*, 1995). All scientific ethics apply to grantsmanship, including the requirement to accurately cite and fully acknowledge the ideas and contribution of others, and not to misrepresent or obscure contradictory evidence. The following must be kept in mind throughout the proposal preparation and research process:

- It is ethical to submit the same or similar proposals to more than one donor at the same time, but unethical to accept funds from more than one donor for a single or similar research project. When one donor funds a research project, notify other donors who have been sent similar proposals that you no longer require funding for that particular research project, thank them for their consideration and mention that you look forward to sending additional proposals to them in the future.
- Grant contracts are legal documents and as the grantee you should feel legally and ethically bound to complete these contracts to the best of your abilities. Always comply with the contractual schedule for technical reports and financial statements in a timely manner. Remember that in these days of competitive research, entitlements and endowments are few and far between. Donor organisations have long institutional memories, and donor agencies willing to fund a particular topic in a particular area are not limitless. Do not feel trapped by your grant. Experience suggests that donor representatives are usually sympathetic to difficulties encountered and changing circumstances, so remember to keep channels of communication between yourself and donor representatives open.
- Avoid double reporting. Often different research projects are complementary to one another and may constitute components of an overall research question. Some donors encourage or readily accept 'piggy-backing', but others shy away from such arrangements. In general, donors do not approve of combining different funding sources into a general pool that does not distinguish the research activities that arise from each funding source. **Double reporting** results when investigators report all their research activities to all funding agencies, regardless of which agency actually funded each individual study. Remember that the members of the donor community are often in close communication with one another and will become extremely disappointed in you if you double-report your research accomplishments.
- Different donors have specific acknowledgement conditions with which you must familiarise yourself and comply. Some donors require that funding be acknowledged in all publications arising from your research. In general, always acknowledge donor assistance unless explicitly forbidden. Some acknowledgement conditions extend to specific wording. For example, one donor organisation discourages grantees from stating 'This research is supported by DONOR X' preferring 'this research was conducted through the financial assistance of DONOR X'.

If you fully acknowledge sources, cite contrary findings, recognise the limitations of your own findings, assert claims only as strongly as warranted and then strive for publication in the leading, peer-reviewed scientific journals, you will not only avoid moral dilemma but also accrue scientific credibility!

More on outputs and impacts

If you seek to improve a situation, its boundary conditions and underlying mechanisms must be defined using broadly applicable scientific procedures, but there is also a need to identify client groups, candidate solutions and the agents and pathways for change. Because of a paucity of demand for research products in the form of publication by those expert at translating findings into profitable technologies, you must reach further towards your potential clients and create research products that your clients can easily understand and test. Publication must remain a major currency of science, but not the only one and as a scientist in a developing country you must become more adept at shaping research products into other forms, particularly as pioneering technologies and pilot products. Good research can often be further synthesised into physical form, whether this be an invention, an extension package or a computer software model, and further testing of these products could in turn signal a new opportunity for research as candidate solutions. You must not merely position yourself within the research and development continuum where you find the most comfort, but you must be prepared to reach in either direction as circumstances dictate. The needs of the end clients are great but it is the intermediate agents for change, who are absent, unaware or indifferent, and you could help to bridge the gap between clients' difficulties and candidate solutions by striving to see your tested ideas formalised into wider practises.

The development of relevant research products begins with the earliest stages of research planning. Well designed research consists of a continuity of elements that start with clearly stated and substantiated objectives that in turn lead to key research questions and counterpart working hypotheses (Figure 2). Properly stated hypotheses identify treatment contrasts and necessary measurements which are in turn translated into experimental design and procedures. Too many proposals become truncated at this point by merely indicating statistical procedures and an intention to publish future findings, but failing to elaborate upon the immediate and end-clients of the research, which additional research products are anticipated, how these products will be delivered and what impacts may be expected from that delivery. Including the latter elements into a research proposal distinguishes that research as 'demand-driven' and 'impact-oriented' and indicates that you are aware that you must find new ways to formalise and popularise your research accomplishments.

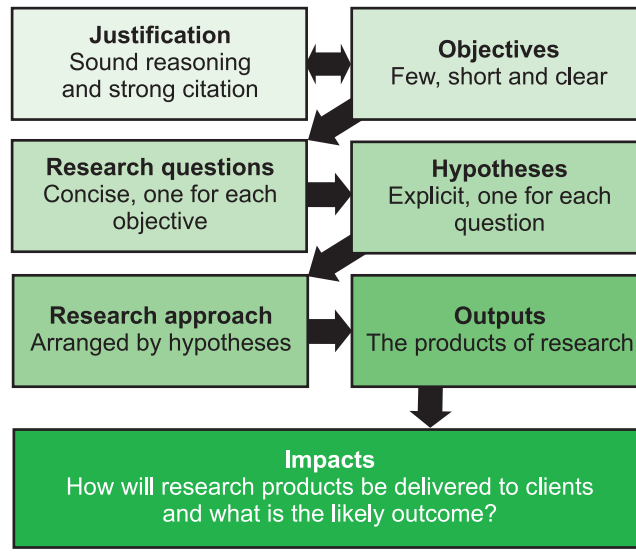


Figure 2. The confluence of proposal elements leads to research outputs and anticipated impacts

Diagnostic indicators of proposal and project viability

There are several indicators of the viability of a given proposal or project that are independent of scientific approach and technical details, but are related to the philosophy and

openness of proposal preparation and project management. Healthy approaches to proposal preparation include true collaboration in its writing, internal review of a proposal prior to its submission, circulation and open discussion of reviewer's comments and careful selection and preparation of references. Similarly, there are several indicators of successful project management including scheduling of regular project meetings, assumption of research responsibilities by the principal investigator rather than operating through top-down delegation, and the clear assignment of tasks and funds to co-operators, including those from outside the principal investigator's organisation. The attitudes of the principal investigator and senior investigators are easily ascertained by reviewers and donor representatives from the proposal contents and short visits to their offices and laboratories.

As a student, your inclusion within a university-based proposal is usually an asset, but only if you are truly integrated into the research team. You should be provided with a copy of the complete proposal so that you may be in a position to better understand your role within a larger context. You should be aware of the funds available to you and be expected to account for these funds as part of your training. Project resources, particularly vehicles and computers must not be treated as personal property by the principal investigator and senior investigators, but should be made available to help all members of the team to complete their work. You must be assigned desk and laboratory work space so that you can work efficiently and be easily accessible to other team members. Your stipend must be sufficient to meet your living needs and must be paid in a timely fashion, otherwise it will be difficult for you to devote your full efforts to your thesis and project responsibilities. The opportunity to creatively contribute to a project and your treatment as a developing professional must both be reflected within any proposal with which you are involved, and again, these considerations are very easily detected by reviewers and donors.

The entire research team must strive for project accomplishments that reflect a healthy and productive research environment, particularly if the senior investigators seek further funds and a lasting relationship with their donors. The principal investigator must meet all project deadlines and goals and must not conveniently ignore, or attempt to redefine those goals at the end of a project. Late technical reporting and lax financial accounting reflect poorly upon a project and its investigators. Projects that lead to publication in leading journals will always be regarded in a favourable light that is not achieved by those that simply produce technical reports with limited circulation. Such other opportunities for research products as pilot products and pioneering technologies must not be overlooked. Senior investigators are better positioned to lead productive research teams when they assume direct research and writing responsibilities rather than operate exclusively through delegation and they must not demand co-authorship as a 'courtesy'. Project accomplishments and the manner in which they are obtained present an entry point for further donor relations and future project funding.

Indicators of healthy and weak approaches to proposal preparation and project management and outputs are shown in Table 1. If you find yourself working in a weak research environment you should to reconsider your position. If you are in agreement with the principles described in the healthy research environment you should take care that your intentions are clearly reflected in the proposals, project reports and research products of your team.

Table 1. Indicators of impacts on MSc programmes through grants

Indicator of positive impact	Indicator of no or negative impact
Proposal preparation	
Proposal is jointly prepared by principal investigator (PI), other investigators and, possibly, candidates for MSc scholarships	Proposal is prepared by PI in isolation, no inputs from other investigators, candidate students are not identified in the proposal
Proposal is internally reviewed by other FORUM grantees before submission	Proposal is sent to FORUM without the knowledge or comments of other local grantees
Reviewers' comments are circulated and revisions made by the project team	PI responds to reviewers' comments in isolation does not circulate reviews and revised proposal to others
Project activities and administration	
Regular project meetings held and attended by all investigators and students	Project meetings seldom held, PI assumes complete authority through delegation
PI pursues individual research interest as well as supervising students	PI delegates all research responsibilities to students or other investigators
Co-operating investigators assigned research and supervision responsibilities	Outside co-operation exists in name only to meet requirements in proposal guidelines
Co-operating investigators and students assigned research budgets	PI withholds budgetary information, preparing the financial statement in isolation
Student relations	
FORUM students group organised and meets regularly to discuss shared concerns	FORUM students discouraged or prevented from organising
Students provided with complete proposal and assigned some financial responsibilities	Proposal or sections of it withheld from students and other investigators
Students assigned designated desk and laboratory work space	Students lack designated work areas due to vaguely worded 'policies'
Students with ready access to project or student computer room established	Computers locked away from students for use by computers PI or other investigators and students require special permission for their access
Students regularly travel to field in project vehicle, vehicle available to other FORUM projects	Students must travel by public means, PIs use vehicle as personal transportation
Students work solely on research and thesis preparation, stipend sufficient for student's needs	Students distracted from thesis by outside employment
Project outputs	
Students submit thesis within 2 years then assist PI in preparing renewal	Students leave campus after conducting field work, completing thesis elsewhere
Project findings results in publication and completed MSc thesis	Research results only appear in submission of MSc thesis
PI serves as an active co-author in the preparation of scientific papers	PI's name appears as co-author as a courtesy claiming time not available for writing
Thesis and papers contain numerous, current citations from leading, peer-reviewed journals	Thesis dominated by grey, in-country literature or unpublished sources

Proposal refinement

If you submit a first version as a 'finished' proposal you are well advised to not consider this the end of your effort, but rather an important stage toward reaching a desired opportunity. The proposal award process may be viewed as a series of interactions between donors and applicants with many important steps required subsequent to submission (Figure 3). A donor's call for submission is met by applicants and then acknowledged by donors who will often request additional documentation. A request for additional documentation should be regarded as a sign of interest by the donor that you should satisfy in a timely manner.

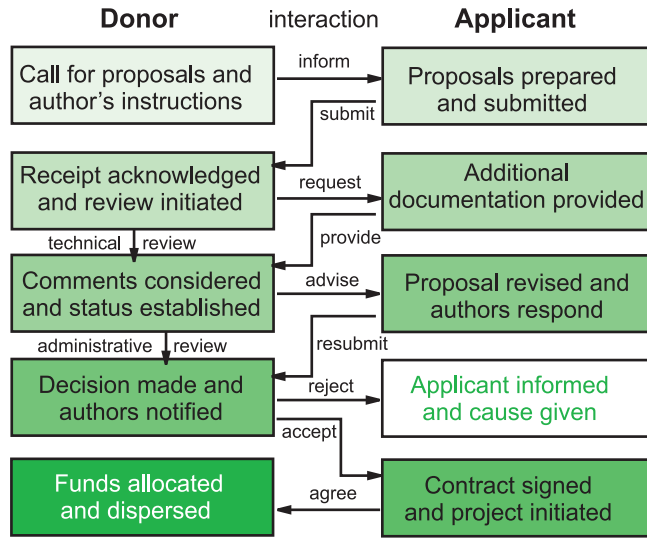


Figure 3. Interactions between the donor and applicants in the proposal submission, evaluation and award process

Proposals are often sent by donors for technical review. This may require several weeks or a few months. Reviewers' comments are then returned to donors and forwarded to applicants. These comments almost always require moderate to major proposal revision and you are well advised to accept and respond to reviews in a constructive manner, but not necessarily to comply with every one of the reviewer's suggestions. In some cases, proposal refinement occurs through several review/revision steps and you should not become discouraged unless it becomes clear that irreconcilable differences in scientific viewpoint exist between yourself and the reviewers. Even then, a proposal could be rescued by preparing a letter to the donor that documents and describes the merits and potential weaknesses of each perspective.

Ultimately, your proposal will be either accepted or rejected (Figure 3). If rejected, you should be told the reasons for this decision, and you should be aware that proposals rejected by one donor based upon their present criteria and priorities may be more acceptable to another donor. If accepted, you will be notified in a letter that is often accompanied by a contract that must be signed and returned to the donor before funds are released. If the donor's acceptance letter requires acknowledgement and requests banking details, you must reply as immediately as possible.

Conclusion

If you are preparing proposals that address agricultural development and natural resource management in Africa you must remember that you are in a crucial and privileged position. Some final advice on proposal preparation and interactions with donor representatives and reviewers is provided in Table 2.

Note particularly the caution against presenting minor and superficial changes as suggested major revision because this is particularly likely to anger the ire of reviewers and

Table 2. Hints on submissions of proposals to donors

Applicants should	Applicants should not
• Inform themselves of donor programme objectives and author's instructions	• Submit proposals without fellow cooperator's knowledge
• Respond to requests for additional information promptly	• Send frequent, unsolicited enquiries about proposal progress
• Respond to reviewer's comments in a constructive, interactive manner	• Respond to reviewer's comments in a dismissive or defensive manner
• Revise and resubmit proposal in a timely manner	• Present superficial changes as major revisions

alienate potential donors. Keep in mind that many donor organisations are extremely concerned over the continent's growing food shortage and depletion of its natural resources and are looking for creative ideas and innovative approaches that may serve to reduce or reverse these ominous trends. The ultimate clients of many agricultural scientists are the rural poor who are relying on society to help them solve their production problems and to obtain a better standard of living. If these societal responsibilities and concerns are reflected within your proposal in a scholarly, but relevant manner, most donors will consider it has promise.

Resource material and references

Appendix 4. Preparing and Refining a Research Proposal. Paul L. Woomer. PowerPoint on CD.

Appendix 5. Stapleton, P., Youdeowei, A., Mukanyange, J. and van Houten, H. 1995. *Scientific Writing for Agricultural Research Scientists*. WARDA/CTA, Ede, The Netherlands. On CD.

Appendix 6. Publication as an Output of Science. Adipala Ekwamu. PowerPoint on CD.

Appendix 7. The Art and Ups and Downs of Scientific Publication. Adipala Ekwamu. PowerPoint on CD.

Appendix 8. Presentations and Style – Tips on Photography and Writing. Eric McGaw. On CD.

Baugh, L.S. 1995. *How to Write Term Papers and Reports*. Future Vision Multimedia. NTC Publishing, Chicago, USA. 259 pp.

Booth, W.C., Colomb, G.G. and Williams, J.M. 1995. *The Craft of Research*. University of Chicago Press, Chicago, USA. 294 pp.

Geever, J.C. and McNeill, P. 1993. *The Foundation Center's Guide to Proposal Writing*. The Foundation Center, New York, USA. 202 pp.

Patel, B.K. and Woomer, P.L. 2000. Strengthening Agricultural Education in Africa: The Approach of the Forum for Agricultural Resource Husbandry. *Journal of Sustainable Agriculture* 16(3): 53–74.

Visit the Forum on Agricultural Resource Husbandry website at: http://www.rockforum.org