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A Biometrics & Research Methods Teaching Resource for sub-Saharan Africa

by

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Abstract

The teaching of applied statistics/biometrics at universities in sub-Saharan Africa in general tends to be theoretical and not directed to the real applied problems of biological research. One of the reasons is the lack of relevant text books and other teaching materials in many universities. The text books that are available tend to have been written in the developed world and contain examples that are for the most part unrelated to the examples that exist in the developing world. To help address this situation ILRI has been developing, with the cooperation of staff from the University of Nairobi and University of Swaziland, an Electronic Biometrics & Research Methods Teaching Resource for Agricultural and Biological Sciences. The Teaching Resource is primarily aimed at teachers in sub-Saharan universities, especially for teaching at the MSc level, and is built around six teaching guides covering the topics of research strategy, study design, data management, exploration & description, statistical modelling and reporting. It brings the subject of applied biometrics alive with the inclusion of various case studies from the Region that interactively demonstrate real-life illustrations of the application of statistical methods. But it is also appreciated that the Teaching Resource will be of use to researchers, especially those who are distant from their nearest applied biometrician. The product is due for release in June 2006 at a workshop to be held in South Africa. This talk will describe the research that has led to the design and construction of the Teaching Resource and demonstrate its current version.

Introduction

"Biometric skills in developing countries are inadequate to support the changing priorities of agricultural research with the consequence that the quality of research aimed at increasing food security and alleviating poverty is often deficient because it lacks good

statistical design" (Riley, 1998). Not only do national scientists and statisticians (biometricians) need training in applied biometrics but they also need to be exposed to the range of problems and complexity of agricultural study design necessary for the developing world (anon).

The agricultural research focus is changing, not just in sub-Saharan Africa but also throughout the world, and now includes agro-ecosystem research, integrated approaches to problem solving, natural resources management perspectives, participation of farmers and an increasing emphasis on providing information about alternative options rather than optimal packages. Whilst there will always be the need to teach classical statistical methods, future teaching of applied biometrics will also need to recognise this changing focus in agricultural research. The subjects of research study design, statistical analysis, interpretation and presentation of results are recognised to be among the top priorities for capacity building in NARS. Yet the teaching of applied statistics/biometrics at universities in sub-Saharan Africa in general tends to be theoretical and not directed to the real applied problems of biological research. One of the reasons is the lack of relevant text books and other teaching materials in many universities. The text books that are available tend to have been written in the developed world and contain examples that are for the most part unrelated to the examples that exist in the developing world.

So what can be done? The inadequacy in the teaching of applied biometrics was addressed at two workshops held in 1999 and 2001 at the International Livestock Research Institute's (ILRI) headquarters in Nairobi and financed by The Rockefeller Foundation (Rowlands, 2000, ILRI, 2001). The subject was 'Enhancement of Capacity in Applied Biometry in East and Southern Africa'. These workshops were attended by biometricians and researchers from national institutions from various countries in sub-Saharan Africa. The workshops confirmed the inadequacy of current biometrics capacity within NARS, and stressed that future teaching of statistics in African universities will need to address better the agricultural problems faced by researchers. Specific activities were recommended to overcome this inadequacy. One was the development of a Regional MSc programme in Applied Biometrics at the University of Nairobi, another the development of a teaching resource to provide biometric and research method knowledge in interactive electronic form for teachers and researchers in sub-Saharan Universities.

Funding was received from The Rockefeller Foundation in December 2002 for this second project. ILRI, together with the collaboration of staff from the Universities of Nairobi and Swaziland and support from the University of Reading, has since been developing a teaching aid, known as the 'Biometrics & Research Methods Teaching Resource', to be available both on CD-rom and on the Internet Web. The approach has followed the general recommendations for the framework, format, structure and content agreed with stakeholders at the two workshops. Thus, the Teaching Resource can be described as being both 'demand driven' and filling some of the knowledge gaps as perceived by the workshop participants. The Teaching Resource is to be released in June 2006.

Goals and objectives

The primary objective is to provide material in electronic form, both on CD-rom and on the Internet Web, that will enhance effective teaching of applied biometrics and strengthen the resources in biometry available at universities and research institutes. The material is presented mainly in the form of illuminating, real-life case studies that provide practical examples relevant to the teaching of applied biometrics in sub-Saharan Africa.

A subsidiary goal has been to provide an opportunity to encourage development of university course curricula that have a stronger applied biometrics and research methods focus than may currently often be the case.

It is expected that the primary beneficiaries will be:

- Teachers of applied biometrics in MSc courses to postgraduate students in agricultural, biological and environmental science
- Teachers of applied biometrics in MSc courses in applied biometry
- Teachers of applied biometrics to undergraduate students

However, it is also expected that researchers and applied biometricians working in research institutes in sub-Saharan Africa will also find the product useful.

A final goal has been to provide opportunities for additional training experience for those engaged in the development of the case studies.

Methodology

The design of the Biometrics & Research Methods Teaching Resource is illustrated by the 'Home page' shown in Fig. 1. It is built around seven teaching guides. The first six, which take users through the typical process involved in the planning and execution of a research programme, are, namely, Research strategy, Study design, Data management, Exploration & description, Statistical modelling, and Reporting. These guides are not complete course notes. Rather their aim is to provide lecturers and their students with supplementary notes that cover some of the more practical aspects of biometrics. The aim of the seventh guide, Training Materials, is to provide links to other relevant teaching material available elsewhere.

In addition to the teaching guides the Teaching Resource will contain several case studies drawn from research conducted in Ethiopia, Kenya, Swaziland, Uganda and Zambia. The case studies go through the research process, as appropriate, (Research strategy, Study design, Data management, Exploration & description, Statistical modelling and Reporting), and illustrate how methods of design and analysis are applied to the examples described. Photographs are included to bring the subjects alive and four short videos have also been shot, not only to demonstrate how arable and animal experiments are laid out in the field but also to illustrate other aspects of research methodology in the field. A fifth video shows a consultation between a biometrician and a client. Fig. 2 illustrates how the

teaching guides and case studies are linked. Each case study has its own data set(s) and study questions.

Relevant publications that illustrate good statistical practice and that are referenced in the case studies will also be held, where possible, in full document form within the Teaching Resource.

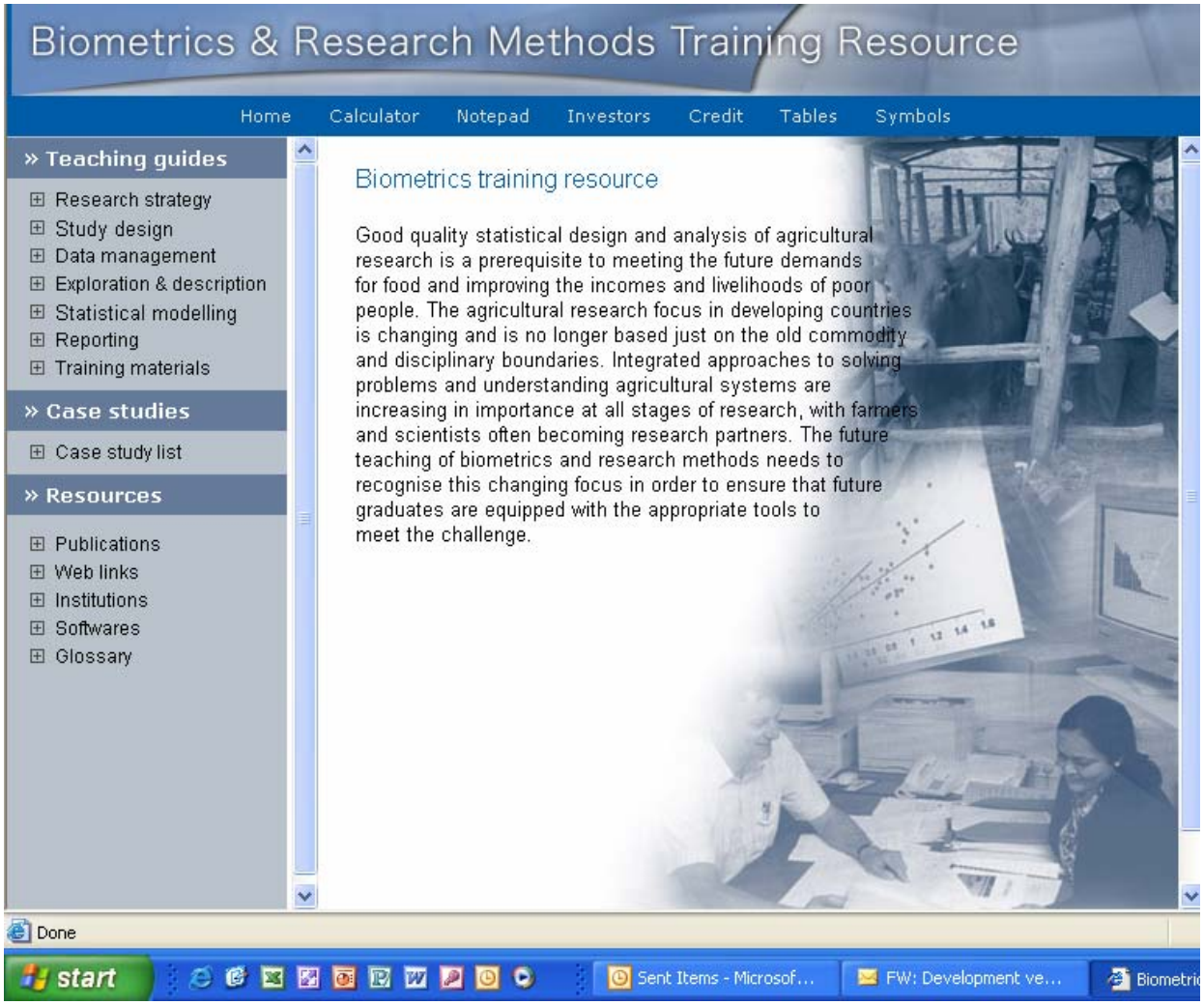

Fig 1. The Home page of the Biometrics & Research Methods Teaching Resource

The contents of the various case studies are shown in Table 1. They represent a range of studies, from environmentally controlled experiments, to studies conducted on-station or on-farm, to those of a more general observational field or survey nature. Some of the studies involve classical experimental designs, others designs of a more general and some times participatory nature, but all are drawn from examples that cover a range of research activities that might be conducted across sub-Saharan Africa. Although the majority of case studies originate from livestock research, much of the statistical methodology is applicable to other agricultural areas. Indeed, Case study 9 describes an experiment

related to agro-forestry research, Case study 14 an agronomic study of Napier grass, and Case study 7 the management and analysis of meteorological data. It is seen from Table 1 that not all case studies cover the complete range of topics covered by the teaching guides. Case Study 13, for example, focuses only on study design. Indeed, its primary aim is to illustrate how to develop a research protocol. Each of the case studies tries to look at different aspects of research and statistical methodology and several emphasise approaches to data management, a topic that is often missing from courses in applied biometrics.

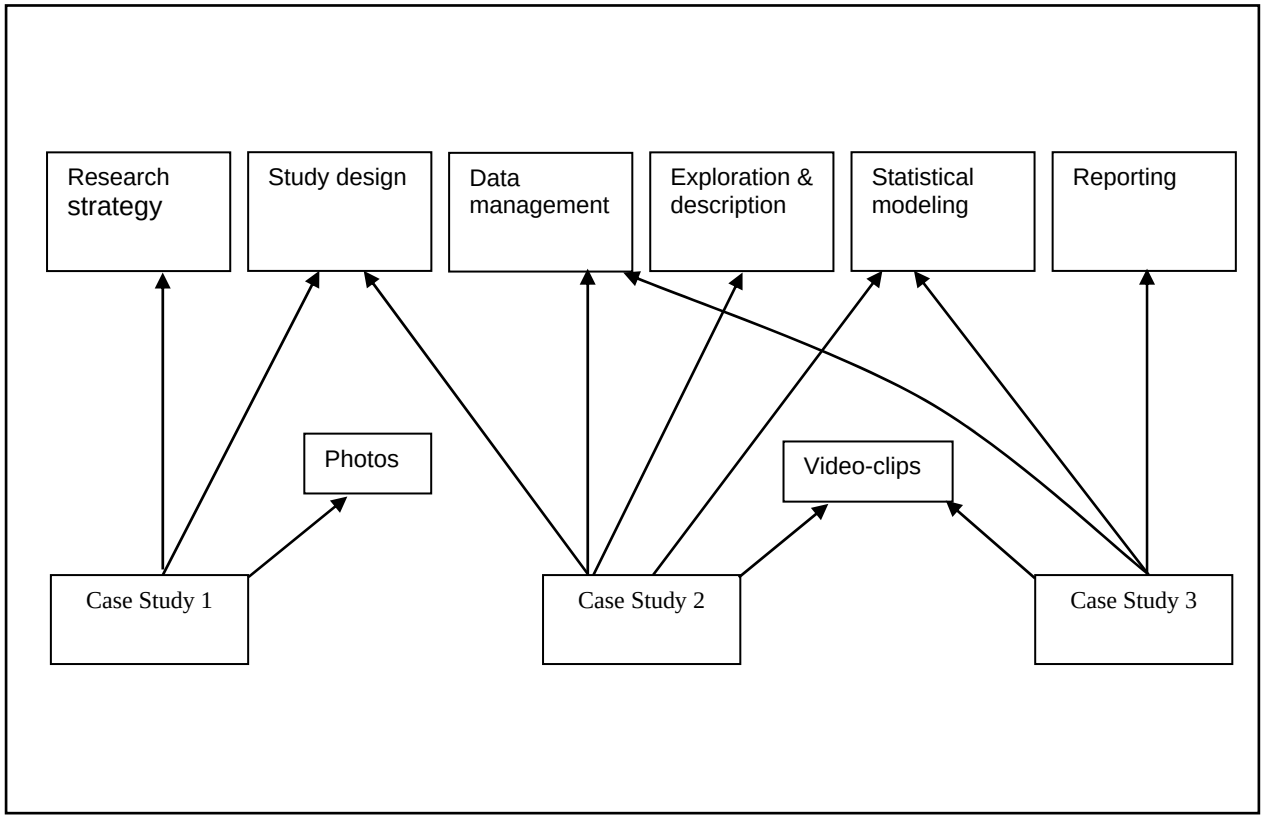

Fig.2 Diagrammatical illustration of the linkage between teaching guides and case studies

Table 2 illustrates a typical contents list within a case study, here Case study 3, dealing with the application of least squares methods in the analysis of factors affecting weaning weights of lambs. The user can click any item within the list and be taken directly to that particular section; subsequently he/she may move forwards and backwards within the case study as desired. Each case study includes a 'Summary', and a 'Background' to describe the source of the study and reasons for it being done. The 'Objectives' (or the hypotheses to be evaluated) – an essential component of research planning - are provided within each case study. The case study then lists the particular 'Questions to be addressed'. The 'Source material', namely the data and documentation files, are described, and these data are available to the user for further analysis.

Table 1. Description of case studies

No	Type of study	Contents	Country of origin	Teaching guides[a]
1	Survey	Pilot household survey, participatory study	Kenya	1**2**345**6**
2	Observational	Cattle longitudinal study, adjusting for fixed effects	Uganda	**2**34**5**
3	On station	Sheep breed comparison study, least squares analysis	Kenya	23**45****6**
4	On station	Sheep breed comparison study, multi-level data , REML	Kenya	34**56**
5	On station	Sheep breed comparison study, survival analysis	Kenya	34**56**
6	On farm	Dairy concentrate study, participatory, research process	Kenya	**12**345
7	Observational	Meteorological data management, analysis & reporting	Zambia	3**46**
8	Controlled	Goat feeding, randomised block, sample size estimation	Kenya	23**5**
9	Controlled	Leguminous tree, polynomial regression, sample size	Ethiopia	234**5**
10	On farm	Cattle disease intervention, longitudinal monitoring	Ethiopia	**1**23**4**56
11	Survey	Livestock breed survey, design, analysis, reporting	Swaziland	**2**3**4**56
12	Survey	Livestock breed survey, population estimation	Swaziland	2**4**
13	Controlled	Goat feeding, experimental design & protocol writing	Ethiopia	**2**
14	On station	Maize accessions, cluster analysis, research process	Ethiopia	**1**24**5**

[a] Numbers represent the teaching guides that feature in the case study, those in bold primarily so. Numbers refer to Research strategy, Study design, Data management, Exploration & description, Statistical modelling and Reporting, respectively.

Having gone through the various aspects of study design and data management and analysis, the 'Findings, implications and lessons learned' from the material provided within the case study are then summarised. Finally, a list of 'Study questions' are given to provide examples for the lecturer to use with his/her students.

Table 2 shows that only five of the topics covered by the teaching guides are covered by the material included within Case Study 3. 'Research strategy' was not considered to be an important component amongst the particular aims of this case study.

The Teaching Resource has been designed to use the statistical software package GenStat for data analysis. A 'Discovery' version of the GenStat statistical package is available free to users in sub-Saharan Africa. Users will thus be able to use the Teaching Resource alongside GenStat for further analysis of the data. Other approved and free statistical software will also be included.

Partnership

The development of the Teaching Resource has been a collaborative project between staff from ILRI, The University of Nairobi, The University of Swaziland and The University of Reading, UK. ILRI has been responsible for developing the teaching guides, editing and formatting case study material ready for implementation into the Teaching Resource, designing the navigation structure for the CD and translating text material into HTML. Staff from the Universities of Nairobi and Swaziland have led the development of many of the case studies. The University of Reading has provided expert review of material

written for the teaching guides and contributed to the development of two case studies and the review of others.

Table 2. Contents of Case Study 3

Contents	Specific topics covered
Summary	
Glossary	Scientific terms that may be unfamiliar
Background	
Study design	Description of 'diallel' design
Objectives	
Questions to be addressed	How best to represent statistical model
Source material	
Data management	
Exploration & description	Exploration of different patterns and relationships
Statistical modelling	Least squares analysis. Comparison of models
Finding, implications and lessons learned	
Reporting	Presentation of results of least squares analysis
Study questions	
Related reading	
Acknowledgements	

Dissemination

Plans for the development of the Biometrics & Research Methods Teaching Resource were presented at the previous SUSAN meeting held in South Africa (Yobera et al., 2003). Other opportunities have since been taken to report progress, especially to university staff in Kenya, who are now evaluating the Teaching Resource in class. However, this meeting in Addis Ababa represents the first opportunity to demonstrate the current version of the Teaching Resource to a wider audience of researchers and biometricians from sub-Saharan Africa. The final product will be released at a workshop planned to be held at the University of Cape Town, South Africa at the end of June and we shall be using the present meeting to seek nominations for participants for this workshop.

We shall subsequently use the GenStat 'Discovery' network, to which over 500 users have subscribed, to disseminate the product wider across sub-Saharan Africa. The World Forestry Centre in Nairobi is responsible for distribution of GenStat licences and we shall collaborate with them. The project has been described to VSN (the developers of GenStat). They have offered to provide technical support and assistance in the distribution of the product. It is expected that ILRI Biometrics Unit will provide a general help desk.

Dedication

The Biometrics & Research Methods Teaching Resource is to be dedicated to Damaris Yobera, who was a member of the staff of the Department of Crops Science at the University of Nairobi until she sadly died in 2002. Damaris was an enthusiastic ambassador for this Biometrics & Research Methods Teaching Resource and was actively involved in the development of several of the case studies. Damaris suffered from cancer for a number of years but her bravery and positive spirit became an inspiration to all who crossed her path. We believe it fitting, therefore, that this Teaching Resource be dedicated in her memory.

Acknowledgements

We thank Eleanor Allen and Carlos Barahana, University of Reading, for their critical review of teaching guide material and also the various authors who provided and gave permission for their research material to be used in the case studies. Two students from the University of Nairobi, Owuor Nelson and Joseph Eyang'an Esekon helped with the development of Case studies 2 and 5, respectively. We are grateful too to other staff from universities in Kenya who are assisting in the evaluation of the Teaching Resource and other members of ILRI staff supporting its development.

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