



Report of a training course on experimental
data and analysis, Tamale, Ghana, 16-27 July
2012

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The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.



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Introduction

Wisconsin International University College was mandated to organise the course through its core biometric staff in the Mathematics Applications Unit of the School of Business. A formal agreement was signed between Wisconsin and IITA.

The planning process for the special course on Experimental Design and Data Analysis began early 2012 as part of the initiatives of coordinating office of the Africa RISING project. After several shifts in dates, the course was finally scheduled for the period 16th to 27th July 2012 in Tamale at the Bigiza Court Hotel as a residential course. The course participants were to be drawn from various institutes of the CSIR that have major role to play in the Africa RISING IITA-coordinated project. The ultimate aim was to improve on the capacity in generating and analysing experimental data. Additionally, it aimed at participants' ability to:

- Identify various types of scientific data and their collection procedures
- Perform routine and advanced data screening and outlier checks
- Explore various data types and perform appropriate statistical analysis

Invitations were sent out from Africa RISING to CSIR institutes to forward nominations of individuals that met the following criteria:

- Must be researchers working within the national agricultural research programmes or must be involved with agricultural data collection and dissemination services
- Must have a minimum of BSc in agriculture or related science (including statistics) and engaged in agricultural research
- Must be conversant with the use of computers

Sixteen participants, including one observer, were selected from among a large number of applicants. The only female selected participant had to be withdrawn due to ill-health. Most participants were of mixed age and experience, with some at the initial stages of their career in research. The list of participants who participated in the course is attached as Appendix 1. Course timetable (Appendix II), with tasks assigned to all resource persons, was finalized, and sent by email to the local coordinating office (Africa RISING) prior to arrival of participants for training course.

General Workshop Report

Opening Ceremony

A simple and brief ceremony was presided over by the Director of CSR- SARI , Dr Nutsugah. Professor Nokoe represented Wisconsin International University College, and after expressing the appreciation for the selection of Wisconsin, outlined the course expectations as well as the ground rules for the course. Dr Nutsugah in his speech expressed his profound gratitude to USAID for the financial and technical support to build capacity of CSR-SARI's scientists in Experimental Design and Data Analysis to ensure quality output and standards. He also mentioned that a workshop of this nature is appropriate and timely as the availability of reliable data is necessary in improving decision making by farmers, policy makers and other stakeholders. He encouraged the participants to commit and fully participate in the training workshop to derive maximum benefits in order to improve their analytical skills. The opening ceremony ended after group photograph and coffee.



Course Schedule

The course schedule was based on the course description and 10 days course duration, including regular and interactive group exercises. Lectures started by 8.30am and ended by 5.30pm daily. GENSTAT Discovery Edition 4 (courtesy of VSN) was the major software used in the course. Other major statistical softwares (SAS and SPSS) outputs were presented and discussed.

Course Summary

The standard course manual of 140 pages in English was compiled by Prof K S Nokoe and made available to all participants. The course examined scientific data from their generation to quality and integrity checks, exploratory analyses of the generated data, and appropriate reporting and presentation of results. Exploratory data analysis emphasized on graphical applications and simple statistics. Participants were introduced to appropriate statistical analysis consistent with the type of data (which could be nominal, ordinal, continuous on interval scale etc.), the underlying distribution if known, and the set of hypotheses to be tested. Experimental and sampling design strategies were thoroughly covered and further discussed in group sessions. In particular, mixed model analysis and categorical association studies and modelling were partially explored and practiced using the GENSTAT statistical package. Participants were guided to download GENSTAT Discovery Edition 4 and reference materials through GENSTAT 'HELP'. Power point presentations were made available to participants.

The course was structured in eight main modules with the following details and expectations.

Modules 1& 2: It was expected that at the end of this module, participants would be able to:

- describe the different types of data and variables;
- list and describe the key steps involved in the proper management of scientific data
- explain the causes of outliers and contaminants
- perform simple exploratory data analysis as a first step in data analysis to describe, summarize and check for inconsistencies of the data collected to ensure that assumptions associated with the different analysis methods are not grossly violated
- implement corrective measures, e.g. imputation, transformations, imputations, prior to analysis as may be required

Modules 3 & 4: It was expected that at the end of this module, participants would be able to:

- explain the principles associated with experimental design, and use GENSTAT software
- describe the characteristics of experimental treatments – qualitative versus quantitative, fixed versus random
- design and produce a randomized layout for any single- or multi-factor experiment for simple designs such as the completely randomized, randomized complete block, Latin square and other higher-level or specialized designs and models, including Mixed Models and Generalized Linear Models, using the GENSTAT (Discovery Edition) software
- perform and interpret analysis of variance of fixed and mixed models
- utilize orthogonal contrasts and polynomials in post-ANOVA analyses

Module 5: It was expected that at the end of this module, participants would be able to:

- utilize knowledge acquired on the different survey designs available and their applications in agricultural research;
- design a simple questionnaire taking into account its important aspects such as the directions to respondents, wording and order of questions and their implications with data coding and analysis
- describe the sampling process and types of samples;
- perform simple survey data analysis such as the calculation of means and confidence intervals/limits

Modules 6, 7 & 8 cover regression and association analyses, and it was expected that at the end of this module, participants would be able to:

- model continuous and discrete response variables
- perform association, classification and data reduction techniques
- utilise other statistical methods available to analyze data collected from surveys and experiments

Daily Evaluation

Participants evaluated the progress of the course on daily basis by course topic and resource person. Participants were expected to assess on basis of following:

- Knowledge acquired: Much, Some, None
- Relevance/Usefulness: Very, Maybe, None
- Depth of Coverage: Deep, Appropriate, Superficial
- Presentation: Good, Satisfactory, Poor
- Training materials: Good, Satisfactory, Poor

In addition, participants could make general comments on the specific topic as well on other conditions, such as on transportation, accommodation and other logistical inputs. Responses from daily evaluation sheets were studied on daily basis by resource persons and local coordinator and necessary corrective measures were taken where appropriate. There was no major issue that could not be addressed.

Group Presentations

This was the last formal class activity. Four groups balanced by disciplines, made presentations on specific assignments. These assignments had been given during the course. Participants reviewed and criticised group presentations, and made useful comments. The idea of getting prepared at all times, even under challenging situations, to present research findings was emphasized.



Group members



Group 2

End of Course Evaluation

The course was evaluated using a questionnaire attached as Appendix III. Completion and analyses of responses of this form by participants in previous courses have aided planning of subsequent courses, and to address emerging issues. Following post-questionnaire completion discussion, all the four groups agreed and suggested strongly a repeat of the course in the near future with slightly different orientation towards analyses of newly generated project-based participants' research data.

Final Course Evaluation

Evaluation from participants

Participants were invited to fill an overall course evaluation. Their main comments follow verbatim:

- Statistical knowledge have been polished
- Exposure to GenStat was beneficial
- Have learnt a lot. Can analyse own data and can design own experiments. Can interpret results from the data analysis
- Build more on partnership.
- Content of the workshop should be disseminated to all research scientist of CSR.
- Interaction of scientists from different background useful in forging collaboration.
- Knowledge acquired may improve quality of scientific papers for publication in national and international journals.
- Course may have contributed to capacity building
- Use and understanding of an appropriate statistical packages

General comments and observations from participants

From the course evaluation participants suggested the following to be considered:

- Organising workshops such workshop for other CSIR staff
- Facilitation has been carefully planned, course content fully covered and understood. Level of knowledge and experience of facilitators has contributed to the success of the workshop. Therefore the selection of resource persons matters.
- More emphasis on the practical aspect than on the theory should be given.
- More emphasis on multivariate data analysis and analysis of data collected over seasons and/or over years.
- Course load need to be reduced.
- Planning of similar courses using other statistical packages.
- Contact hours need to be reduced (consequence of course load)
- Conduct of such courses more regularly for young researchers
- Plan a session on the analysis of time series data
- Course notes should be more simplified: more practical than theoretical

Closing Ceremony

There was no formal closing reception. However, the last session evaluated the course through open interactions with all participants. The course representative Kennedy Agyeman from CSIR-Crops Research spoke on behalf of the course participants and expressed the appreciation to the resource persons, Africa RISING and CSIR for the knowledge gained, and pledged to put these to effective use. On the course itself, a review of expectations before and after the course suggests that the course objectives and participants interests had been well served. It is our expectation that participants take advantage of the network of facilitators and participants for their future development.

Conclusion and Acknowledgement

The organization of the course was superb, with a strong team effort. Staff of the “Africa RISING Coordinating Office” and Bigiza Court Hotel are acknowledged. Audio-visual facilities provided were adequate and greatly facilitated teaching and learning. Computer and Internet access were more than adequate with uninterrupted supply of electricity which enabled prompt completion of tasks. Participants were enthusiastic and dynamic. They had participated fully and contributed in providing relevant cases for consideration during the workshop. Finally, we express the sincere gratitude of IITA for the selection of Wisconsin International University College and its resource persons to deliver the course.

APPENDIX I: List of Participants

Last name	First name	Current Employer	Position	Qualification	Discipline	Official Address	E-mail
Sekyi-Annan	Ephraim	CSIR-SOIL RES INSTI	Research Scientist	Msc(Knust) 2010	Agric Water Mgt	CSIR, Kwadaso -Kumasi	seyiannan@yahoo.com
Salifu	Sadat	CSIR-ANIMAL RES	Asst Res Sci	Bsc(Uds)2007	Agric Animal Sci	Box 52, Nyanpala Tml	ssalifuari@gmail.com
Dawuda	Mohammed	BOX 25, WINNEBA	Principal Technician	Msc(Knust) 2010	Agronomy	Box 40 Asante Mampong	mmdawuda@yahoo.com
Bortey	Hillary M.	CSIR-CROPS RES	Research Scientist	Msc(Knust) 2010	Seed Science	Box 3785 Kwadaso Kms	hmireku@gmail.com
Baidoo	Elvis Alfred	CSIR-FOOD RES	Research Scientist	Mphil(Legon) 2008	Food Storage	Box M20, Accra	Kobinaelvis@yahoo.com
Buah	Saaka	CSIR-SARI	Agromist	Phd	Crop Physiology	Box 494, Wa	ssbuah@yahoo.com
Yahya	Asieku	CSIR	Agric Res	Msc(Knust)	Agronomy	Box 52, Nyanpala Tml	yasieku@yahoo.com
Asungre	Anabire P.	CSIR-SARI	Principal Technician	Bsc(Knust) 2010	Millet Breeding		pasungree@yahoo.com
Asamoah	Gideon	CSIR-SOIL RES INSTI	Lab Technol	Bsc(Ucc) 2010	Lab Techno	CSIR, Kwadaso -Kumasi	gasamoah97@yahoo.com
Quarcoo	Gerard	CSIR-WATER RES	Research Scientist	Msc(Legon) 2010	Environmental Sci Enctist	Water Research Institute -Tml	geraquabs@mail.com
Acheremu	Kwabena	CSIR-SARI	Research Scientist	Msc(Knust)	Breeding(Root& Tube Crops)	Box 52, Nyanpala Tml	acheremuk@yahoo.com
Agyeman	Kennedy	CSR-CROPS RESEARCH	Research Scientist	Msc(Knust) 2010	Crop Physiology	Box 3785 Kwadaso Kms	agyemanken@yahoo.com
Owusu Danquah	Eric	CSIR-CROPS INSTITUTE	Research Scientist	Mphil(Knust) 2011	Agronomy	Box 3785 Fumesua Kms	ericdany7@gmail.com
Mellon Bedi	Shaibu	IITA	Research Supervisor	Bsc(Legon) 2008	Agric Econs	Box 3248, Accra	sbmellon2005@gmail.com

Nboyine	Jerry Asalma	CSIR-SARI	Research Scientist	Mphil(Legon 2010)	Entomology	Box 52, Nyanpala Tml	nboyinejerry@yahoo.co.uk
Shaibu	Mohammed T.	CSIR-ANIMAL RES	Principal Technician	Bsc(Uds)2007	Agric Econs	Box 52, Nyanpala Tml	kinasao7@yahoo.com

RESOURCE and LOCAL COORDINATOR

1. Prof Kaku Sagary Nokoe (KSN)
2. Mr. Mamadou Lamine Diedhiou (MLD)
3. Lois Leikib (Secretarial/General Logistics)
4. Kofi Amoah (Secretarial/General Logistics)

Appendix II – Course Time Table

TIMETABLE – EXPERIMENTAL DATA AND ANALYSIS					
WEEK 1					
Time	Monday 16 July	Tuesday 17 July	Wed 18 July	Thurs 19 July	Friday 20 July
08.30–09.00	Registration and Opening	Module 2(i) Outliers and Contaminants (KSN)	Module 3(i) Experiments – concepts (MLD)	Module 4(i) Mixed Model Analysis - basics (MLD)	Module 5(i) Sampling Basics KSN
09.00 – 10.00	Expectations /Groupings (KSN)				
10.00 – 10.30	Tea/Snack Break				
10.30 – 12.30	Module 1(i) Data and Data Types (MLD)	Module 2(ii) Simple Diagnostics with GENSTAT (KSN)	Module 3(ii) Basic Experiment Analysis with GENSTAT (MLD)	Module 4(ii) Mixed Model – repeated measures (MLD)	Module 5(i) continued Sampling Basics KSN
12.30 – 13.45					
13.45 – 15.15	Module 1(ii) Data and Data Types (MLD)	Module X(ii) GENSTAT practice - basic analysis (MLD)	Module X(iii) Generating Designs with GENSTAT KSN	Module 4(iii) Mixed Model – augmented designs (KSN)	From 14.45 Module 5(ii) Design of Questionnaire (Interactive Session) MLD
15.15 – 15.45					
15.45 – 17.15	Module X(i) GENSTAT Software – data and basic stats MLD	Module P(i) (GROUP PRACTICE) MLD/KSN	Module P(ii) (GROUP PRACTICE) MLD	Module P(iii) PRACTICE with Software MLD	
WEEK2					
Time	Monday 23July	Tuesday 24 July	Wed 25 July	Thurs 26 July	Friday 27 July
08.30 – 10.00	Module 6(i) Regression Basics MLD	Module 7(ii) Categorical Models KSN	Module 8 (i) Multivariate –measures and distances KSN	GROUP or INDIVIDUAL ANALYSES	Module 8(iv) Multivariate – Canonical and Correspondence (KSN)
10.00 – 10.30					
10.30 – 12.30	Module 6 (ii) Multiple Regression with	Module 7(iii) Categorical with GENSTAT (KSN)	Module 8 (ii) Multivariate – Cluster with GENSTAT	GROUP or INDIVIDUAL ANALYSES	COURSE EVALUATION

	GENSTAT MLD		KSN		
12.30 – 13.45					
13.45 – 15.15	Module P(iv) GROUP PRACTICE MLD/KSN	Module 7(iii) Categorical with GENSTAT (KSN)	Module 8(iii) Multivariate – PCA & Factor (MLD)	REVIEW OF GROUP ANALYSES	Close Ceremony
15.15 – 15.45					
15.45 – 17.15	Module P(v) GROUP PRACTICE MLD/KSN	Module P(vi) GROUP PRACTICE KSN/MLD	GROUP PROJECT	REVIEW OF GROUP ANALYSES	

Appendix III: Final Evaluation by Participants

We will appreciate your finding time to complete the following to aid in our planning of future courses. USAID/Africa RISING also requires this.

SECTION A: Course objectives/expectations

EXPECTATION – Indicate to what extent you agree/disagree with the proposition				
	Strongly Agree	Agree	Disagree	Strongly Disagree
<p>Modules 1& 2: DATA TYPES & OUTLIERS</p> <p>I am able to</p> <ul style="list-style-type: none"> • identify different types of data and variables; • explain the causes of outliers and contaminants • perform simple exploratory data analysis • implement corrective measures on outliers, missing data prior to analysis <p>Modules 3 & 4: EXPERIMENTAL PROCESS:</p> <p>I am able to:</p> <ul style="list-style-type: none"> • Identify characteristics of experiments: - qualitative vs quantitative, fixed vs random • design and produce a randomized layout for any simple designs using the GENSTAT (Discovery Edition) • perform and interpret analysis of variance of fixed and mixed models 				

<ul style="list-style-type: none"> utilize contrasts in post-ANOVA <p>Module 5: SURVEY</p> <p>I am able to</p> <ul style="list-style-type: none"> design a simple questionnaire describe the sampling process perform simple survey data analysis such as the calculation of means and confidence intervals/limits <p>Modules 6, 7 & 8: ASSOCIATION</p> <p>I am able to:</p> <ul style="list-style-type: none"> model continuous and discrete response variables perform association, classification and data reduction techniques 				
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SECTION B: Course Content

Indicate not more than 3 aspects of the course that you liked most:

1. -
2. -
3. -

List any (maximum 3) topics that you liked most:

1. -
2. -
3. -

List any (maximum 2) topics that you did not like:

1. -
2. -

SECTION C: Long term plans

Support of AFRICA RISING: how will the outputs support the longer term objectives of Africa RISING?

Scalability: if these deliverables are intended to increase in scale during years 2-5 of Africa RISING, what actions do you propose to be implemented in future?

Lessons learnt: what lessons, including about the partnership you had within the project, have been learnt during the implementation of the project that will help Africa RISING to succeed in future?

Publicity: Africa RISING encourages publication of the study results in refereed publications and presentation in conferences for wider public consumption. Advise the potential of your work getting to this stage

SECTION D: Suggestions on future courses and how your expectations can be facilitated

Thank you
Resource Persons (MLD/KSN)

Appendix IV: Narrative Technical Report

In paragraphs or bullet point, please provide the following information (3 pages):

- **Purpose, objectives, planned outputs:** from submitted proposal
 - **-Not Applicable to WIUC**
- **Partners:** provide a comprehensive list of partners involved in project implementation and their roles
 - **WIUC – deliver course on Experimental Design and Data Analysis -**
 - **CSIR-SARI – implementing agency**
- **Achievements against plan:** describe the achievements and deliverables.
 - **Course delivered within stated period**
 - **Participants 16 from 6 CSIR institutes linked with the projects**
 - **Add participants evaluations or refer to**
- **Key Deliverable Deviation:** if specific key deliverables were not met according to proposed plan, discuss the reasons.
 - **NONE**
- **List of geo-tagged locations/sites where activities took place:** when activities were site specific
 - **TAMALE, within the project mandated region**
- **Support of AFRICA RISING:** how will the outputs support the longer term objectives of Africa RISING?
 - **Not Applicable to WIUC**
- **Scalability:** if these deliverables are intended to increase in scale during years 2-5 of Africa RISING, what actions do you propose to be implemented in future?
 - **REGULAR Monitoring of participants research outputs (linked with the project)**
 - **REGULAR UPDATE of participants skills**
- **Lessons learnt:** what lessons, including about the partnership you had within the project, have been learnt during the implementation of the project that will help Africa RISING to succeed in future?
 - **STATISTICAL and EXPERIMENTAL DATA analytical skills of several project partners within CSIR rudimentary; formal engagement of institutions (e.g. WIUC) or individual resource persons in consulting role to BACK-STOP project may be necessary**
- **Publicity:** Africa RISING encourages publication of the study results in refereed publications and presentation in conferences for wider public consumption. Advise the potential of your work getting to this stage
 - **The course has provided necessary or minimal acceptable analytical support to ensure project output are analysed effectively for success with high quality publications in respected peer review journals.**
- **In addition:**

-
- **USAID indicators:** In attached list of indicators, fill in numbers for targets achieved in column N for those indicators your project has identified.
-
- **Custom indicators:** Treat this in a similar way to the USAID indicators
-
- **Documentation of success:** For the reports to the donor, description of success stories illustrated with pictures is requested. If you consider your project a particular success story that should be reported in detail, please provide a narrative description and attach some pictures.

List of indicators and their definitions

SPS Location	ID number under SPS location	Indicator Title	R - required/mandatory RiA - required if applicable S - Standard	Who le of Gov (WOG)	Level of Collection	Who collects?	Frequency of collection?	Indicator Type	Data points requested (if more than one data point)	Disaggregation
4.5.2	5	Number of farmers and others who have applied new technologies or management practices as a result of USG assistance	RiA	WOG	Project-level, targeted beneficiaries with USG assistance	Implementing Partners	annually	outcome	30	Duration: New, Continuing Sex: Male, Female
4.5.2	6	Number of individuals who have received USG supported long-term agricultural sector productivity or food security training	S		Project-level, targeted beneficiaries with USG assistance	Implementing Partners	annually	output		Sex: Male, Female
4.5.2	7	Number of individuals who have received USG supported short-term agricultural sector productivity or food security training	15	WOG	Project-level, targeted beneficiaries with USG assistance	Implementing Partners	annually	output		GOVERNMENT Research Organization Male 15; Female 0
4.5.2	11	Number of	RiA	WOG	Project-	Implementing	annually	output		Type of

		food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance			level, targeted organizations with USG assistance	ting Partners				organization (see indicator title for principal types) Duration: New, Continuing
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