

**ASSESSMENT OF RESEARCH AND STATISTICAL RELATED PROCESSES IN
THREE INSTITUTIONS OF HIGHER LEARNING IN KENYA**

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(Research Methods)**

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TECHNOLOGY**

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THREE INSTITUTIONS OF HIGHER LEARNING IN KENYA**

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**A Dissertation Submitted in Partial Fulfilment of the Requirements of Master of
Science Degree in Research Methodology at Jomo Kenyatta University of
Agriculture and Technology**

2012

DECLARATION

This dissertation is my original work and has not been presented for a degree in any other University.

Sign: _____ Date: _____

Nancy W. Chege

This dissertation has been submitted for examination with our approval as University Supervisors.

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Dr. John Kihoro
JKUAT, Kenya

DEDICATION

I dedicate this project with much love and appreciation to my family. I owe gratitude to God.

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ACRONYMS AND ABBREVIATIONS

AA	Academic Affairs division
APD	Administration, Planning & Development division
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
DFID	Department for International Development
IBS	International Biometric Society
ICT	Information and Communication Technology
IGU	Income Generating Unit
IGA	Income Generating Activity
IP	Innovation Project
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KIE	Kenya Institute of Education
KTTC	Kenya Technical Teachers College
M&E	Monitoring and Evaluation
RPE	Research, Production & Extension division
RUFORUM	Regional Universities Forum for strengthening Agriculture
SSC	Statistical Service Centre

ABSTRACT

Institutions of higher learning are mandated to conduct applied research and promote innovations among other functions. The purpose of this study was to assess four research and statistical-related processes in three institutions of higher learning namely, Jomo Kenyatta University Agriculture and Technology (JKUAT), Kenya Technical Teachers College (KTTC) and Kenyatta University (KU). The research and statistical related processes were identified after a one- to -one consultation with the people in charge of crucial research departments in the three institutions. The four tasks included, assessment of an approach that could be used to develop content for an innovation policy document at RPE, assessment of some aspects of an instrument used in monitoring and evaluation of innovation projects at RPE, assessment of training in research and statistical methods at JKUAT and KTTC, and finally an assessment of data analysis procedures of one dataset from ASARECA project based at KU.

A qualitative approach was used to gather information and analyse data on appropriate content of the innovation policy documents. Two key informants, purposively selected from RPE provided the necessary textual data for this assessment. The tool used to collect the data was an open interview schedule (see appendix I for the schedule). Qualitative procedures were used to analyse the data including transcription of textual data, data display, data reduction and drawing of conclusions to develop content of the policy. Two aspects of the instrument used in monitoring and evaluation of innovation projects were assessed. Data were collected from innovation proposals forwarded to RPE. More data were also collected during the actual monitoring and evaluation process. The data were entered in excel and summaries made using tables and graphics.

Assessment of training was done in two folds; One, through assessment of use of Moodle, (a learning management system), in teaching of an MSc course in research methodology at JKUAT. The data for this assessment were collected using an observation profoma form the SSC Moodle web site which hosted the course. The data

were later analysed using descriptive statistics including the frequency distributions and measures of central tendencies. The second fold was an assessment of teaching research methods at KTTC. Statistical Package for Social Sciences (SPSS) was used in the analysis. The dataset from KU was analysed in stages, first step was to use the Meta data availed and formulate research questions to guide the analysis process. Pivot tables were then created in excel to summarize the measurements of the variables. Exploratory analysis in GenStat and R softwares followed before doing hypothesis testing and statistical modeling.

The study revealed that a qualitative approach can be used to gather information from key informants to generate content for innovation policy document. It also showed that the field of application of most of the innovation projects at RPE, JKUAT is agriculture. Among the collaborators suggested in all the proposals, none was a biometrician/research methods professional, or an economist, very few entrepreneurs were included. According to the findings, the learning forums on Moodle site were not fully utilized. As in assessment of teaching at KTTC, the rating of availability of resource materials for students was low. The findings from analysis of data from KU revealed that organizing the analysis such that it begins with an outline of analysis objectives, followed by creation of pivot tables, carrying out exploratory analysis, testing hypotheses and doing a regression analysis towards the end.

The study recommends that; a policy document be formulated at RPE to guide the management of the innovation projects, Biometricians /RM professionals and economists be included as collaborators, innovators from all fields be encouraged to participate by RPE, use of Learning Management Systems be promoted by the e-learning department to enhance teaching at the University, Simplified manuals in research and statistical methods be availed at KTTC for the diploma students and correct procedures for data analysis be followed in order to produce accurate and reliable findings from research.

CHAPTER ONE

INTRODUCTION

1.1 Background information on host institutions

This study was hosted in three institutions of higher learning namely, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya Technical Teachers College (KTTC) and Kenyatta University (KU).

JKUAT is a public University near Nairobi, Kenya. The University was started in 1981 as Jomo Kenyatta College of Agriculture and Technology (JKCAT). Currently, the University is structured into three divisions, namely; Administration, Planning & Development Division (APD), Academic Affairs Division (AA) and Research, Production & Extension Division (RPE).

Kenya Technical Teachers College (KTTC), on the other hand is a middle level college in Kenya. The college opened its doors to the first students in 1978. It is among the leading colleges of this kind in Eastern and Central Africa. KTTC derives its authority from the Education Act Cap 211 (revised in 1980) and Legal Notice N0 242 of 1978, which mandates it to train technical teachers for technical institutions in the country. Initially, the bulk of teaching staffs were Canadians. However, immediate steps were taken by CIDA to train Kenyans in Canadian Universities. Between 1978-1993, about 135 Kenyans effectively replaced Canadian teaching staff at the Kenya Technical Teachers College. This was one of the most successful CIDA projects in Kenya. The first graduation was held in 1979.

Kenyatta University is situated about 23 kilometres from the city of Nairobi on the Nairobi-Thika superhighway on 1,100 acres of land. The University started in 1965 when the British Government handed over the Templar Barracks to the Kenya Government. These were converted into an institution of higher learning known as Kenyatta College.

1.1.1 The core functions

The core functions of JKUAT are; first, to provide facilities for university education including agriculture, scientific, cultural, technological, and professional education, and integration of teaching, research and effective application of knowledge and skills to the life, work and welfare of citizens of Kenya. The other is to participate in the discovery, transmission and preservation and enhancement of knowledge and stimulate the intellectual participation of students in the economic, technological, agricultural, professional and cultural development of Kenya. The third function is to play an effective role in the development of agriculture and technology. The fourth and the final function is to cooperate with the government in the planned development of university education (Jomo Kenyatta University Agriculture Technology, 2011)

The core function of KTTC is to train technical teachers in Kenya. other functions are but not limited to, teach in secondary schools and tertiary institutions, implementation of various syllabi under TIVET Programs in collaboration with stakeholders, development of relevant syllabi for technical training in collaboration with stakeholders, to develop, administer and process examinations and award certificates, diploma, and higher diploma to successful candidates, development and implementation of curricula in response to demands of the labor market, promotion of entrepreneurial skill and culture within the KTTC staff and student undertaking of income generating activities through production, consultancy, to conduct applied research and promote innovation and finally to foster linkages with industry and other institutions for promotion of quality and relevant training, (Kenya Technical Teachers College, 2011).

The core functions of Kenyatta University is to provide quality education and training, promote scholarship, service, innovation and creativity and inculcate moral values for sustainable individual and societal development (Kenyatta University, 2010). Enhance the level of participation in research, dissemination and preservation of knowledge for both academic and societal development among other objectives. A close observations of the functions stated above shows that training, research and innovations are major components the institutions' mandates.

1.1.2 Current status of biometry

Biometrics is the use of statistics to analyse observations from biological phenomena. It is applied statistics that deals with design of experiments and surveys, analysis of data and interpretation of results obtained (Mwangi, 2005). According to Riley, (1997), Biometric skills in Africa, the Caribbean and the Pacific are inadequate. The evidence is based upon the biometric skills and training opportunities of professional biometricians, the biometric skills and training opportunities of research staff and the availability of modern biometric facilities.

In a study conducted at the University of Reading on biometric training for agricultural students, Allan and Stern (2000) found that the university students were not being exposed to the types of situations to which they would find themselves later. Even within their MSc or PhD courses it did not prepare them sufficiently for their subsequent research projects. Too much time was spent on the mechanical application of statistical methods so that students were not given sufficient tuition on how to plan and manage their own research investigations. They were also not exposed to datasets that were of sufficient size and complexity to relate to the data that might be collected in a research project. The study also showed that students were not being introduced to the methods needed for dealing with complex data structures.

The situation is not different in Kenyan universities. According to a study conducted among agriculture students at University of Nairobi, students received a major shock at the end of year one when suddenly they found themselves thrust into the situation of applying what they had learnt for real (Akundabweni, 2000). Indeed, a questionnaire to students at this time demonstrated the need for extra training prior to the writing of research proposals. Researcher's lack of knowledge of how to manage his/her data has contributed to his/her inability to conduct a full and satisfactory analysis (Allan and Stern, 2000). Cummings (2004) noted that trained biometricians, who can be consulted, were hard to find in many Universities especially in developing countries. Many institutions do away with their biometricians under mistaken belief that biometrics skills can be replaced by use of more junior staff or by statistical computer software.

Some of the tasks carried out in this study aimed at evaluating some research and statistical related processes that would help to hint to where challenges observed in the areas of research in institutions of higher learning can be traced. One such area relates to policies.

1.1.3 Project innovation policy

Good policies are fundamental to progress in the economic and social spheres .Before a policy can be created, a problem must exist (cliffs, 2012). A problem existed in the production department in RPE division JKUAT due to absence of a policy to spell out managerial issues of the innovation projects. This is one of the areas that was assessed in this study

1.1.4 Monitoring and evaluation (M&E)

An M&E system can provide a regular flow of information on the performance of policies (World Bank, 2011). It is for this reason that the RPE at JKUAT monitored and evaluated innovation projects occasionally. A number of innovation projects have been funded through JKUAT'S innovation Fund. The fund is administered from Research, Production and Extension Division and overseen through the Innovation Production Committee of Senate. For the day to day management of the innovation projects there is a standing subcommittee of Innovation and Production known as the Monitoring and Evaluation subcommittee. The subcommittee consists of 7 members drawn from all academic departments of the university. Since 2007, when the fund was administered, about 30 innovators had applied for this fund however some of the proposals did not qualify for funding. The fund has supported 14 ongoing innovation project activities and 4 newly approved projects that were funded in 2010/2011 academic year. To ensure that the fund is well utilized, every year innovators present the progress of the work to the Innovation and Production Committee.

1.1.4.1 Overview of innovation projects

A total of 18 projects had been funded since introduction of innovation fund in 2007 at JKUAT in 2007, (Jomo Kenyatta University Agriculture, 2011). The proposals are

usually sent to reviewers that score on various aspects of the proposals basing it on an established criterion to determine which innovation qualifies for funding (JKUAT, 2011). The following section presents an overview of some of the projects evaluated during the monitoring and evaluation activity by the monitoring and evaluation subcommittee of JKUAT.

1.1.4.1.1 Gemmology course for small scale miners in Taita Taveta district

According to the project innovator, the number of small scale miners in Taita Taveta area is quite large, but the majority, if not all, operate without any technical knowledge in geology, mining or mineral processing. It was for this reason that he developed a short course to train the small scale miners and provide modern skills of mining. Figure 1 shows some of the minerals mined by operators from Taita Taveta district.



Figure 1: Some of the minerals in Taita Taveta district

The training course was meant for the local community who continually used traditional methods of mining. These methods were risky and non profitable. Figure 2 shows some of the members who were going on with the gemmology training course at Taita Taveta.



Figure 2: Members of gemmology training course at Taita Taveta

1.1.4.1.2 Development of sustainable construction materials and technologies for eco-housing infrastructure

The purpose of this project was to develop and avail appropriate sustainable eco-building, pavement construction materials and technologies (see figure 3). One of the objectives was to evaluate the strength, stability and durability characteristics of model eco-structures. This objective would probably require a data analyst.



Figure 3: Eco -housing

1.1.4.1.3 Development of 3 wheeler motor cycle

According to the innovator this was simple technology that is easily adaptable for wide range of micro transport needs in Kenya. This tricycle (see figure 4) was expected to be different from the Chinese make in that it would be more adapted to local conditions including the roads.



Figure 4: Three-wheeler tricycle

1.1.4.1.4 Determining the Scientific Basis for Up-Scaling the System of Rice Intensification (SRI), for Increased Rice Production in Kenya

SRI stands for System of Rice Intensification .It is a method of growing rice which uses less water, yet increases yields (see figure 5). SRI involves intermittent wetting and drying of paddies (Not continuous flooding). This is another example of a project likely to generate datasets that would require the services of a biometrician and an economist (to do the cost –benefit analysis)

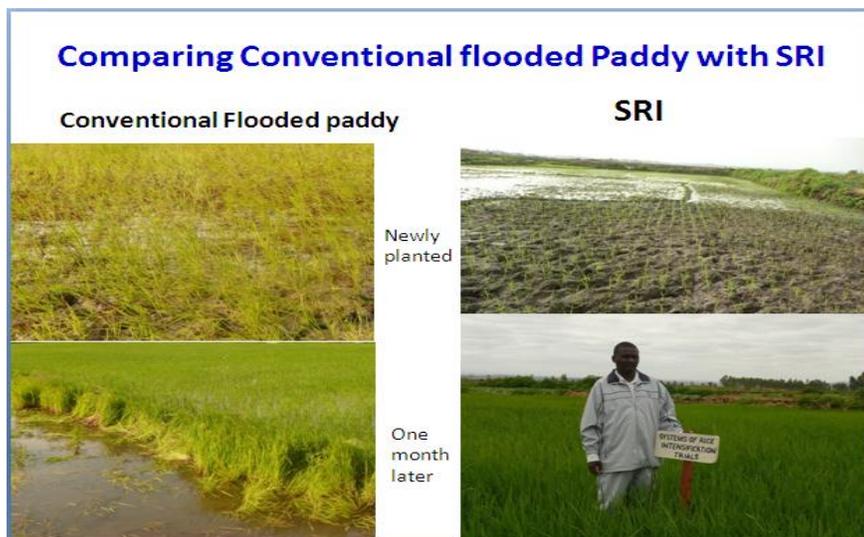


Figure 5: comparing conventional flooded paddy with SRI

1.1.4.1.5 To develop an alternative non-chemical novel tick control method.

This project (see figure 6) aimed at but not limited to validating the efficacy of a pheromone baited trap carrying a mixture of *Metarhizium anisopliae* and *Beauveria bassiana* in the control of *A. variegatum* in small scale farms in Mwala Division of Machakos District (RPE, 2011). This project is likely to require services of an IT specialist and engineer to design a more attractive trap for the purpose of commercialization. The distribution of the ticks getting attracted by the trap maybe modelled statistically. There is a possibility of using poison, binomial or use of Bayesian statistics. This is a project that would have benefited from an inclusion of a biometrician.



Figure 6: Pheromone baited trap

1.1.4.2 Current procedure of monitoring and evaluation at RPE

Data for monitoring and evaluation is collected using an M&E progress report form. The names of the innovator and collaborators are given followed by the title of the project. A brief summary of the project is the given together with the objectives of the research. Date of project commencement is given and the objectives accomplished so far. Time frame for accomplishing all objectives is given. Here the work plan and Gantt chart has to be attached. Amount of money allocated is the given and the amount utilized is given. Equipment bought is shown and if there are any conferences attended or workshops that has to report. Human capacity development showing number of PhD and MSc students sponsored is reported. Expected outputs of the projects are described briefly. The challenges and how the challenges have been addressed are reported too.

1.1.5 Training

Assessment of training was carried out at JKUAT and KTTC. At JKUAT use of Moodle in teaching an MSc course in research methods was evaluated, while at KTTC teaching of research and statistical methods courses were assessed.

1.1.5.1 Use of a Moodle in teaching MSc research methods

Moodle is a software package for producing Internet-based courses and web sites. It is a global development project designed to support a social constructionist framework of education (Moodle community, 2012). The word Moodle stands for Modular object-Oriented –Learning Environment. Moodle offers a very interactive learning environment due to enabled use of internet and websites which can be used to enhance teaching and learning. The Moodle website that was used in teaching the MSC course was hosted by University of Reading in collaboration with Regional University forum for strengthening agriculture (RUFORUM) and JKUAT. Some of the site pages are displayed in figures 7, 8 and 9



Figure 7: one of the Moodle pages used in research method's MSc course

At the beginning of the MSc research Methods course all students took an online course offered by University of Reading. The name of the course was Statistics Made Simple (see figure 7 for introduction page). The site had a question and answer forum and discussion news forum where students posted their research related questions. There was also a social forum for students and facilitators which was like a meeting place for a “cup of coffee” The facilitators would answer the questions on the Moodle site.



Figure 8: one of the Moodle pages that hosted “Statistics Made Simple course”

The discussion and learning forums were open to anyone who was registered as a participant in the Moodle site. Both the students and the facilitators were free to post topics of their choices and initiate discussions in these forums. See figure 9 for one of the discussion threads.

Discussion	Started by	Replies	Last post
Effective system for data and information storage	Maxwell Mkondiwa	3	Maxwell Mkondiwa Thu, 24 Feb 2011, 02:04 PM
RUFORUM- In Complete Breach of Our Contractual Agreement	Blessing Masamha	15	Washington Ochola Fri, 11 Feb 2011, 02:02 PM
What should I put in an R course?	Ric Coe	9	Ric Coe Thu, 3 Feb 2011, 08:26 PM
SUSAN conference June 2011	Roger Stern	0	Roger Stern Tue, 28 Dec 2010, 12:14 PM
update on attachments	Ric Coe	0	Ric Coe Thu, 11 Nov 2010, 07:56 AM
Msc Research Methods: What a course! so useful so relevant.	Nancy Waitherero Chege	3	Nancy Waitherero Chege Tue, 2 Nov 2010, 09:31 AM
this is significant	Ric Coe	1	Birhanu Mulugeta Yitayih Tue, 2 Nov 2010, 07:11 AM
Conception and design of research	Cosmas Mugambi Gitobu	3	Ric Coe Tue, 2 Nov 2010, 05:27 AM
GIS in Agriculture	Nancy Waitherero Chege	5	Enock Kangogo Kiplagat Thu, 14 Oct 2010, 05:19 PM
What about my sampling problem?	Ric Coe	21	Nancy Waitherero Chege Wed, 13 Oct 2010, 08:49 PM

Figure 9: one of the Moodle pages that hosted the discussion forum

1.1.5.2 Teaching of research and statistical methods

Research methods course is compulsory to all students pursuing a diploma in Technical education. This education course is offered to diploma holders enrolled in technical courses including but not limited to; electrical engineering, mechanical engineering, building and civil engineering, foods and beverages and secretarial courses. The technical teachers are expected to teach in the technical institutes after graduation. The course takes two terms to be completed.

The students had problems in developing researchable problems. This problem was solved by covering the topic on types of variables first and this helped the students to identify the dependent and the independent variables from their research topics. This enhanced the ability to do research in suggested topics by the students. The relationships between the variables were carefully illustrated on a power point presentation. Another problem observed was citing of references. Even after clear illustration of how different styles are used in citing references, majority of the students did not get it right. The students were given a lot of exercises to do some practice on citing documents. In data analysis, the students had major problems in understanding coding of data and developing a data matrix. Students were divided into small groups and explained the concepts during tutorials when learners were in small groups. Following is an example of a coding scheme and a matrix used to teach the students.

1.1.5.2.1 Data coding scheme

Example:

Suppose some of the questions included in a questionnaire are as shown below

Questionnaire item 1

What is your Gender?

Male

Female

Questionnaire item 2

What is your age group?

Less than 15 years

16-20 years

21-25 years

Over 25 years

Questionnaire item 3

Students' performance in Research methods

Excellent

Very good

Good

Fair

Poor

The students were shown how to code the variables shown above in order to organize the data and make analysis easier.

Table 1: An example of a coding scheme

	Description of variable	Variable code	Response code	Label codes	des
Var1	Gender of students	01	Male Female	1 2	Nominal
Var2	Age of students	02	Less than 15 yrs 16-20 yrs 21-25yrs 25yrs and above	1 2 3 4	Interval
Var 3	Students performance in RM	03	Poor Fair Good Very good excellent	1 2 3 4 5	ordinal

1.1.5.2.2 Data matrix

An appropriate data matrix for above scheme given to students was as shown in the table 2

Table 2: Data matrix

Units of analysis / Respondents	01	02	03	04	05	06	07	08
Respondent 1	1	3	4					
Respondent 2	2	2	4					
Respondent 3	2	2	4					
Respondent4	2	4	5					
Respondent 5	1	1	4					

To make an analysis of variable 1, a frequency table is drawn as shown in table 3.

Table 3: Analysis of students by gender

Gender of student	Frequency	Percent total
Male	3	60
Female	2	40
Total	5	100

Manual processing of the data was an essential skill in this course bearing in mind that this was a diploma level who may get posted to remote areas with no electricity to run computers and data analysis has to be done even in the absence of the computers, besides Computers may also be beyond the reach of many at this level.

1.1.6 Data analysis

Assortments of softwares were used in data analysis including SPSS, R and GenStat. Simple summaries and graphics were done in excel.

1.1.6.1 GenStat software

GenStat is a general statistics package that is particularly appropriate for agricultural research. It was originally developed by staff at Rothamsted Research Institute. This is the oldest agricultural Institute in the world and one where Fisher was their first statistician (GenStat, 2009). This institute has a long history of supporting statistical applications for agricultural research. In 2003, the developers of GenStat responded to requests from staff at the SSC (Reading), University of Nairobi and ICRAF to make a version of GenStat available free-or-charge to support improved (agricultural) research, particularly in Africa. The developers of the software agreed, and GenStat Discovery has been available ever since. It is for these reasons that this statistical software was chosen for use in this analysis. The software was freely available not to mention the friendly menus.

1.1.6.2 R software

R is open-source software which is free to use, distribute and modify under the open-source type license. The newest version of R and its documentation can be downloaded from <http://www.R-project.org>. R can be defined as an environment within which many classical techniques are implemented. A few of these techniques are built into the base R environment, but many are added as packages. It is a language with many functions for statistical analyses and graphics. To see the packages that are currently loaded into memory, one types in 'search ()'. Below are the 7 packages that are initially loaded.

```
[1] ".GlobalEnv"      "package:stats"  "package:graphics"  
[4] "package:grDevices" "package:utils"  "package:datasets"  
[7] "package:methods" "Autoloads"     "package:base"
```

If a package is not among the 7 loaded packages, e.g. 'nlme', this can be loaded using the menus (Package -> Load packages..). R was used in this to analyse data from KU

1.2 Statement of the problem

Biometric skills in Africa, the Caribbean and the Pacific (ACP countries) are inadequate (Riley, 1997). This has resulted in poor quality research, generation of non-representative research and subsequent rejection of research publications. This has had the implication of exclusion of the African scientists from the research debate at international forums. This situation can be worsened by issues including but not limited to, lack of guiding policies lack of assessing instruments used in, monitoring and evaluation of research or innovation activities, failure to use appropriate approaches to training and lack of understanding of certain procedures in data analysis. Previous studies have only made strong recommendations to encourage university departments of statistics to develop stronger links with research institutions.

No study has been carried out to assess policies, instruments used in monitoring and evaluation, approaches to training students in research methods and procedures used by students in data analysis in institutions of higher learning in Kenya. There is need to

identify and assess research and statistical related processes in institutions of higher learning so as to document challenges that may arise from these processes. This project aimed at assessing ways of formulating a policy document, evaluating some aspects of monitoring and evaluation instrument used by RPE, assessing some approaches to training in research methods and assessing certain procedures in data analysis. The assessment was carried out in three institutions of higher learning in Kenya.

1.3 Purpose

The purpose of this study was to assess research and statistical related processes in three institutions of higher learning in Kenya. The three institutions included JKUAT, KTTC and KU.

1.4 Specific objectives

- i. To assess a qualitative approach in developing content for innovation policy at RPE, JKUAT
- ii. To assess the distribution of innovation projects according to faculties and the adequacy of collaborators during monitoring and evaluation of innovation projects at RPE, JKUAT
- iii. To assess approaches to training in research and statistical methodologies at KTTC and JKUAT
- iv. To assess appropriate data analysis procedures using data from an MSc student attached to ASARECA project, KU

1.5 Research questions

- i. What are the critical issues that should be addressed by an innovation policy at RPE?
- ii. How many innovation projects have been proposed per Faculty since the initiation of innovation fund in 2007 and what are the collaborators' areas of expertise?
- iii. What are the challenges of teaching research and statistical methods using Moodle in teaching an MSc course in research methods at JKUAT and using conventional method at KTTC?

- iv. What appropriate procedures can be used to analyse data a from one of the MSc student attached to ASARECA projects based in KU?

1.6 Scope of the study

A total of four research related tasks were carried out .The first tasks was to assess how a qualitative approach could be used to gather information that would lead to developing content of a policy document to guide management of innovation projects at RPE division, JKUAT. The second was to assess some aspects of the instrument used in monitoring and evaluation of innovation projects at production department, RPE division, JKUAT. The third task involved Training. This was done in two folds, first an assessment of use of Moodle in teaching an MSc research methodology course at JKUAT. Another fold had to do with assessment of teaching of research and statistical methods at KTTC. Data analysis assessment carried out in KU was the fourth and final task of the study.

1.7 Significance of the tasks

Assessing the content that should be included in a project innovation document was important as the policy can be used to guide the management of innovation projects in production department. It was hoped that the policy would spell out the formulation and execution of the whole innovation process. Monitoring and evaluation of innovation projects is crucial as it provides feedback on what is going well or wrong during the implementation of innovation projects. It is important to assess the tools used to collect data for monitoring and evaluation purposes, in order to collect valid and reliable evaluation data. Many institutions are integrating ICT in their teaching programmes. There was need to assess a research methodology course which uses a Learning Management System (LMS), called Moodle in teaching research and statistical methods at JKUAT. The evaluation would help to bring out the challenges of using the LMS.

To enable accurate identification of challenges facing teaching of research and statistical methods, it was important to have the practice and do the actual teaching of the course and do an evaluation at the end of the course. Accurate data analysis is important as it

produces valid and reliable findings and there was need to assess the procedures used to analyse dataset from ASARECA, one of the projects based at, KU.

1.8 Justification for carrying out the tasks

There was an urgent need to formulate a policy document to guide the management of innovation projects in production department RPE division. Good policies are fundamental to progress in economic and social spheres (Corkery et al, 1995). Corkery also suggested that a policy framework is critical in performance of a firm. The production department at JKUAT is mandated to oversee innovation projects in the university with a budget of over 15 million shillings per year and hence the need to assess the procedures used in monitoring and evaluation of the innovation projects. Beside, a policy is likely to ensure participation by all departments equitably.

According to Odhiambo (2000), there is a need to popularize biometry and statistics at all levels of education and the community at large. It is for this reason that the training component of this study was carried out first at KTTC which is a middle level college, and not a university. Assessing use of Moodle was justified as many educationists have continually advised that educators should move away from making the teacher the centre of interest in learning but rather give the power to learn to the learners themselves. The Carnegie Forum task Force examining teaching as a profession in the USA put the challenge as “Students must be active learners busily engaged in the process of bringing new knowledge and ways of knowing to bear on a widening range of increasing difficult problems. The focus of schooling must shift from teaching to learning, from passive routines to active application of ideas to problems” (Carnegie Forum on Education and the economy, 1986) .Use of Moodle in teaching and learning helps to shift schooling from teaching to learning. The learner becomes the centre of interest. Moodle is very interactive and the student becomes an active rather than a passive participant. It was for this reason the assessment of how JKUAT was doing in areas of e-learning was assessed specifically where Moodle was used to teach an MSc course in research methodology.

Due to lack of exposure to large datasets during training (Stern, 2000), sometimes students get stuck in data analysis. There was need to demonstrate how one would get started in analysing such datasets. Observations on students analysing the ASARECA data showed that the procedure of making pivot tables, data explorations and checking of selected models are ignored. Checking statistical models ensures use of correct statistical tests and accurate result findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Assessment of research and statistical challenges in institutions of higher learning are crucial if any developments are to be achieved. This chapter looks at the current status of biometry in institutions of higher learning and some research institutions. The chapter ends with a summary of the reviewed literature

2.2 Current Status of Biometry Skills

According to Odhiambo, 2000, there is need to popularize biometry and statistics at all levels of education and the community at large. This will require more trained biometricians in the region. Keogh (2000) noted that trained biometricians were in short supply at the University of Zimbabwe and, consequently, unable to provide the needs for biometric support. This situation is the same in many other Universities in East and southern Africa (Riley 1998).

2.2.1 Status of computing facilities

Computing facilities are extremely weak with only a few lecturers having a computer in their office in Bunda College which is a constituent college of University of Malawi (Jonaz, 2000). He added that Mstat was the only statistical package available to undergraduate students; a few students had access to unlicensed copies of GenStat, SAS and SPSS. According to Sikosana(2000), most computer hardware in Matopos research station in Zimbabwe had been purchased through donor-funded projects, SAS, one of the statistical packages had long expired and there were no funds to renew the license. Sikosana further noted that research scientists and their research technicians needed training to update themselves with the latest statistical packages. They also required training in the design and analysis of on-farm experiments.

2.2.2 Biometry and institution management

Institutional management must be persuaded to recognise the importance of biometrics both in the maintenance of research quality and in the decision making process (Riley, 1997, 2000). Additionally, the management structure must encourage interdisciplinary studies to maintain funds for all scientists including biometricians. Riley continues to say this will require an understanding by the scientists and the biometricians of biometric methods for multi-component studies and skills development in this area.

2.2.3. Biometry and training

The purpose of training is to build capacity that addresses the knowledge and skill requirements in biometry (Ibrahim, 2000). Owing to poor previous training in statistics, sometimes students have to be separated to follow a less rigorous course (Akundabweni, 2000). On the other hand there appears to be the mistaken idea in many students' minds that the more complicated the experimental design the more impressive would be the thesis (Akundabweni, 2000). Most biometry courses in many universities are modular and vary from two to four lectures per week with three-hour weekly tutorials.

In a study conducted by Kenya Agricultural Research Institute (KARI) majority of the scientists working in KARI regard themselves as either poor or average in various aspects of biometry (Mwangi, at el, 2005). Akundabweni (2000) noted that students undertaking MSc degrees received a major shock at the end of year one when suddenly they found themselves thrust into the situation of applying what they had learnt for real. Biometric courses at most universities typically are inappropriate to modern research as they do not incorporate powerful, accurate computing exposure (Stern, 2000). Universities training in biometry are perceived to be too mathematical involving the learning of rigid formula. The way biometry is taught at the universities depends on syllabuses that were developed many years ago and based on mathematical statistics. This Material is no longer up to date, and appears complex and does not incorporate modern statistical computing (Stern, 2000).

2.2.4 Availability of trained Biometrician

According to Keogh (2000), biometricians are in short supply in SSA region and, consequently, unable to provide the needs for biometric support. Riley (2004), noted that the biometricians were so heavily overworked that they “had very limited time even to participate in surveys. They had no time available to complete questionnaires” this may complicate the situation in that the biometrician may lose the opportunity to bring out ideas on how they could be helped. It has also resulted to using junior staff to do the work of the biometrician leading to poorly analysed data that results into making decision based on wrong premises.

2.2.5 Biometric Skills and external linkages

Biometric skills and facilities may require a lot of funding which may be lacking in many universities. Insufficient contact with other biometricians and exposure to modern technology forums such as professional meetings, internet communication, does not allow the biometrician to keep up with what is happening in the modern times (Coe 2000). This may result to over reliance of old and obsolete ways of biometry which may be inaccurate and quite expensive. In-service biometric training courses provided by funding agencies are often too short, restricted in application and have little impact and lasting value unless they are supported by longer-term collaborative work with course presenters (Ibrahim, 2000). There is an urgent need for faculty staff to be educated in the benefits of correct biometric procedures in their research and in the dangers of amateur dabbling. A research network among biometricians, both practicing biometricians in research and lecturers teaching applied biometrics in universities in the region would be beneficial (Odhiambo, 2000). Many biometricians work in isolation (Keogh, 2000) and regular communication would help to bolster their confidence in the work they do and enable them to exchange experiences and ideas with others in the application of biometric methods. Organizational models that may be adopted for this purpose are, for example, the International Clinical Epidemiology Network (INCLRN) that holds regular research workshops, with the Royal Statistical Society in the UK (Janssen, 2000).

2.2.6 Biometric ability

According to Janssen (2001), a well-trained biometrician should be able to: provide statistical expertise so that the experiment is correctly designed, advise project teams on the statistical elements of the experiment/study (selection of relevant biological/medical parameters) produce summary statistics, analyses and reports and give a professional interpretation of the results of the statistical analyses.

2.3 Participation in research

Internship provides a learning opportunity for an intern. Effective learning occurs when there is genuine participation and interaction between the intern and the host institution. Allan (1992) identifies six critical issues that make participatory learning effective. There should be transparency, access to information, accountability, comprehensiveness and non alienation. Participation itself describes both an act and, as Oakley (1991) says, an umbrella term for a supposedly new style of research and development intervention. It can also be viewed as a desired end point related to the degree of involvement in decision-making. Oakley and Marsden (1984) described a continuum of participation which spreads from collaboration to empowerment.

2.3.1 Policy formulation

Policies are often made on the basis of perception, stored conventional wisdom, and attitudes of particular interest groups or bureaucratic interests, to which some partial technical analysis and information, whenever available, are added in the form of a brief technical memorandum (Cockerly, Land and Bossyut, 1995). According to World Bank, 2011, identifies the following stages in policy formulation; problem identification, search for causes of problem(s), fact gathering and analysis including linkages with other policy areas, identification of options to address problems, process of choice of preferred policy option, specification of policy objectives, design of implementation strategies, process of policy decision making, existence and use of monitoring and feedback mechanisms, policy review and reformulation and a desirable background information.

2.4 Monitoring and evaluation

Monitoring is the periodic oversight of the implementation of an activity which seeks to establish the extent to which input deliveries, work schedules, other required actions and targeted outputs are proceeding according to plan, so that timely action can be taken to correct deficiencies detected. "Monitoring" is also useful for the systematic checking on a condition or set of conditions, such as following the situation of projects. Monitoring can also be said to be a management function which uses a methodical collection of data to determine whether the material and financial resources are sufficient, whether the people in charge have the necessary technical and personal qualifications, whether activities conform to work plans, and whether the work plan has been achieved and had produced the original objectives

Evaluation on the other hand, is a process which attempts to determine as systematically and objectively as possible the relevance, effectiveness, efficiency and impact of activities in the light of specified objectives. It is a learning and action-oriented management tool and organizational process for improving current activities and future planning, programming and decision-making.

2.5 Training

Gibbs (1991) says that “pre-occupation with teaching has..... actually constrained the effectiveness of higher education and limited its abilities to meet society’s demands....we might say that we are now beginning to perceive that the purpose of education is learning”. And we are beginning to realise that frequently teaching interferes with learning. Teaching frequently relies on lecturing and structured practical sessions. Yet there is no simple relationship between what is taught and what is learnt. Meaning cannot be simply transferred to students in lecture there is simply too little scope for the negotiation and construction of meaning (Gibbs, 1989).

2.6 Data analysis

In the same way it takes time to design and to carry out a good experiment, it also takes time to conduct a good data analysis (Rege, 2003). The first issue is data entry to the computer and ensuring it is in a suitable format for analysis. The data may have to be

summarized to the "right" level, e.g. plant height to mean height per plot, or transformed, for example from kgs/plot to tons/ha. This can be done in the statistics package or in the database environment e.g. Access or Excel, which was used for the data entry.

2.6.1 Preliminary analysis

Objectives of the analysis are clearly specified before the commencement of the actual data analysis. This is followed by understanding of the variability in the data. Preliminary analysis is then carried out which aid at observing the patterns of the data and may require some descriptive statistics (Statistical Service Centre, 2001). Analysis of Variance can be used as a descriptive tool to explore the treatment structure further, and to do statistical inference. The next step would be to fit statistical models. A few complications may arise during data analysis if the data is in multiple levels and repeated measures.

2.6.1.1 Pivot tables

Pivot tables can be used to summarize, analyze, explore and present data. Pivot tables can be used to summarize or cross tabulate data into tables of one, two or three dimensions they can also be modified interactively, offer a range of summary statistics and lastly can be used to summarise data from various sources (Statistical Service Centre, 2002).

2.6.2 Statistical inference

This is where population parameters are estimated from sample statistics. This has to be done at a certain level of confidence (CI) is confidence interval. The standard Error of the mean must also be given. Statistical methods should be used to test for hypothesis. There are two types of hypothesis, null hypothesis (there is no difference) and alternative hypothesis (question explored by investigator). The null hypothesis is the basis for hypothesis testing (Coe et al, 2000). It is also important to understand the meaning of P-value. The smaller the p-value, the more unlikely the null hypothesis seems an explanation for the data, for instance, a p-value of 0.005% meaning there are only 5 chances in 1000 that result termed "significant" could occur by chance alone (Coe and Franzel, 2000). Table 2.1 shows various parametric tests that may be performed in case the analysis required dictates so.

Table 4: Summary of statistical tests

Parametric test	Null hypotheses /Research question
One group	There is no difference between sample mean and population mean (t-test)
Two unrelated groups t-test (Pooled t test)	Whether the group significantly differ from each other statistically
One –way ANOVA	Comparison of means from k unrelated groups
Two way ANOVA	Comparison of means for k related variables
Multiple comparison	Used when the null hypotheses is rejected and want assess which pairs of means differ for all possible pairs

In multiple comparisons of means several techniques can be used. Pair wise technique is used when group sizes are equal in which case we use Tukey test (Coe *et al*, 2001). If there are unequal group sizes, Tukey- Kramer or Scheffé test is used. Pair wise technique cannot be used if there is a control in which case we use Dunnet. If planned, we use Borniferroni and if not planned, Scheffé. Least significant difference can also be used

$$L.S.D = t \left(\frac{\alpha}{2}, nt - t, s_2 \right) \text{ and } S = \sqrt{MSE \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

n_1 and n_2 are the number of observations in the treatments being compared. If the absolute value of the difference between two treatment means is equal or larger than L.S.D then the difference between the two is considered significant (Coe, et al, 2000).

2.6.3 Statistical modeling

Statistical modelling is an approach to statistical data analysis that helps scientists to discover something about a phenomenon that is assumed to exist (Baker, et al, 2003). The purpose of this approach is to help identify patterns in data and to explain variability found in the data set. Modeling is a unifying process that brings together the estimation process and hypothesis tests under one umbrella (Nguti and Wangechi, 2003). Depending on the study objectives, modeling approach constructs a summary model that represents current knowledge (Anon., 2003).

CHAPTER THREE

PROJECT APPROACH

3.1 Introduction

This chapter describes approaches used to achieve specific objectives highlighted in chapter one. They include approaches to; assessing a qualitative method in developing content for an innovation policy document at RPE, JKUAT, assess the distribution of innovation projects according to faculties and the adequacy of collaborators during monitoring and evaluation of innovation projects at RPE, JKUAT, assess use of Moodle learning Management system in teaching MSc Research methodology course (JKUAT), to assess training in research and statistical methods, KTTC and finally to assess data analysis procedures used by an MSc students attached to ASARECA project, KU.

3.2 Approach to content development of an innovation policy at RPE division, JKUAT

Two people from production department (regarded as key informants in this study) were interviewed. They were in charge of these projects and therefore conversant with day to day overseeing of the projects. An open ended interview schedule, (see appendix one), was used to collect qualitative or textual data from the key informants. Qualitative data can often add insights and explanations that are hard to capture in quantitative or numerical data (Kay and Coe, 2009). The aim was to gather information on important content that would be included in the project innovation policy.

3.2.1 Approach to qualitative data analysis

The textual data collected from the interview were analysed by evaluating, classifying, and summarizing of the responses. First a thorough reading of the responses was made and certain themes were isolated. This was followed by data reduction, data display and conclusion drawing or verification.

3.3 Approach to assessment of monitoring and evaluation

Monitoring can be defined as a management function which uses a methodical collection of data to determine whether the material and financial resources are sufficient, whether the people in charge have the necessary technical and personal qualifications, whether activities conform to work plans, and whether the work plan has been achieved and had produced the original objectives (UNICEF, 2002). To assess the adequacy of expertise among the project collaborators, a sample of 30 proposed projects was selected randomly through balloting. A list was prepared in excel showing number of project proposed from each faculty in the University. The results were then summarised in excel. In the same way the Collaborators' areas of expertise were summarised in excel.

3.4 Approach to training

Two aspects of training were evaluated the first one involved assessment of use of Moodle in teaching research and statistical methods in an MSc research methodology course at JKUAT. Data was collected using an observation profoma (See appendix II for the observation profoma) and analysed using SPSS. A complete paper on use of Moodle was written and the paper accepted for oral presentation at SUSAN conference in Botswana (see the abstract and invitation letter in appendix III and IV respectively). The full text of the paper can be found in the dissertation CD. The second training component of this study was conducted at KTTC, where students were taught research and statistical methods and the course evaluated at the end of the two terms allocated to the course unit. The course was evaluated through an evaluation questionnaire (See appendix V the for evaluation questionnaire).

3.3.1.1: Approach to evaluation

Stratified sampling technique was used to select students from mechanical, electrical, Computer, and business studies. The population of the students was 86 students from which a sample of 44 students was selected. Table 5 shows the population of students and the size of the samples drawn from every department.

Table 5: Accessible Population of the students evaluated at KTTC

Department	Population	sample
Mechanical engineering	36	18
Electrical engineering	18	9
Computer studies	23	13
Business studies	9	4
Total	86	44

3.5 Approach to data analysis

The dataset used for the analysis was obtained from one of the MSC students attached to the ASARECA project KU. Maize was grown using thirteen different soil fertility technologies. There were four replicates for each treatment. Among the measurements taken included maize yields, weight of cobs, weight of strove, moisture content of the harvested maize and sizes of the plots.. Three research questions were established to aid in the analysis of the data. Pivot tables were prepared first followed by descriptive statistics to explore the data. ANOVA was then carried out to check on the adequacy of the operations of the previous steps and for adding precision to the findings of the exploratory analysis.

3.5.1 Understanding variability

The variability observed in the data was due to soil treatments and the blocks. There was also plot to plot variability. This analysis was concerned with explaining the variability in the data, and determining whether treatment effects are larger than expected random variability.

3.5.2 Preliminary analysis

To create a PivotTable, the MicrosoftTM excel for statistics procedure was adapted .Care was taken to ensure that data were in **list (database)** format -records (cases) as rows, fields as columns, first row with field names and no gaps between rows. To create a PivotTable for data in a list, a click was made on one of the cells in either the list or

database. Another click was made on **PivotTable Report** in the **Data** menu PivotTable wizard's instructions were then followed. At the first step **Microsoft Excel list or database was chosen**, followed by **Next >**

Step 2 looked like this ...

The data range was confirmed by clicking **Next >**



Figure 10: Pivot table wizard

In order to identify this data easily a name was chosen and given to this range of data

In the next dialog, the **Layout** tab was pressed, which is the main step for designing the pivot table.

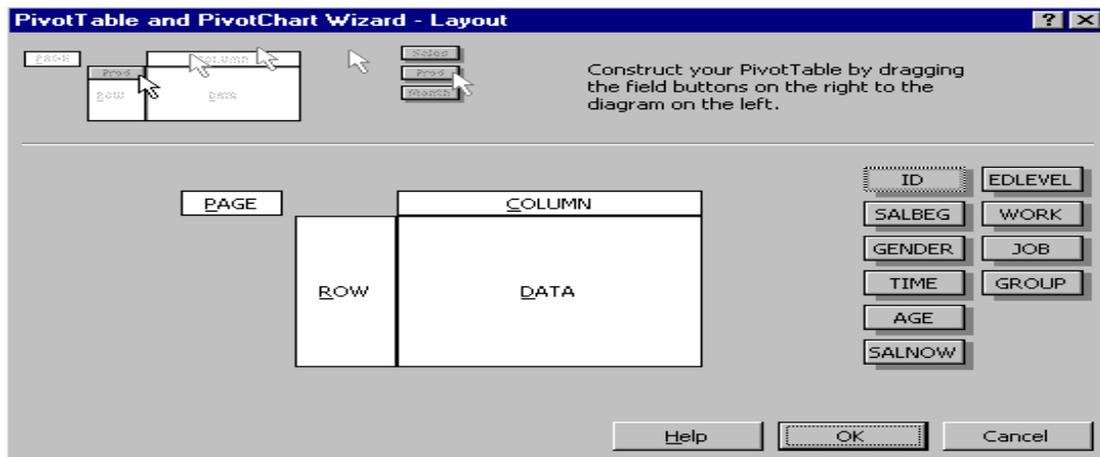


Figure 11: Pivot table layouts

The field names appeared as a set of buttons on the right. The mouse was used to drag the names into place on the table layout. A PivotTable can be structured into one, two or three dimensions and these are arranged in rows, columns and pages. The fields used for defining the table structure were dragged into the *ROW*, *COLUMN* and *PAGE* spaces.

The fields used for defining structure should normally be factors, i.e. discrete, categorical variables (numeric, character or other types). Using a measurement variable could produce a large table of nonsense. The body of the table, labelled *DATA*, contains the Variable to be summarised in the table. The data fields will usually be numeric, but other data types can be allowed, depending is to be summarised.

Analysis began with use of pivot tables, a data summarization tool found in data visualization programs. It helped to automatically sort, count, total or give the average of the data stored in one table or spread sheet. Results were displayed in a second table (called a "pivot table") showing the summarized data. Changes in the summary structure were set up by dragging and dropping fields graphically.

3.5.3 Approach to statistical modeling

Data were imported fro excel using GenStat and R. Hypotheses were tested at 5% level of significance i.e. 95% confidence level, ($P \leq 0.001$). Models were fitted after estimation of parameters from a regression analysis and their residuals.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This study was guided by the following objectives:

4.1 Specific objectives guiding the study

- i. To assess a qualitative approach in developing content for innovation policy at RPE, JKUAT
- ii. To assess the distribution of innovation projects according to faculties and the adequacy of collaborators during monitoring and evaluation of innovation projects at RPE, JKUAT
- iii. To assess training by evaluating use of Moodle learning Management system in teaching MSc Research methodology course at JKUAT and evaluate teaching of research and statistical methods at KTTC.
- iv. To assess data analysis procedures used by an MSc students Attached to ASARECA project, KU

4.2 Qualitative approach in developing content for innovation policy

Objective one: to assess a qualitative approach in developing content for innovation policy at RPE, JKUAT; Table 4.1 shows the qualitative data collected from the key informants. This data was summarized from an interview schedule (see appendix D), displayed, reduced and interpreted to develop innovation policy content. A complete innovation policy developed using this approach can be obtained from to the dissertation CD.

4.2.1 Data display

Table 6: Transcribed textual data Respondent No (Responses)

1.	The problem is that there is no policy to guide innovation projects
2.	Some of the words used in project innovations should be defined so that all stakeholders share the same meaning. Words like project execution, innovation fund, project innovator, project collaborator, innovation, proposal reviewer, project dissemination, innovation commercialization, project monitoring and project evaluation
3.	It is important to link these innovations with the vision and mission of the university at large.
4.	It is hard to say what exactly is required of these innovations. The roles of various interested parties are not defined.
5.	Sometimes we get stuck in management of these projects and we do not know whether it is the university's responsibility to carry out some activities or our department.
6.	There is no established office for project innovations.
7.	We need a document that will specify the limits we can get to as we go about our duties
8.	We need a written document specifying the ownership of various innovations.
9.	To be honest, I do not know how publications on these innovations can be kept in confidence there is nothing binding legally.
10.	We need something that can deal with disclosure of information, commercialization, development of innovations, conflict of interest, and application for funding,
11.	We have some problems in determining how monitoring and evaluation should be done. Should it be in the field or in a workshop set up?
12.	We need guidance on monitoring and evaluation of the project innovations and criteria for fund application.
13.	We need some governing laws and regulations
14.	As innovations become bigger and requiring huge funding there is need to have ways of exemption review of the policy and amendments.
15.	A section should deal with how agreements concerning the innovations should be conducted
16.	Dispute resolution spelt out in the management of innovation projects is necessary.
17.	Some of the innovation ideas are not completely new but have been borrowed fro our traditions and we need a guideline on how to deal with such.
18.	There should be an agreement between the innovator and JKUAT in the first schedule.

4.2.2 Data reduction stage

The statements in table 6 are responses obtained from key informants in production department. The aim of the interview was to formulate objectives of innovation projects

policy. Table 7 shows how the responses were categorized into various themes. The responses were categorized depending on whether the issue was to be a policy objective or an item to inform the users of the policy.

Table 7: Data reduction (categorization)

OBJECTIVES	4, 8,9,10,11,12,13, 14,15,
INFORMATION TO USERS	2,3,5, 6,16,17
SCHEDULE	18

4.2.3 Data interpretation

The content of the policy was then put into various sections. In this case eleven sections were found to be adequate. The following sections were included as preliminaries of the policy. JKUAT’s mission, vision, definition of terms commonly used in innovation projects. Section II was a list of abbreviations and acronyms to ease communication among all the stakeholders of the policy.

The key informants revealed that they needed to have the picture of how the innovations fitted in the University at large, hence the inclusion of the preliminaries. Section III was a brief introduction of the policy that gives some background information of JKUAT and how the mandate of innovations fits in its mission and vision. The vision, mission and the motto of JKUAT was repeated in section IV, V, and VI respectively for emphasis. The functions and objectives, of JKUAT are displayed in section VII of the policy document. The objectives of the innovation policy come in section VIII of the document. University’s responsibility under the innovation policy is in section IX.

One of the concerns of the key informants interviewed is that there was no innovation office. To ensure establishment of the said office there was need to inscribe specification of the holders of the office and if there are co-opted members, that too had to be included. Enhance administrative affairs of the innovations in the university. This will identify policies were derived from the key informants interview responses. The responses are displayed in table 4.1. The information given by the key informants helped to derive the

following objectives for the policy document. Each of the objectives was used to inform the other sections of the policy, the sections included:

- ❖ The scope of the policy was also identified
- ❖ Ownership of innovated product/technologies or processes
- ❖ Funding of innovation projects
- ❖ Marketing of innovated product /technologies or processes
- ❖ Execution of innovation projects
- ❖ Royalty distribution
- ❖ Implementation
- ❖ Governing laws and regulations
- ❖ Exemption, Review and amendments
- ❖ Innovated project agreements
- ❖ Use of University's name
- ❖ Dispute resolution
- ❖ Traditional knowledge and folklore
- ❖ First schedule Jomo Kenyatta University of agriculture and technology

4.2.4 Discussion on process of policy development

The qualitative data collected above is expected. For instance every department at the university would like to harmonise its activities to be in line with the cooperate institution i.e. JKUAT. Any innovator would want to know if his project will be funded, how he can commercialize the innovation, how his innovation will be protected. These issues emerged from the qualitative data.

4.3 Assessment of distribution of innovations according to field of applications and adequacy of collaborators

Objective two: To assess the distribution of innovation projects according to field of applications and the adequacy of collaborators during monitoring and evaluation of innovation projects at RPE, JKUAT

Innovation projects were drawn from various academic faculties of JKUAT. The results displayed in table 8 is an analysis of data collected from all the proposal sent to RPE requesting for funding of various innovations. The data includes the projects that qualified for funding and those that did not qualify. This meant there was some effort from the departments to be innovative.

4.3.1 Projects' field of application

Table 8: Frequency distribution of number of projects per faculty

Faculty	No. of projects	% No. of projects
Agriculture	13	43
Engineering	8	27
Science	6	20
ICSIT	2	7
Human resource development	1	3
Total	30	100

43% of the innovation projects were from agriculture faculty. This was followed by engineering projects which had a percentage of 27%. The faculty that produced the least innovations was human resource department. ICSIT had only two projects out of the 30 proposed projects.

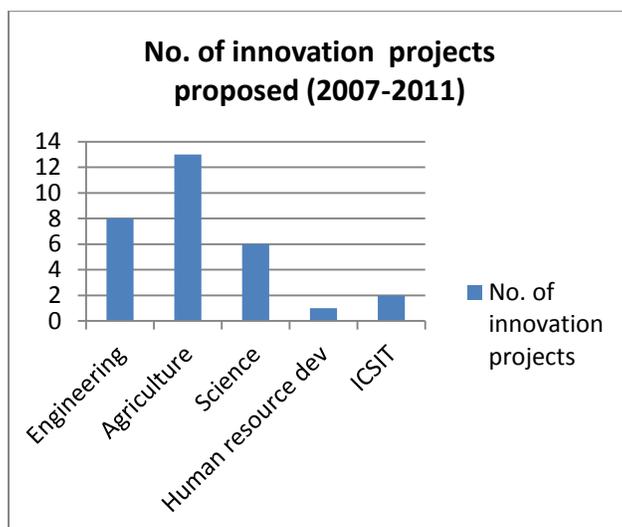


Figure 12: Graphical representation of the number of projects per faculty

4.3.2 Adequacy of collaborators

Table 9 shows the number collaborators per areas of expertise. It can be noted that most of the project innovators did not include a biometrician or a research methods professional. This was 0% of the total 100%. ICSIT had a percentage of 0% too, while in the area of entrepreneurship the percentage was 5%.

Table 9: showing areas of expertise for the collaborators

Area of expertise	Collaborators	%
Agriculture	16	43
Engineering	8	22
Science	8	22
Human resource dev	2	5
ICSIT	0	0
Biometry/RM professional/Statistician	0	0
entrepreneurs	2	5
others	1	3
Total	37	100

Figure 13 shows areas of expertise of selected collaborators. On the basis of their fields of expertise, most of the collaborators had expertise in Agriculture. This was followed by engineering and sciences.

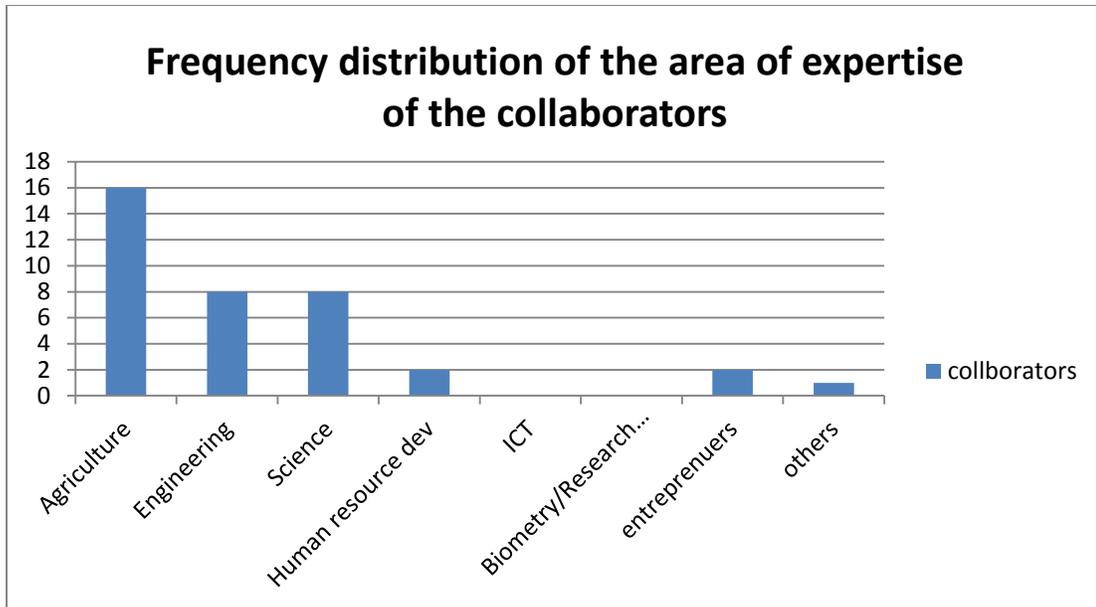


Figure 13: Graphical representation of the number of collaborators per areas of expertise

4.3.3 Discussion on field of application and adequacy of collaborators

Majority of the innovation projects were agricultural based followed by engineering projects. This is expected owing to the mandate of the university as the name suggest, this is a university of agriculture and Technology. There were very few innovations from information and communication institute of technology. This is contrary to what is expected as JKUAT is known for producing highly qualified students in the area of information and technology.

It is also important to note that most innovators selected collaborators from other fields. It also was worth noting that no innovator included a biometrician or a research methods professional despite their objectives pointing out to a need of expertise in data analysis. No economist was included which is not expected because the goal of innovation was to commercialise the innovation, meaning a cost-benefit analysis and econometrics modeling would be essential and this would require the services of an economist and an entrepreneur.

4.4: Assessment of training

Objective three: To assess training by evaluating use of Moodle learning Management system in teaching MSc Research Methodology course at JKUAT and evaluate teaching of research and statistical methods at KTTC

Analysis of data from the observation profoma used to collect data from SSC, Moodle site was done by first feeding the data in SPSS. The data were checked first and then analysed as shown in section 4.3.1 and 4.3.2

4.4.1 Evaluating use of Moodle in teaching MSc research methodology course at JKUAT

The learning forums were rated depending on whether they were busy or not on a continuum scale of five. The mean score was 2.27, which is well below the average the results are displayed in table 10.

Table 10: Rating of the learning forums on Moodle

Rating of learning forums	N	Min	max	mean	Std Dev
	15	1	1	2.27	1.67

The rating of the learning forums was poor, about two out of a possible maximum of 5.

Table 11: Reporting of students' grades on Moodle

Students grades uploaded	Frequency	Percent
Yes	6	40
No	9	60
Total	15	100

60 % of the facilitators did not report the students' grades on the Moodle site as was agreed initially. However 40% of the facilitators were able to upload the grades and comments of the students' performance.

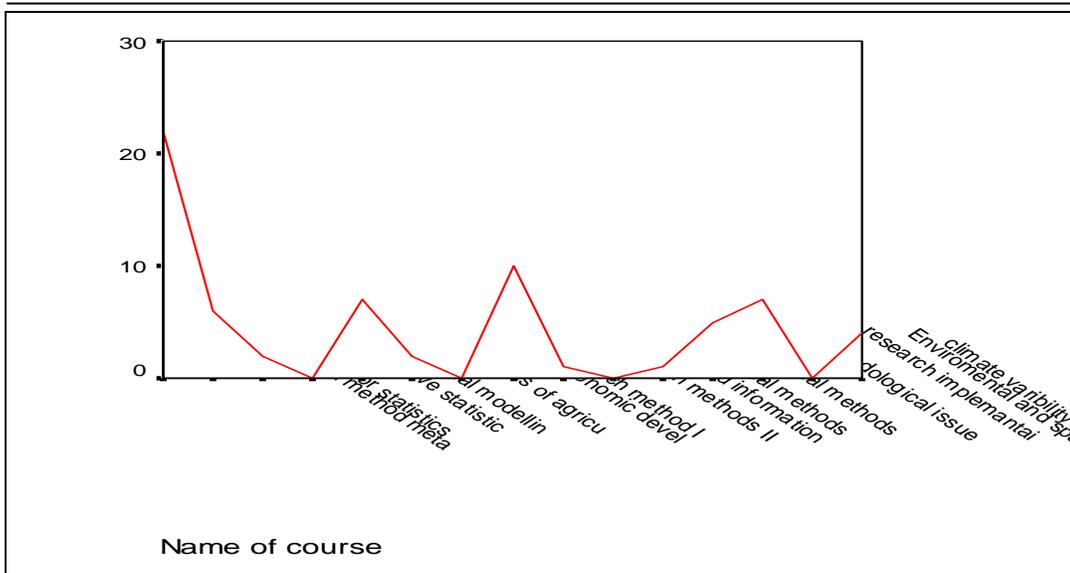


Figure 14: Number of discussion forums per course module

Most of the discussion forums were not active with majority posting zero discussions, e.g. statistical modelling, research methods I, statistical methods II, Environmental and spatial statistics. The most active site page was research methods Meta course which posted over 22 different discussion topics which were responded to by over 89 participants

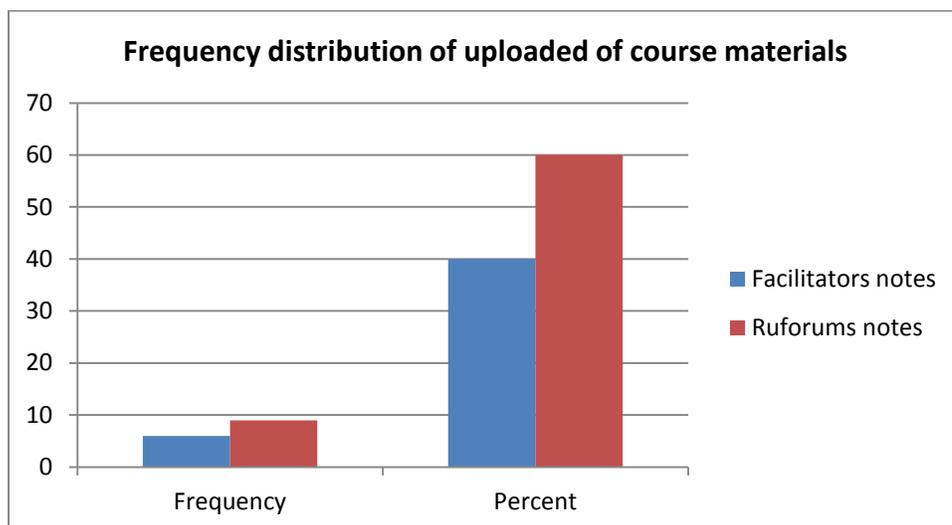


Figure 15: Frequency distribution of uploaded course materials

Most of the materials uploaded were from the RUFORUM CD. Majority of the facilitators did not prepare their own course material to be uploaded in the site preferring

instead to use the ready made course materials from the sponsor of the MSc course, RUFORUM.

4.4.1.1 Discussion on use of Moodle on teaching an MSc course

Majority of the facilitators did not post their own materials on Moodle. This was not expected as they had all been given the skills of uploading documents during a Retooling workshop organized at the beginning of the course. It was also expected that feedback for the assignments given would be posted on Moodle however 40% of the facilitators did not do it.

4.4.2 Assessment of training in research and statistical methods at KTTC

Figure 4.1 shows the responses obtained from the students after an evaluation was carried out on research and statistical course unit at KTTC. The data is already keyed in SPSS ready for analysis. There was checking of the data for any mistake, missing values and other errors that may have been entered.

	q4	q5	q6	q7	q8
1	too much	not as 4	not as 5	very goo	not as 5
2	too much	not as 3	not as 5	very goo	very clear
3	more than4	too difficult	not as 5	very goo	not as 5
4	more than4	not as 5	not as 5	very goo	very clear
5	more tha 5	not as 4	yes always	very goo	very clear
6	too much	too easy	yes always	very goo	very clear
7	too much	too difficult	yes always	very goo	very clear
8	more than4	not as 5	yes always	very goo	very clear
9	too much	too easy	yes always	not as g	very clear
10	more tha 4	not as 4	not as 5	not as g	very clear
11	too much	not as 3	not as 5	not as g	very clear
12	too much	too easy	not as 5	not as g	very clear
13	more than4	too easy	not as 4	not as g	very clear
14	more than4	not as 3	not as 5	not as g	very clear
15	more than4	too easy	not as 4	not as g	very clear
16	too much	too easy	not as 3	not as g	not as 4
17	more tha 4	not as 4	no seldom	not as g	not as 4
18	more tha 4	not as 3	not as 5	not as g	not as 4
19	more tha 5	too easy	yes always	not as g	not as 5
20	too much	not as 4	yes always	very goo	very clear
21	too much	not as 3	yes always	very goo	very clear
22	too much	not as 4	yes always	very goo	very clear
23	more than4	not as 4	yes always	very goo	very clear
24	more tha 5	too difficult	yes always	very goo	very clear
25	too much	not as 4	yes always	very goo	very clear
26	more than4	not as 3	yes always	very goo	very clear
27	too much	not as 4	yes always	not as g	very clear
28	too much	too easy	yes always	very goo	very clear
29	too much	too easy	yes always	very goo	very clear
30	too much	too easy	yes always	not as g	very clear
31	too much	too easy	yes always	not as g	very clear

Figure 16: Course evaluation dataset (already keyed in SPSS)

Checking of the data was then followed by analysis. Table 4.5 shows students frequency distribution by departments.

4.4.2.1 Distribution of students by Departments

Table 11: Frequency distribution of students by departments

Department	N	Frequency	Percentage
Mechanical engineering	44	18	40.9
Electrical engineering	44	9	20.5
Computer studies	44	13	29.5
Secretarial	44	4	9.1
Total	44	44	100

Majority of the students in this study came from Mechanical Engineering department (40.9%). There were very few secretarial students (9.1 %). Computer and electrical departments had percentages of 29.5% and 20.5 % respectively.

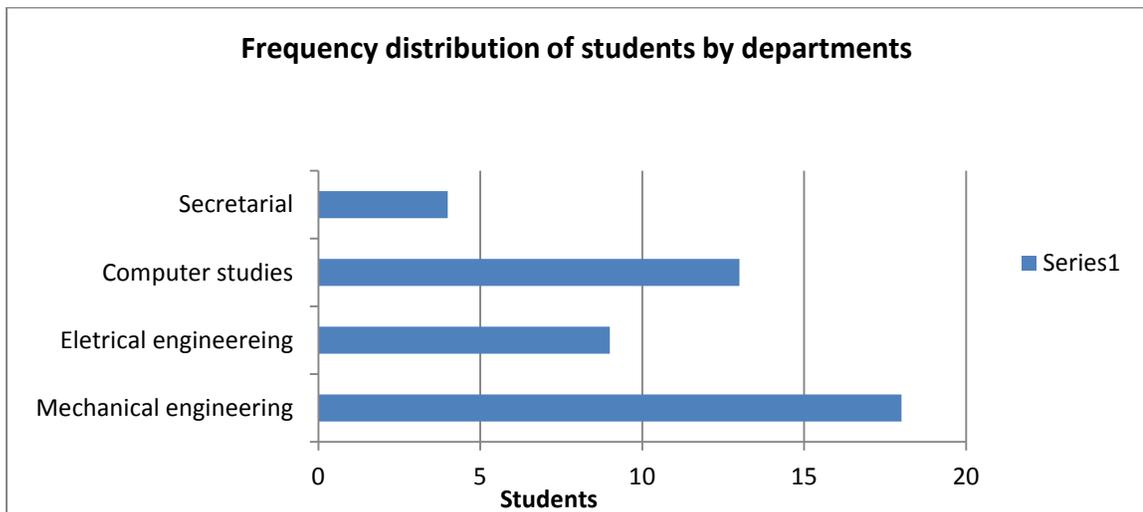


Figure 17: Graphical representation of students sampled per department

4.4.2.2.1 Discussion

Popularity in secretarial course is on the decline owing to the computer technology that is now replacing the old type writer technology. This may explain why there were very few students taking secretarial course. Most male students undertook Engineering courses. These results are therefore expected.

4.3.2.2 Distribution of students by Gender

Majority of students were males (73%). The females made a mere percent of 27%. This is expected in most technical institutions. Majority of the students are usually males especially when considering engineering courses. All the secretarial candidates included in this study were females. This is expected.

Table 12: Frequency distribution by gender

Gender	Frequency	Percent
Male	32	72.7
Female	12	27.3
Total	44	100

A graphical representation of the distribution of students by gender is shown in figure 18. The figure shows that there were more males than females taking the course evaluated in this study.

Gender

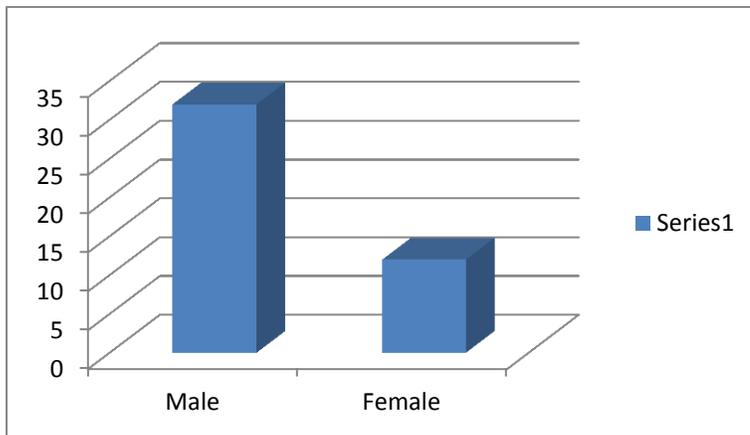


Figure 18: Graphical representation of male and female frequency distribution

4.4.2.3. Evaluation of course content

The mean score of course content was about 3.00 out of a maximum value of 5. This translates to 60% score. Coherent progression of the course scored 85% while amount of material covered scored 1.64 which translates into 32.5%. In which case a measure of 100% shows the material covered was too little and a measure of 1% shows the material

covered was too much. A score of 32, 5 then indicate that the material covered tended to be closer to “too much” than to “too little”. The results are displayed in table 13.

Table 13: Mean scores for course content elements

Course content aspects	N	Mean	STD Dev
Coherent progression of the course	44	4.25	1.1
Prior knowledge assumed	44	3.00	2.00
Degree of difficulty	44	3.09	1.55
Amount of material covered	44	1.64	1.00
Grand mean	44	3.00	1.37

4.4.2.4 Evaluation of course organization

Most of the course organization aspects were scored highly by the students. For instance majority of the student felt that the objectives of the course were stated clearly with a score of 85%. Quality of the course outline scored highly too, with a mean of 4.18 which translates to 83.5%.The element the scored the least in this category was organization of course activities which had a percentage of 78.6% which is quite high also. Table 14 displays these results.

Table 14: Mean scores for course organization elements

Aspects of organization	N	Mean	STD Dev
Statement of course objectives	44	4.25	1.14
Quality of course outline	44	4.18	1.14
Course expectations	44	4.18	1.14
Organization of course activities	44	3.93	1.20
Grand Mean	44	4.15	1.16

4.4.2.5 Evaluation of teaching and learning support

Majority of the student felt the teaching staff was very helpful and gave it a score of high score of 90%.. It is also worth noting that the interest developed after the course was taught was and that was scored at 89%, with a mean of 4.45. The usefulness of the course materials did not score as high as the other. In fact under this category this element of

teaching and learning support was scored the least. Table 15 shows the results of the analysis.

Table 15: Mean scores for teaching and learning support elements

Aspects of Teaching & learning support	N	Mean	STD Dev
Helpfulness of teaching staff	44	4.52	0.95
Interest in the subject after course	44	4.45	0.82
Feedback on progress	44	4.43	0.82
Clarity of presentation	44	4.16	1.07
Usefulness of course material	44	3.73	1.42
Availability of course materials	44	1.66	0.74
Grand mean	44	3.83	0.97

4.4.2.6 Evaluation on overall course evaluation

The Overall organizational rate was scored highly by the students. This was followed by the overall rating of the course. Overall teaching quality was scored the lowest in this category with a mean of 3.82 which translate into 76.4%. The results are displayed in table 16.

Table 16: mean scores for overall rating of the course

Overall course evaluation	N	Mean	STD Dev
Overall organization rate	44	4.25	1.10
Overall course content rate	44	4.20	0.88
Overall of course rate	44	4.09	1.07
Overall teaching quality rate	44	3.82	0.97
Grand mean	44	4.09	1.06

4.3.3 Discussion on teaching of research and statistical methods at KTTC

The ratings presented above are expected in KTTC. This is an institution that is very organized in as organization of the courses is concerned. The students are provided with a well structured course outline in week one of the term. The course outline shows what the

students expect to cover during block lecture and what to expect in the tutorials. Every topic in the block lecture is taken by the best lecturer in college in the area. A total of seven lecturers divide the research and statistical methods content among themselves. During tutorials the individual classes are allocated to the seven lecturers. The tutorials are following up of what is covered in the block. Tutorials are more interactive and conducted mostly through group discussions rather than the traditional lecture method. The poor rating of the course materials maybe attributed to the fact that there are few resource materials in research and statistical methods produced specially for the diploma students. The text books in the library are either too advanced for this group of people or are too mathematical which discourages most students. It is for this reason that the intern wrote two guides one is statistical methods and the other in research methods. (See the cover page of the guides in appendix IV, the full text of the guide can be found in dissertation CD).

The best features of the course were identified as ICT integration during the teaching of the research and statistical methods. The structuring of the course, in which the topic at hand was introduced to the students during block lectures followed by more interactive tutorials where students were put in small groups and concepts not understood during block lectures clarified, was also rated very highly.

Among the features rated poorly by the students included lack of simplified reference materials including books, periodicals and manuals in research and statistical methods. Two research guides (see appendix VI for the cover pages) were prepared for the students, one in research methods and the other in statistical methods. The full texts of these guides can be obtained from the dissertation CD. The findings revealed that those students, who did not have a good background in mathematics, did not enjoy statistical methods. This was expected because statistical methods course unit required some basic understanding of mathematics especially in hypothesis testing.

4.5 Assessment of dataset from KU

Objective four: To assess possible ways of analyzing one of the datasets from ASARECA project based in KU

4.5.1 Effects of different soil technologies on maize yields

The overall objective of this study was to assess the effect of different soil technologies on maize yield. A complete randomized block design was used with four replications for each treatment used in this experiment. The field trials were conducted on-station during the crop season 2009 July. A total of thirteen treatment factors namely Cattle manure (60Kg N per ha), Manure + fertilizer (30Kg N per ha from manure and 30Kg N per ha from fertilizer) , Inorganic fertilizer (60Kg N per ha), Inorganic fertilizer (90Kg N per ha) Tithonia diversifolia (60 Kg N per ha), Tithonia diversifolia (30 Kg N per ha from tithonia and 30Kg N per ha from fertilizer), Maize bean intercrop (MBILI), Maize bean intercrop (MBILI),with fertilizer(30Kg N per ha), Maize bean intercrop (conventional), Maize bean intercrop (conventional) with fertilizer (30Kg N per ha), Control, Maize mono crop no inputs and farmers practice, were tested. Data collected on grain maize yield were submitted to an analysis of variance to assess the effect of each soil fertility technology on maize yield.

Other measurements which were taken included, dry cob and grain weight, dry cob weight, dry grain weight, grain moisture content and strover field weight. ANOVA was done using GenStat 12th edition. Exploration of the data was done first before doing the formal analysis, but before then the analysis research questions were formulated. The Meta data shown in figure 19 attached to the data was used to help structure the analysis research questions. The Meta data gives important information of the data like dates when the experiment commenced, the types of treatments given and the principal scientist undertaking the research.

	A	B	C	D	E	F	G	H
1	Date of establishment	13 th October 2009						
2	Objective-	To assess the effect of different soil fertility technologies						
3	Plot size	27m ²						
4	Date of planting	21 st October 2009						
5								
6								
7								
8								
9		Treatment	Treatment description	Materials to apply				
10		1	Cattle manure(60Kg N per ha Manure +fertilizer (30Kg N per ha from manure and 30Kg N per ha from fertilizer)	80 Kgs of cattle manure +two bottle top of TSP per hill at planting per hill -Maize spacing (75cm x 50 cm,2 maize per hill)				
11		2		40 Kgs of cattle manure +one bottle top of NPK per hill at planting 1bottle tops of TSP per hill -Maize spacing (75 cmx 50cm,2 maize per hill)				
12		3	Inorganic fertilizer (60Kg N per ha	Two bottle tops of NPK per hill at planting, no TSP- Maize spacing (75cm x 50cm,2 maize per hill)				
13		4	Inorganic fertilizer (90 Kg N per ha	Two bottle tops of NPK per hill at planting, Maize spacing 80 Kgs of tithonia and 2 bottle tops of TSP per hill - Maize spacing (75cm x 50cm,2 maize per hill)				
14		5	<i>Tithonia diversifolia</i> (60 Kg N per ha)					
15		6	<i>Tithonia diversifolia</i> (30 Kg N per ha from tithonia and 30Kg N per ha from fertilizer)	40 Kgs of tithonia +one bottle top of NPK per hill at planting 1bottle tops of TSP per hill -Maize spacing (75 cm x 50cm,2 maize per hill)				

Figure 19: The metadata

4.5.1.1 Research questions

1. What yields are obtained with each soil fertility technology?
2. What yields are obtained within each treatment and how variable are they?
3. To what extent does the application of soil fertility technology improve the maize yield?

4.5.1.2 The dataset

The data consisted of 12 treatments and one control treatment each treatment was replicated four times. information collected includes the size of the field (field size), stand count per plot, plot number, number of cobs per plot, grains and cobs' field weights, Stover field weights and yields (tons) based on population per ha. A subset of the dataset is shown in figure 20.

Row	Treatment No	Replicate	Plot number	Treatment	Plot Net size m2	Stand count per plot	Number of cobs
1	1	R1	7	Cattle manure (60 kg N ha-1)	21	110	11
2	1	R2	17	Cattle manure (60 kg N ha-1)	21	101	11
3	1	R3	32	Cattle manure (60 kg N ha-1)	21	105	10
4	1	R4	48	Cattle manure (60 kg N ha-1)	21	81	9
5	2	R1	5	Manure + Fertilizer (30 kg N ha-1 from manu)	21	89	10
6	2	R2	26	Manure + Fertilizer (30 kg N ha-1 from manu)	21	86	9
7	2	R3	36	Manure + Fertilizer (30 kg N ha-1 from manu)	21	87	9
8	2	R4	46	Manure + Fertilizer (30 kg N ha-1 from manu)	21	88	8
9	3	R1	12	Inorganic fertilizer (60 kg N ha-1)	21	53	6
10	3	R2	23	Inorganic fertilizer (60 kg N ha-1)	21	88	9
11	3	R3	33	Inorganic fertilizer (60 kg N ha-1)	21	70	6
12	3	R4	42	Inorganic fertilizer (60 kg N ha-1)	21	37	5
13	4	R1	1	Inorganic fertilizer (90 kg N ha-1)	21	96	9
14	4	R2	15	Inorganic fertilizer (90 kg N ha-1)	21	60	7
15	4	R3	37	Inorganic fertilizer (90 kg N ha-1)	21	69	8
16	4	R4	52	Inorganic fertilizer (90 kg N ha-1)	21	110	9
17	5	R1	4	Tithonia diversifolia (60 kg N ha-1)	21	113	11
18	5	R2	16	Tithonia diversifolia (60 kg N ha-1)	21	101	9
19	5	R3	28	Tithonia diversifolia (60 kg N ha-1)	21	99	10
20	5	R4	43	Tithonia diversifolia (60 kg N ha-1)	21	100	9

Figure 20: A subset of the dataset

4.5.2 Use of Pivot tables

The next step was to develop pivot tables using procedure described in chapter three. Pivot tables are used for summarising and cross tabulating selected variables in the dataset. The following steps were followed in creating a pivot table from the dataset.

- Click on any cell in the list or database
- Click pivot table

Treatment	Replicate	Plot number	Treatment	Plot Net si	Stand cou	Expected	Number of Field	Field weigh	Field weigh	Dry weigh	Weight of Grain	Std MC	% MC	Yields	Standi	Area Ha	pop/ha	Yields(Kg) per ha with		
1	1	R1	7	Cattle mar	21	110	112	70	5.6	6	5	3.8	1.2	12.5	12.5	3.8	10000	53333	1809.52381	
2	1	R2	17	Cattle mar	21	101	112	70	5.6	6	5	3.8	1.2	12.5	12.5	3.8	10000	53333	1819.04762	
3	1	R3	32	Cattle mar	21	105	112	70	5.6	6	2	1.6	0.4	12.5	12.5	1.6	10000	53333	761.90476	
4	1	R4	48	Cattle mar	21	81	112	70	5.6	6	3	2.4	0.6	12.5	12.5	2.4	10000	53333	1142.85714	
5	2	R1	5	Manure + F	21	89	112	70	5.6	6	6.4	5.2	1.2	13.3	12.5	4.887218045	10000	53333	2476.19048	
6	2	R2	26	Manure + F	21	86	112	70	5.6	6	4	3	1	11	12.5	3.409090909	10000	53333	1428.57143	
7	2	R3	36	Manure + F	21	87	112	70	5.6	6	2.4	2	0.4	12.7	12.5	1.965053937	10000	53333	652.3809524	
8	2	R4	46	Manure + F	21	88	112	70	5.6	6	2.4	1.2	1	12.2	12.5	1.229698197	10000	53333	671.4285714	
9	3	R1	12	Inorganic fi	21	53	112	70	5.6	6	3.2	2.6	0.6	12.4	12.5	2.620967742	10000	53333	1239.09524	
10	3	R2	23	Inorganic fi	21	88	112	70	5.6	6	1.2	0.6	0.5	12.8	12.5	0.6859375	10000	53333	285.7142857	
11	3	R3	33	Inorganic fi	21	70	112	70	5.6	6	2.8	2.2	0.6	10.9	12.5	2.52293578	10000	53333	1047.61905	
12	3	R4	42	Inorganic fi	21	37	112	70	5.6	6	3.8	2	1.2	14.1	12.5	1.773049645	10000	53333	952.3809524	
13	4	R1	1	Inorganic fi	21	96	112	70	5.6	6	4.8	4	0.8	10	12.5	5	10000	53333	1904.76190	
14	4	R2	15	Inorganic fi	21	60	112	70	5.6	6	4.2	3.2	1	10.8	12.5	3.703703704	10000	53333	1523.80952	
15	4	R3	37	Inorganic fi	21	69	112	70	5.6	6	2.2	1.8	0.4	12.1	12.5	1.859504132	10000	53333	857.1428571	
16	4	R4	52	Inorganic fi	21	110	112	70	5.6	6	4	3	1	12.4	12.5	3.024193548	10000	53333	1428.57143	
17	5	R1	4	Tithonia di	21	113	112	70	5.6	6	5	3.8	1.2	13.1	12.5	3.625954198	10000	53333	1809.52381	
18	5	R2	16	Tithonia di	21	101	112	70	5.6	6	19	14.4	1.2	12.5	12.5	4.4	10000	53333	2095.23810	
19	5	R3	28	Tithonia di	21	81	112	70	5.6	6	4.8	3.6	1.2	12.6	12.5	3.574228571	10000	53333	1714.28571	
20	5	R4	43	Tithonia di	21	88	112	70	5.6	6	4.6	3.6	1	11.6	12.5	3.879310345	10000	53333	1714.28571	
21	6	R1	6	Tithonia di	21	65	112	70	5.6	6	6.2	5.2	1	12.4	12.5	5.241935484	10000	53333	2476.19048	
22	6	R2	18	Tithonia di	21	93	112	70	5.6	6	9	5.4	4.2	1.2	11.5	12.5	4.565217391	10000	53333	2000
23	6	R3	38	Tithonia di	21	86	112	70	5.6	6	10	4.2	3.2	1	13.5	12.5	2.962962963	10000	53333	1523.80952
24	6	R4	50	Tithonia di	21	80	112	70	5.6	6	4.2	3.2	1	12.3	12.5	3.252032520	10000	53333	1523.80952	
25	7	R1	10	Maize bez	20	62	84	63	5.8	5	5.2	4	1.2	12.8	12.5	3.90625	10000	53333	2000	
26	7	R2	20	Maize bez	20	68	84	24	1.2	2.8	1	0.6	0.4	12.6	12.5	0.595239096	10000	53333	3000	
27	7	R3	27	Maize bez	20	61	84	44	1.8	2.6	1.2	1	0.2	10.8	12.5	1.157407407	10000	53333	5000	
28	7	R4	44	Maize bez	20	60	84	44	1	2	0.8	0.4	0.4	11.2	12.5	0.446428571	10000	53333	2000	
29	8	R1	2	Maize bez	20	61	84	39	2	4.4	1.6	1.2	0.4	14.1	12.5	1.053829787	10000	53333	6000	

Figure 21a: step one of creating pivot table

A Pivot table can be structured into one, two or three dimensions and these are arranged in rows, columns and pages. The fields used for defining the table structure should be dragged into the row, column and page spaces. The fields used for defining structure should normally be factors, i.e. discrete, categorical variables (numeric, character or other types). Figure 21b and c shows the result of what was obtained after carrying out the steps described above of pivot table formation.

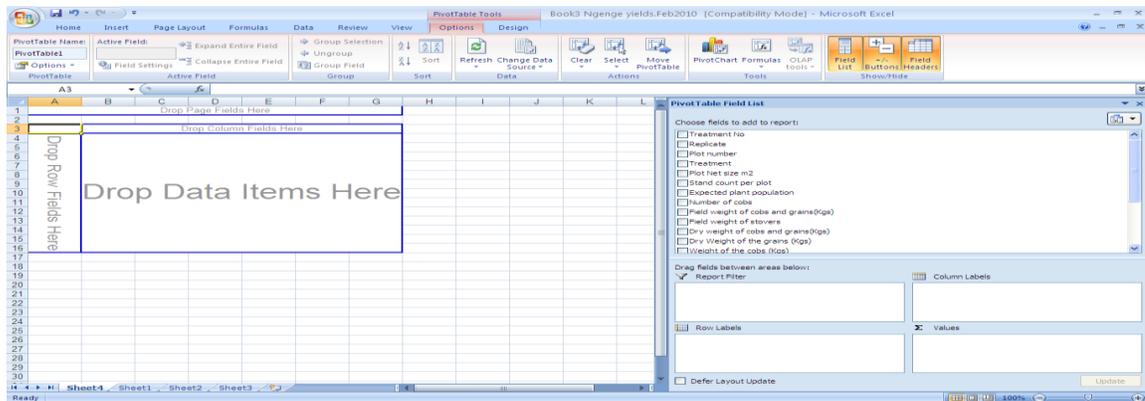


Figure 21b: Step 2 of creating pivot table

The final steps displays in list form the selected variables. In the example in figure 21c, the first column shows all the thirteen treatments and the other column shows the corresponding yields obtained after subjecting the soil to the thirteen treatments outlined in the Meta data

fx Sum of Weight of the cobs (Kgs)		B	C	D	E
1	Drop Page Fields Here				
2					
3	Sum of Weight of the cobs (Kgs)				
4	Treatment	Total			
5	Cattle manure (60 kg N ha-1)	3.6			
6	Control, Maize monocrop (No inputs)	3.2			
7	Farmers practice (No inputs)	3			
8	Inorganic fertilizer (60 kg N ha-1)	2.9			
9	Inorganic fertilizer (90 kg N ha-1)	3.2			
10	Maize bean intercrop (Conventional) (No inputs)	2.1			
11	Maize bean intercrop (Conventional) with fertilizer (30 kg N ha-1)	1.8			

Figure 21c: Step 3 of creating pivot table

4.5.3 Use of GenStat

4.5.3.1 Checking assumptions prior to formal analyses

It was important to check for normality of the by examining a histogram or frequency distribution of the data which was done by observing a normal probability plot. Checking for variance homogeneity was done by calculating means and variances for data under each treatment where the ε_i , referred to as “error” or “residual” terms, are assumed to be independent and identically distributed normal variables having zero mean and constant.

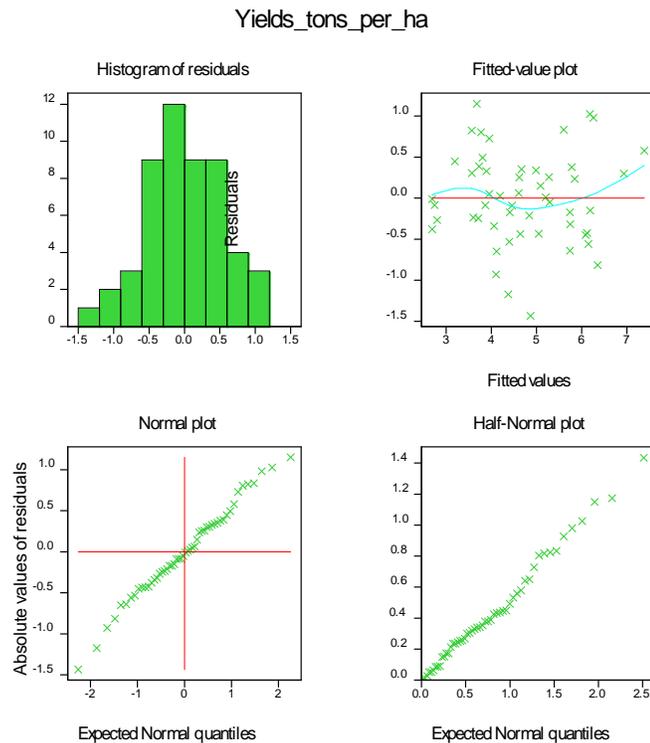


Figure 22: Checking ANOVA assumptions

The normality of the data was checked by examining a histogram and normal probability plot. The plot should be a straight line. This data then satisfies the assumptions of ANOVA because the plot is a straight line. The residual do not show a sign of any pattern and seem to have a mean of zero. Therefore we can proceed with the analysis without doing any transformations to the data.

4.5.3.1 Exploratory stage

The exploratory stage the exploratory stage was carried to check if the data as computerised were of sufficient quality to be used for analysis. The summaries were done using GenStat. In the first exploration, box plots were used. The treatment that produced most varied maize yields was treatment 2. This means it is not easy to predict the amount of yields to expect after applying this treatment. The least varied yields were obtained in treatment 13. You can almost predict with a higher level of confidence the yield to obtain after giving the treatment to the soil.

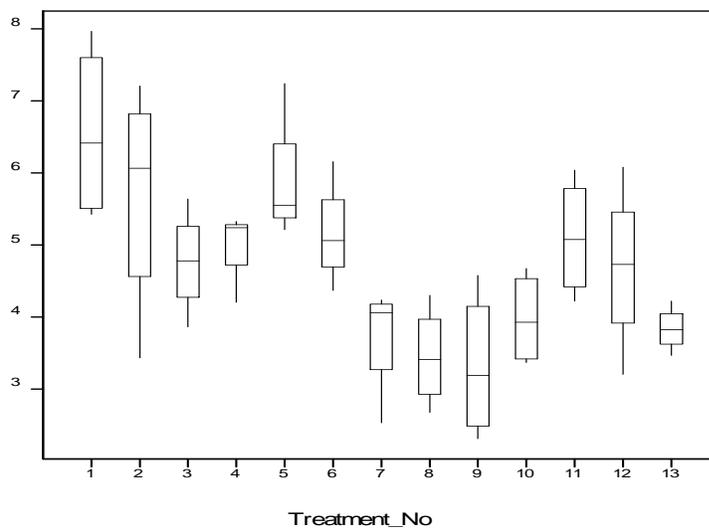


Figure 23: Box plots for maize yields per treatment

Box plots were used to assess the variation of maize yields in every treatment conducted. The results are displayed in figure 23. Summaries of the data were also made in GenStat. The results are also displayed in figure 24. The summary shows the mean yield per treatment, the maximum yield, the minimum yield, the median, the mean and the mode yield per treatment. It also shows the standard deviation of the yields.

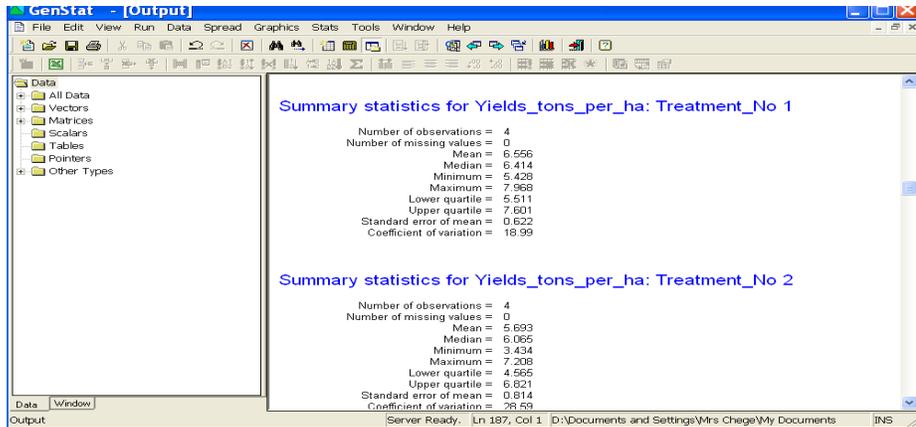


Figure 24: Output of the Summary statistics

4.4.3.2 Use of Analysis of Variance in exploratory analysis

ANOVA was also used as exploratory analysis tool. Figure 25 is a plot of means produced from every treatment. The plot was generated after doing summaries with ANOVA. The figure shows first plot the mean yields of the thirteen treatments.

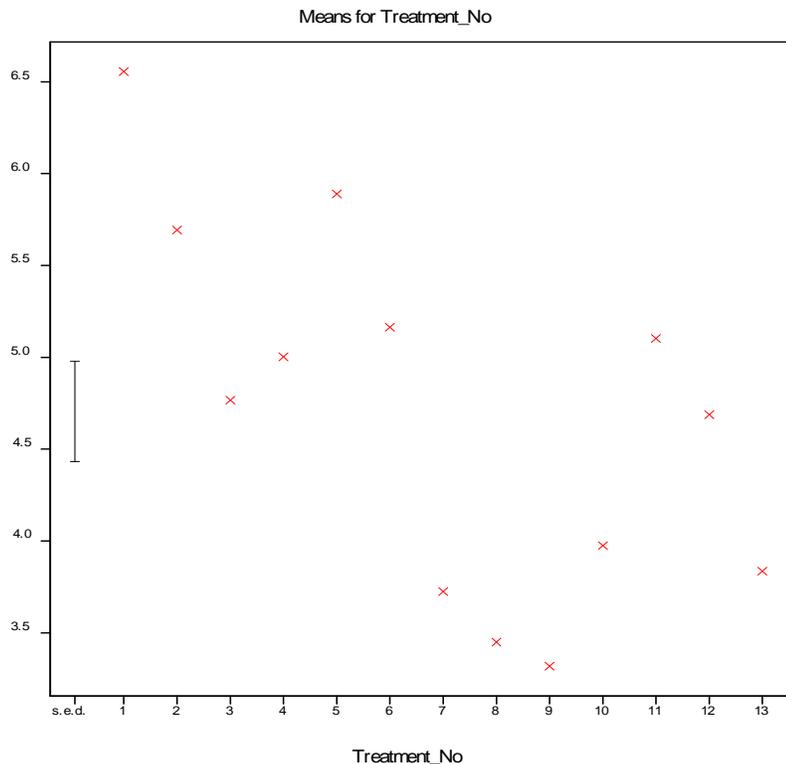


Figure 25: Mean maize yields for the thirteen treatments

According to the plot the treatment that produced highest yield was treatment 1 followed by treatment 5. the least yielding treatment was number 9 followed by number 8. These

results agree with those obtained in the summaries shown in figure 24 and the box plots in figure 23. Referring to F tables on 3,12 and 36 degrees of freedom, we see that the value 48.0725 is highly significant, and conclude that there is a difference between the thirteen treatments.

Analysis of variance					
Variate: Yields_tons_per_ha					
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Replicate stratum	3	11.9827	3.9942	6.67	
Replicate.*Units* stratum					
Treatment No	12	48.0729	4.0061	6.69	<.001
Residual	36	21.5662	0.5991		
Total	51	81.6218			

Figure 26: Analysis of Variance showing the F probability

4.4.3.3 Statistical modeling

Q3. To what extent does the use of treatment improve maize yields?

To answer this research question, the following analyses were carried out Regression analysis which aimed at fitting a model at the end of the analysis. Analysis of variance was carried out first to test the significance of the model fitted. The F-probability showed that the model was significant at 5% level of significance. The following treatments were found to be significant, 1,7,8,9, 10 and 13. The following model could therefore be fitted

$$Y = 6.556 - 2.832 \text{treatment } 7 \pm (2 \times 0.656)$$

Figure 27 shows that the estimated rates of change in maize yield for each of the thirteen treatments. For instance in treatment number 7 the farmer will lose 2.832 tons of maize yield if he fails to apply treatment 1 which comprises 80kg of cattle manure. A 95% confidence interval for the true rate of change is (-4.433, -1.780). The estimated loss if he uses treatment 8 instead in maize yield would be 3.107 ton per ha and a 95% confidence interval for the true change is (-4.433,-7.80).

Regression analysis

Response variate: Yields_tons_per_ha

Fitted terms: Constant, Treatment_No

Summary of analysis

Source	d.f.	s.s.	m.s.	v.r.	F pr.
Regression	12	48.07	4.0061	4.66	<.001
Residual	39	33.55	0.8602		
Total	51	81.62	1.6004		

Percentage variance accounted for 46.3

Estimates of parameters

Parameter	estimate	s.e.	t(39)	t pr.
Constant	6.556	0.464	14.14	<.001
Treatment_No 2	-0.863	0.656	-1.32	0.196
Treatment_No 3	-1.789	0.656	-2.73	0.010
Treatment_No 4	-1.553	0.656	-2.37	0.023
Treatment_No 5	-0.666	0.656	-1.02	0.316
Treatment_No 6	-1.393	0.656	-2.12	0.040
Treatment_No 7	-2.832	0.656	-4.32	<.001
Treatment_No 8	-3.107	0.656	-4.74	<.001
Treatment_No 9	-3.238	0.656	-4.94	<.001
Treatment_No 10	-2.581	0.656	-3.94	<.001
Treatment_No 11	-1.453	0.656	-2.22	0.033
Treatment_No 12	-1.868	0.656	-2.85	0.007
Treatment_No 13	-2.720	0.656	-4.15	<.001

Parameter	lower95%	upper95%
Constant	5.618	7.494
Treatment_No 2	-2.190	0.4636
Treatment_No 3	-3.116	-0.4625
Treatment_No 4	-2.879	-0.2263
Treatment_No 5	-1.993	0.6602
Treatment_No 6	-2.719	-0.06634
Treatment_No 7	-4.159	-1.506
Treatment_No 8	-4.433	-1.780
Treatment_No 9	-4.565	-1.911
Treatment_No 10	-3.908	-1.255
Treatment_No 11	-2.780	-0.1267
Treatment_No 12	-3.195	-0.5418
Treatment_No 13	-4.047	-1.394

Parameters for factors are differences compared with the reference level:

Factor Reference level
Treatment_No 1

Figure 27: Regression analysis

The display the differences between the yields obtained from different yields. A number of differences were found to be significant. This includes treatments, 7, 8 9, 10 and thirteen. This is at 5% level of significance.

Where treatment numbers 1,2,3,4,5,7,8,9,10,11,12and 13 denotes Cattle manure (60 kg N ha-1), Control, Maize monocrop (No inputs), Farmers practice (No inputs), Inorganic fertilizer (60 kg N ha-1), Inorganic fertilizer (90 kg N ha-1), Maize bean intercrop (Conventional) (No inputs),Maize bean intercrop (Conventional) with fertilizer (with 30kg N), Maize bean intercrop (MBILI), Maize bean intercrop (MBILI) with fertilizer(30 kg N ha-1), Manure + Fertilizer (30 kg N ha-1 from manure and 30 kg N ha, Soil conditioner (AGRI-SOC), Tithonia diversifolia (60 kg N ha-1), Tithonia diversifolia + Fertilizer (30 kg N ha-1 from manure respectively).

4.4.4 Importing data into R

Data was stored in excel software program. The data were then exported as an ASCII file which can be used in R. From Excel, a commonly used spreadsheet program, the data was saved as ‘.csv’ (comma separated values) format. The name of the excel file where the data were stored was **chege.xls** The Excel file chege.xls was opened. The first row was checked to ensure that it read the variable names and then the data. Any extra rows before the row indicating variable names were deleted and then saved as ‘**chege.csv**’. To read in the dataset, the following commands can were used, **data4<-read.table('c://Chege.csv', header=TRUE, sep=',')** **data**. The information displayed below shows a section of the data that was imported into R.



Figure 28a: data imported into R

The factors that were reading “!””, R converts and puts “.”. To display the variables existing in data4 and their characteristics, the following command was typed in “str(data4)”

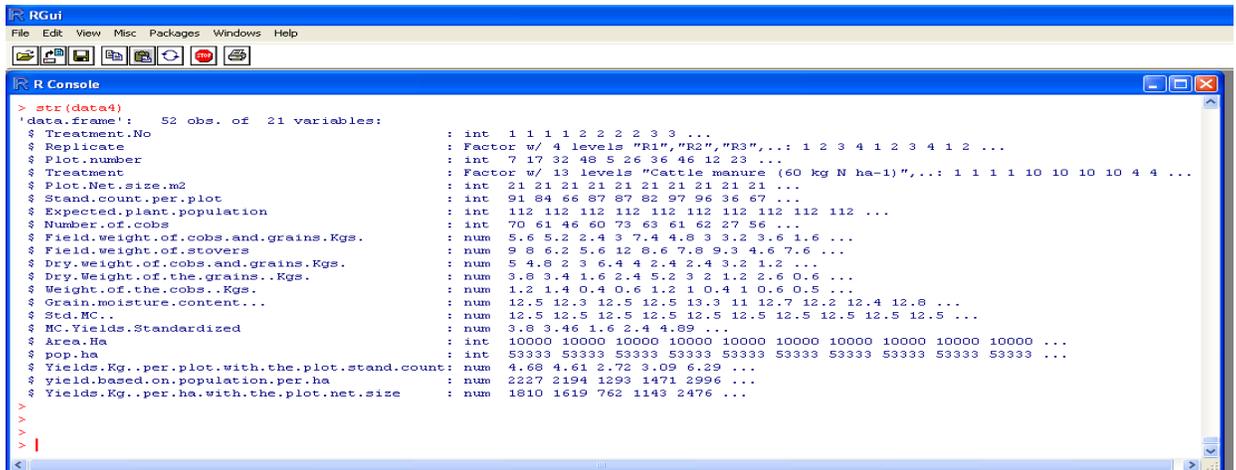


Figure 28b: Factor variables displayed in R console

4.4.4.1 Data exploration in R

Before undertaking any statistical analysis, it is a good statistical practice to explore the data. To summarize the yields of maize per given treatment, the following command was typed in “**summary (data4)**”

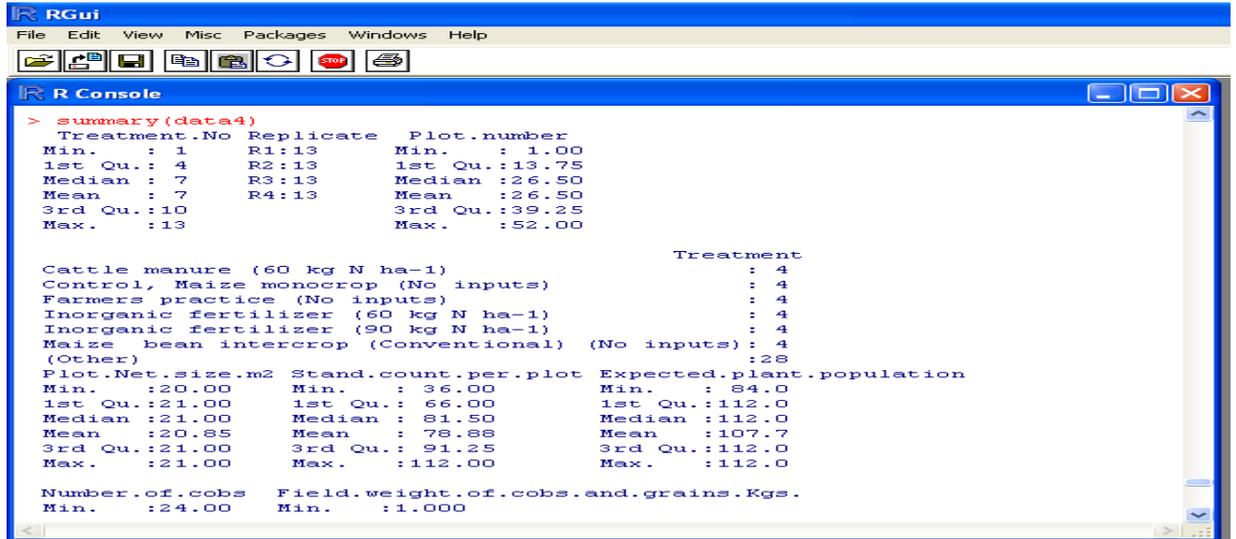


Figure 28c: Summary of variables in data4

The following command was run “**attach(data4)**”, to avoid typing **data4\$** each time she wanted to recall a certain variable command, to check the distribution of the dependent variable that is yield of maize per ha., the following command was typed `boxplot(Yields.Kg..per.ha.with.the.plot.net.size,ylab = "maize yields")`

The following box plot was obtained

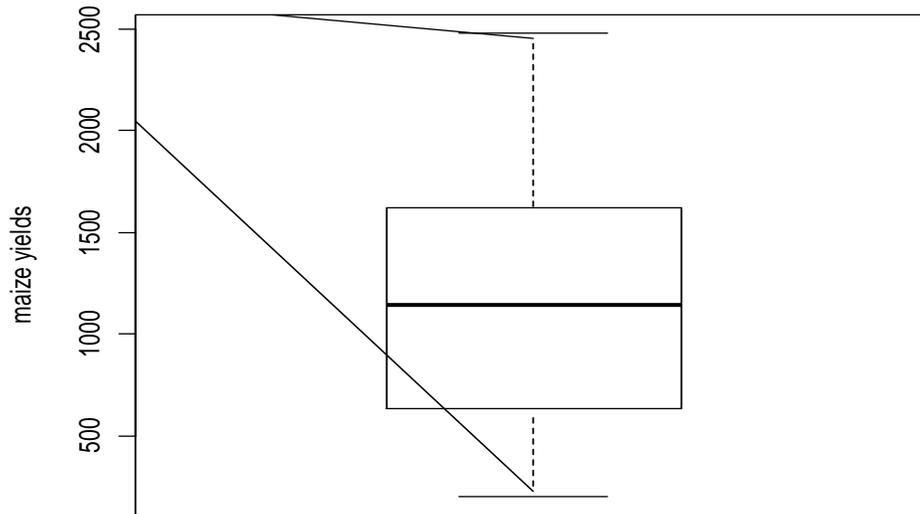


Figure 29: Box-plot to check the distribution of dependent variables

The maize yield appears normally distributed, as indicated by the relative position of the median within the box that contains half the data. Normality of the maize yields could also be checked by use of a Q-Q plot using the following commands. `QQnorm (Yields.Kg..per.ha.with.the.plot.net. size, ain = "Normal Q-Q Plot for maize yields", ylab="maize yields") qqline(Yields.Kg..per.ha.with.the.plot.net.size)`. The following results were obtained which showed that maize yields per ha were normally distributed.

Normal Q-Q Plot for maize yields

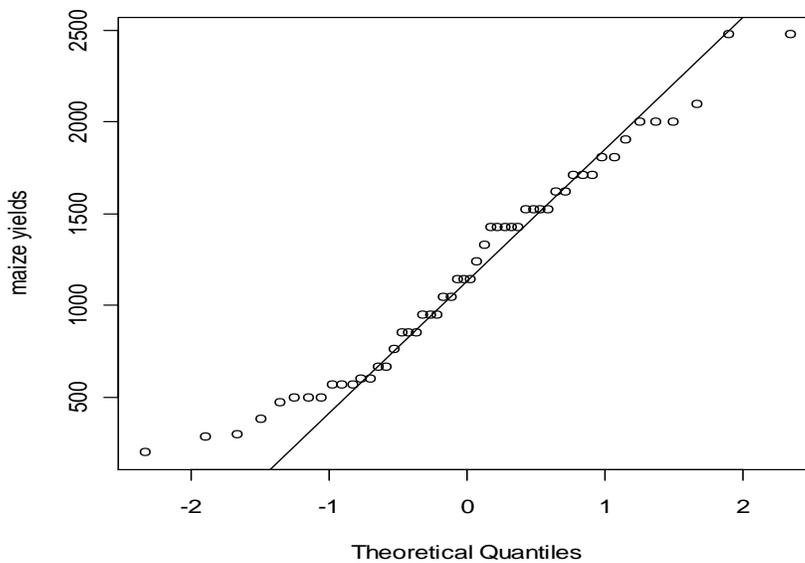


Figure 30: Normal Q-Q plots for maize yields

“qqnorm” produces a QQplot and qqline adds a line to a normal qqplot. The plot showed that maize yields per ha was normally distributed as the points fall close to the line. It was proper to test the normality of the data to avoid violating some of the assumptions of ANOVA where normality is one of the conditions. To have an overview of the effect of all the thirteen treatments on maize yields, boxplots were produced using the following command `boxplot(Yields.Kg.per.ha.with.the.plot.net.size ~ Treatment., data=data4 col="orange", xlab="Treatment", ylab="maize yields(kg)", ylim=c(0,2476))`

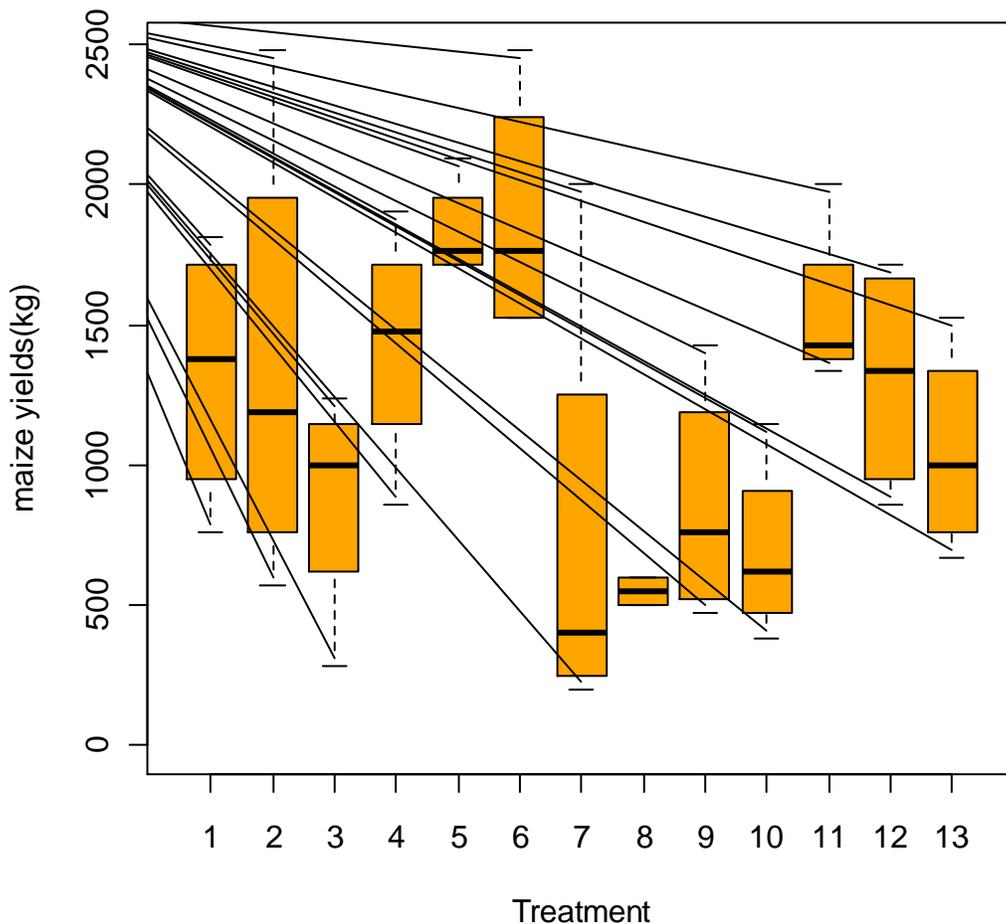


Figure 31: Box-plots showing an summary yields from thirteen treatments

The results displayed in figure 31 showed that treatment 7 had the most varied yields while treatment 8 gave the least varied yield. Treatment 6 gave the highest yields. There were no outliers in the data.

4.4.5 Discussion on data analysis

A meta data is necessary in any data analysis procedure. It was expected that this information would accompany the data but this did not happen. The analysis was delayed until the day the metadata was available. Analysis objectives and research questions were derived from the Meta data. It was expected that the student knew how to develop the pivot tables but she had no idea. Creation of pivot tables is important as it helps to summarize data in list form. From the list, the data can then be sorted in the order that is preferred. The student was only conversant with analysis using SPSS but for agricultural research GenStat and R are superior to SPSS.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

To develop policy content for innovation policy document, a qualitative approach can be used to collect and analyse data at RPE, JKUAT, a full text of a proposed innovation policy drafted using this approach can be obtained from the dissertation CD.

Most of the innovation projects initiated at RPE, are in the field of Agriculture. There are very few projects from the ICSIT. None of the project innovators has selected a biometrician /research methods professional or an economist as a collaborators in their projects since the initiation of JKUAT's innovation fund in 2007.

Use of Moodle learning Management system in teaching MSc Research Methodology course at JKUAT was not fully maximised. Most of the facilitators and students did not make use of the learning forums in the SSC Moodle site. Majority of the facilitators preferred to upload course materials already prepared by RUFORUM rather than create their own and upload for use by the students. (A full text of the use of Moodle in teaching MSc research Methods can be obtained from the dissertation CD).

The content, course organization, teaching and learning support of the research methodology course at KTTC were rated highly by the students. However, majority of the students identified some weakness in availability of research and statistical resource materials, prompting writing of two guides one in research methods and the other in statistical methods, full text can be obtained from the dissertation CD.

To produce accurate and reliable findings in the data analysed from the KU student, it is important to follow a systematic procedure which begins with, formulation of analysis objectives, creating pivot tables to summarize data in list forms, exploring the data to identify outliers (which could be pointers to new discoveries or mistakes), checking the assumptions of the models chosen, this can be followed by formal analysis of the data

and end with statistical modelling. For agricultural research GenStat and R softwares were found to be very good.

5.2 Recommendations

- ❖ A policy document on innovation projects should be formulated at RPE to guide the management of the innovation projects
- ❖ Project innovators should be encouraged to include biometricians/ research methods professionals (research methods professionals are also trained to manage data), economists, entrepreneurs and IT experts in their projects. Alternatively RPE can employ full time professionals in these areas who can work together with the innovators.
- ❖ JKUAT should now move away from old conventional lecture methods that emphasize teaching and encourage use of learning management systems like Moodle which encourages learning and removes power of learning from the teacher to the learner.
- ❖ Teaching of research and statistical methods should include the analysis of data manually and some statistical computing. Teachers should be encouraged to prepare teaching manuals for students at all levels of our education cadres including suitable material for diploma students, undergraduates and postgraduate students.
- ❖ Training at the universities, in data analysis, should expose students to real datasets with all the complexities to enable the students analyse complex datasets after university education.

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APPENDICES

APPENDIX I: Interview schedules for the key informants

1. What major problem do you face in managing the innovation projects?
2. Are there words used in these projects that need definition so that all stakeholders understand their meaning? Give a few examples of such words
3. What other concerns you would wish addressed in a policy document on innovations
4. Do you have an equipped office that serves the innovators, an office with office bearers, an office that has internet facilities, a website that facilitates the functions of the innovation project, with somebody on standby to respond to any queries that may be raised by the innovators?
5. Do you have defined roles in managing the innovations?
6. Who owns the innovations?
7. Do you understand the scope of the innovation projects?
8. Do you have any that binds legally, as far as innovations are concerned?
9. Kindly comment on other inclusions that you would consider important in the running of the innovations

END

Thank you for the response. God bless you.

APPENDIX II: Observation Profoma on use of Moodle

Use of Moodle in teaching an MSc Research Methodology course

1. Name of the course_____

2. Number of discussion forums started_____

3. Number of replies to the discussion forums_____

4. Uploading of the course resource materials done

Yes No

5. Source of the materials uploaded

Ruforum Facilitator

6. Uploading of assignments done

7. Overall rating of the learning forums

1 2 3 4 5

Appendix III: Abstract

Use of Moodle system in a regional MSc Research Methodology course

GLOBAL TRENDS IN QUALITY OF LIFE THROUGH BIOMETRY

Using Moodle in a regional MSc Research methodology course

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Abstract

This paper describes the experiences and some of the lessons learned while blending a face to face MSc course in Research Methodology (RM), with an on-line learning management system known as Moodle. The MSc course is run at Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya, with both staff and students from a range of countries in Eastern and Southern Africa region. By use of Moodle, JKUAT was able to coordinate different course units taught by different people, gave a unified format to course modules and helped students from different countries, with different backgrounds all begin the RM MSc, with an adequate background in basic statistics. At the start of the MSc, an orientation Moodle was combined with an e-learning course known as e-SMS (Statistics Made Simple) and this provided the much needed foundation in statistics to all students. In their second year, the students continued to use Moodle as a tool for support during internship. Overall, the experience of using Moodle was Very enriching to all students. However, majority of the lecturers required further support and incentives to use it fully.

Key words: Statistical education, research methods, e-learning, Moodle

APPENDIX IV: Invitation letter

Invitation letter to SUSAN conference

SUSAN CONFERENCE 2011

(27 June - 1st July 2011) @

UNIVERSITY OF BOTSWANA

17-02-2011

Dear 2011 SUSAN PARTICIPANT,

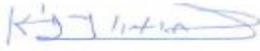
PRESENTATION AT THE 2011 IBS-SUSAN CONFERENCE

Please refer to our previous communication on your abstract submitted to 2011 IBS-SUSAN conference. The Editorial Committee of the 2011 IBS-SUSAN conference has pleasure to inform you that your paper has been accepted for presentation. You will have 15minutes for the presentation and 5 minutes will be allowed for discussion.

Please be advised that the registration for the conference is a pre-requisite for oral presentation and that your abstract will be published in the conference book of abstracts only if you submit full manuscript to the editorial committee before 1, April, 2010.

I have attached a copy of registration details with this letter, should you have any questions regarding your submission, please feel free to contact me at shangodoyink@mopipi.ub.bw or Kenny_shangodoyin@yahoo.com

Sincerely yours,



Professor D K Shangodoyin
Chairperson Editorial Committee

Appendix V: Course evaluation questionnaire

Research and Statistical Methods Evaluation form



Please respond to the following questions to help evaluate the research method and statistical methods course you have just completed.

General information

Department _____

Gender Male Female

This questionnaire gives you the opportunity to express your views about this course. Your responses will be totally anonymous. The results will be used as part of an overall assessment of the effectiveness of this course and for course improvement. Please answer all questions. For those questions, which use numerical scales, please select the number closest to your view.

A. General Aspects of the Course

Course Content

1. Prior knowledge assumed:
2. Amount of material covered:
3. Degree of difficulty:
4. Was there a coherent progression of the course from beginning to end?

ii. Course Organization

5. Quality of course outline:
(i.e. document detailing course aims, content, organization of teaching, assignments, reading, assessment, etc.)
6. Statement of course objectives:
7. Course expectations:
(i.e. what was expected of you)
8. Organisations of course activities:
(e.g. lectures, seminars, labs, coursework, etc)

iii. Teaching and Learning Support

9. Helpfulness of teaching staff:
10. Availability of course material:
(e.g. reading lists, handouts, etc)
11. Usefulness of course materials:
12. Feedback on progress:
13. Clarity of presentation:
14. Interest in the subject as a result of the course:

B. Overall Evaluation

15. Overall, how would you rate the course content?
16. Overall, how would you rate the organisation of the course?
17. Overall, how would you rate the quality of the teaching?
18. Overall, how would you rate this course?

19. State what you liked most about this course

20. State what you hated most about the course

21. How could this course be improved?

Appendix VI: Research and Statistical Guides Title Pages

A guide to Statistical Methods



Nancy W. Chege

One major problem facing University students in East African region is lack of text books, more so in Statistical Methods. Most of the good e-books found in the internet have to be bought and this leaves students with little option other than using non-authenticated materials from the internet. This guide is an attempt to alleviate the problem. It is assumed that students taking statistical methods course will have basic knowledge of statistics as prerequisite in understanding principles of statistical methods. Although the guide has adequately covered all topics relevant in Statistical methods, students are expected to make use of other relevant books that are available online and

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A guide to research methods.



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