An Assessment of Biometry Application in Sudan a Case Study of Agricultural Research Corporation (ARC)

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ABSTRACT: Biometrics plays an active role in the research methods for scientists and research interns during planning, development and implementation of research projects. A number of measures have been put in place to improve the research capacity among the scientist in various sectors of agricultural research among other related disciplines. The present statistics shows that the field of biometry in a number of research institutions especially in Africa is still wanting. Therefore, the objective of this study was to addresses the role of biometry in developing capacity of research methods for agricultural research scientists. The study was carried in Agricultural Research Corporation (ARC), Wad Medani, Sudan. Where sample size of 50 scientists was selected using simple random sampling procedures. The major variables tested were methods used in data analysis, research experience, refresher courses, institutional capacity and quality of published papers among others through administering semi-structured questionnaire. The data was analyzed using descriptive statistics, non-parametric methods and regression modeling. The results showed that there was a significant difference ($p<0.01$) on agreement of the methods used in data analyses where over 90% strongly valued application of various statistical methods as compared to about 8% who did not value the said methods. In addition, there was a significant correlation ($p<0.01$, $R^2=41.7\%$) between the number of scientific papers and years of research where the result indicated that for every ten years of research there was about four peer reviewed journal papers. Overall, 100% of researchers indicated biometrics has an active role in developing agricultural scientific research and its most ideal solution for improving performance and building capacity through provision of training/refresher courses. In conclusion, the creation of a sustainable capacity building program in Biometrics will help researcher to produce science of high quality through use of effective statistical design, interpretation and presentation of results.

KEYWORDS: Agricultural research, Biometrics, Scientific Research.

1   INTRODUCTION

Agricultural research help farmer to produce a quantity and diversity of product within contractive of acceptable, profitability and risk, this title is however, too broad in one sense and too narrow in another [7]. The agricultural research focus in developing countries is changing and is no longer based just on the old commodity and disciplinary boundaries [8]. Agricultural research has played a key role in the development of statistical methods; statistics in fact provides scientific tool for representative data collocation, appropriate analysis and summarization of data inferential procedures for drawing conclusion in the face of uncertainty [2]. However in agricultural research, statistics find some of very interesting application which often led to development of newer statistical technique or at least refinement of exciting one [1]. Agricultural statistics has three-core object area namely sampling survey, experiment design and biometrical tools [18]. Agricultural research comprises several branches of science, and permits the formulations methods and perfection of techniques which, once they have been checked and confirmed under optimal conditions, are made available to farmers through extension services [13]. The agricultural research focus in changing, not just in sub Saharan African but also through, the world and now includes agro-ecosystem research, integrated agricultural system to problem solving natural resources management perspectives

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,participation of farmers and an increasing emphasis on providing information about alternative options rather than optimal packages [6]. Biometrics skills in developing countries are in adequate to support proprieties of agricultural research with the consequences quality researches [11].

2   WHAT IS BIOMETRICS?

Biometrics in anther core area under agricultural statistics, even though biometrics as such, is a wider term, it often used for genetics statistics involving studies of plant and animal for assessing genetic potential in section trial for genetic material improvement such trial are often conducted to develop new better performing varieties or animals with respect to chosen trials under different environments are not same [9]. Biometrics plays a significant role in all forms of scientific investigation contribute effectively on planning, statistical design, data management, data analysis, presentation results, reporting among other related research [20]. Biometrics plays a significant role in, planning experiments, conducting experiments and decision-making process of agricultural research [17]. Applied biometrics is very importance in the development of agricultural research strategies, because the nature of agricultural research is changing; the agricultural investigations are based on the application of biometrics which is helpful in testing hypotheses using observed data for effective practice in resolving the different problems that arise in the many branches of agricultural research [12]. Because of the variability inherent in biological and agricultural data, knowledge of biometrics is necessary for their understanding and interpretation different agricultural research methods such as plant breeding, soils, plant diseases, seeds, etc., statistical genetics (micro-arrays, genome data, analysis of genetic data etc, ecological modeling (forestry, fisheries and wildlife and other ecosystems, Functional and data analysis (time series, spatial analysis and data methods in GIS mapping, etc [5]. Appropriate use of biometrics allows an independent, non-pedagogic methodology for the student to arrive at his own conclusions concerning the biophysical component of the decision-making process [4].

3   ROLE OF BIOMETRICIAN IN AGRICULTURAL RESEARCH

In the most of institution of biometrician's report, may achieve three mission functions: (1) assessment, to identify problems related to the agricultural researches and determine their extent; (2) tools for developing, to prioritize the identified problems, modeling hypothesis and/or estimate and predict the effect of changes and (3) in assurance, to make certain necessary services to reach the desired goal-as determined by statistics measures-and to monitor how well the regulators and other sectors of the society are complying with agricultural research [19]. Biometrics plays a key role in each of these functions. In assessment, the value of biometrics lies in deciding what information to gather to identify agricultural researches problems, in finding patterns in collecting, summarizing and presenting of data in an effort to best agricultural strategies [14]. Biometricians are adept at developing the necessary mathematical tools to measure the problems, and predict the effects of agricultural changes will be addressing the studying relationships among variables, a long -Term Statistical Development Programs and Institutional framework for biometrics [16].

4   BIOMETRICS RESEARCH

Biometrics can enhance research and development, and encourage collaboration between the agricultural scientist and statisticians the research activities of Biometrics are still undergoing development, with the current focus on statistical modeling [10]. The research programs are listed below; describing the research directions and the common underlying methods such as Statistical Genetics: QTL analysis, Mixed models, generalized Linear Models , spatial and Temporal Modeling, genetic Resources Conservation, genotype by Environment Interaction, Optimal Experimental Designs [15]. Therefore, agricultural development also required formulation implementation and monitoring of Biometrics research program.

5   STATEMENT OF THE PROBLEM

The problem has little to do with knowledge of statistics in the strict sense , but rather with Appling common sense in trying to solve development and environmental problem through applied biometric based on hard evidence and there are some of absence of a biometrician as research collaborative way in different field of research and there is still on same challenges in statistical consultancy a case of ARC. Also there are weakness of teaching statistics course in most of Sudanese's universities with full missing in teaching of biometrics in Sudan We note that, some of the papers presented by Agricultural Research corporation (ARC) wad Medani , Sudan or theses submitted by graduate students in national universities for example a Gazira university, often demonstrate serious weaknesses in data analysis and interpretation. Continued reliance

by university instructors or by Researches Institutes (RI) upon outdated and "classical" teaching methods contributes to this problem. Weaknesses in statistical principles, knowledge in use of statistical software, and data exploration technique often leads to incompletely analyzed data and incorrectly interpreted findings.

A biometrics tool has become increasingly important and urgent in the light of the adoption of the Millennium Development Goals (MDG) and the managing for development results approach. Biometrics approach is new strategic approach will contribute to the production and dissemination of timely, reliable, and relevant statistics on a regular and sustainable basis. However, the statistical developments in agricultural research will most likely need to be pursued with vigor as the development of sustainable and durable biometrics capacity building.

The biometrician frequently quotes scientific articles assessing the roles of experimentations, exercise, the environment, and for maintaining and improving statistics. Furthermore, there is a need for investigations to continue, in order to establish biometrics capacity building in agricultural research on a global scale. To achieve this, many more sustainable researches need to be carefully studied and the problems in an environment of capacity agricultural research. So the capacity building acquire us better understanding of the nature agricultural problem and needs of a Biometrics services, or to give training courses.

6 PURPOSE OF THE STUDY

The purpose of this study is to assess the Biometry applications in agricultural research as well as addresses the role of biometry in developing capacity of research methods for agricultural research scientists and to enhance the quality and credibility of biological research at ARC through the research program and responsibilities of conducting research in experimental designs, sampling procedures, statistical genetics, computer software's and data processing along with providing advisory services on experimental design/layout for field/labs.

7 RESEARCH QUESTIONS

The research question of an assessment of Biometry applications in agricultural research encompasses the country's scientific research and biometrics capacity building. The building of biometrics capacity does not begin and end in cantered statistical, a number of Fundamental research questions are addressed:

- Biometrics can be effectively applied to agriculture.
- Biometrics in agriculture has an active role in scientific research?
- What is training required for the priority given national need such as workshop or training course or conference in the field of biometrics?
- Statistical analysis tools and statistical packages are requested to meet a conclusion.
- The Importance of biometric capacity building, to create institute of statistical research for biological studies in Sudan.

A series of detailed (interview-based) surveys were implemented in order to generate the data required to measure the number of published papers and numbers of experiences associated with the age determinants of the output of scientific research within ARC, Wad Medani, Sudan. The study used multiple choice and scale type questions in order to identify and assess researchers' education level, performance of research, a accessibility of information and capacity building of their scientific research, etc. Most of the questions in the study were research method.

8 RESEARCH METHOD

8.1 QUESTIONNAIRE DESIGN

A series of detailed (interview-based) surveys were implemented in order to generate the data required to measure the quantitative and qualitative variables associated with the determinants of the role of biometrics capacity building, experiences, and number of papers publication within statistical subject in life work and training course. The study used multiple choice and scale type questions in order to identify and assess role of biometrics and statistical capacity to build to scientific research and overlap the relationship between research and agricultural institution, training courses, workshop, encouragement and understanding of scientific research methods beside of importance of statistical methods for agricultural research. Examples of the questions asked within the questionnaire include. The study used multiple choice and scale type questions in order to identify and assess researchers' education level, performance of research, a accessibility of information

and capacity building of their scientific research, etc. Most of the questions in the study were in relation to the statistical tools, biometrics application and trainings, as access to the impact of biometrics capacity building in the agricultural scientific research. The structure of questionnaire content about 26 questions distributed for a different researches in different scientific program. Examples of the questions asked within the questionnaire include:

- How many scientific papers did you published,?
- How many practical experiences do you have?
- Is a statistical science and its applications in the agriculture have an active role in scientific research?
- Statistics is one of the scientific research methodologies
- For the research to be considered as scientific, the researcher must follow the scientific research methodologies?
- Statistics is the most ideal solution for improving performance and building capacity in scientific research?
- Do you think that statistics plays a visible role in contributing to scientific research?
- How many statistics courses did you take at the undergraduate level?
- How many training courses in statistics did you take while being employed?
- Do you agree that biometrics-training course will improve scientific research?
- Have you participated in a workshop, training course or conference in the field of statistical science?
- What is the role-played by universities and research institutions in the integration of biometrics in scientific research?
- Does your agency encourage the training in statistical analysis?
- Do you think there is a need to establish an institute of statistics research in biological studies in Sudan?
- Do you think this institute will contribute to development of agriculture and natural recourses science?
- What are most problems do you faced in the field of statistical analysis?
- How do you analyze your scientific experiment?
- How do you get advice in biometrics?
- Which statistical analysis packages do you commonly used?

8.2   DATA COLLECTION AND ANALYSIS

The data were collected used survey questionnaire day by day and interviewed researchers; the final version of the questionnaire was then produced accordingly in Arabic and then translated into English language. The data were analyzed using non-parametric statistical methods in order to test a significance difference for all questions among their option. Results of the surveys were transcribed and analysis using Statistical Package for the Social Sciences (SPSS). This statistical software provided data analysis by frequencies, means, minimum, maximum, control chart for confidence interval and linear regression modeling considerations of trend analysis using Minitab software.

9   RESULTS AND DISCUSSION

Table 1. Descriptive statistics of scientific number of papers published, experiences numbers and age

Descriptive statistics	Number of scientific papers published	Practical experiences	Age
Minimum	1.00	3.00	34.00
Maximum	27.00	35.00	62.00
Mean	5.85	17.68	45.29
Std. Deviation	5.91	8.89	7.44

Table 1 shows desiccative statistics such as minimum, maximum, mean and standard deviation (SD. The results indicated that researcher under age 34 he had published one scientific paper, otherwise the researchers who has at least three years' experience work as scientific researcher under maximum age 17-years experiences, he able to published approximately at least 6 scientific paper. Researchers with maximum age were 62 and 35 year experience has 27 paper published. In general average of paper published is 6 and 18-year experiences with age 45. This means that every three years the researcher must be published at least one scientific paper.

Table 2. The percentages of statements studies concerning of statistical method to the scientific research

Statements	SAG	AG	DAG	H	NO	Sig
Is a statistical science and its applications in the agriculture have an active role in scientific research?	96.0	4.0	-----	----	------	0.007
Statistics is one of the scientific research methodologies	36.0	34.0	8.0	14.0	8.0	0.001
For the research to be considered as scientific, the researcher must follow the scientific research methodologies?	92.0	8.0	-----	----	------	0.002
Biometrics is the most ideal solution for improving performance and building capacity in scientific research?	50.0	44.0	2.0	2.0	2.0	0.001
Do you think that statistics plays a visible role in contributing to scientific research?	46.0	48.0	4.0	2.0	------	0.001
Do you think there is a need to establish an institute of statistics research in biological studies in Sudan?	64.0	26.0	4.0	2.0	4.0	0.001

Where the SAG= Strongly agree, AG= Agree, DAG= Disagree, H= Hesitant, NO= don't know and Sig= significant

Table 2 shows were statistical significant differences for all statements and their option choice. Most of responders strongly agree that, the statistical science and its applications in the agricultural sciences had an active role in scientific research by 96% while 4% agree only. As for statistics is one of the scientific research methodologies was 36%, 34%, 8%, 14% and 8% of option choice (strongly agree and agree only disagree, hesitant and don't know, respectively. However we suggesting that about 30 % 0f the researchers was not understand the statistical methods and 70% of them have knowledge of statistical methods and its relation. 92% of researchers strong agree that, the research to be considered as scientific, the researcher must follow the scientific research methodologies while 8% agree only. The results showed that 50% and 44% strong agree and agree respectively, the biometrics is the most ideal solution for improving performance and building capacity in scientific research while 2% for all other answer of (disagree, hesitant and I don't know). Generally we estimated that about 94% agree and 6 disagree. 46% and 48% of the researchers strong agree and agree respectively, that the statistics / biometrics plays a visible role in contributing to scientific research while 4% and 2% of disagree and hesitant. We estimated about 94% represented that, the biometrics has a clear contribution in scientific research. 64% and 26% of researchers of strong agree and agree respectively, the need of establishment an institute of statistics research in biological studies in Sudan, this indicted that is there an importance of creation such as institute of statistical research of biological studies to reflect contribution in scientific research particularly in agricultural research while 4%, 2% and 4% disagree, hesitant and don't know respectively. Generally we estimated that about 90% of researchers agree establish this institution while 10% disagree.

Table 3. Indicates the statement of training course and statistical subject

Statements	Yes	No	Sig
Have you taken statistics courses at the undergraduate level?	98.0	2.0	0.000
Have you taken training courses in statistics while being employed?	42.0	58.0	0.258
Do you agree that biometrics training course will improve scientific research	100.0	----	0.001
Have you participated in a workshop, training course or conference in the field of statistical science?	8.0	92.0	0.002
Does your agency encourage the training in statistical analysis?	58.0	42.0	0.396

Table 3 shows that there were a statistical significant difference among the yes and no for statements of 1, 3, 4 and 5 respectively. 98% of researchers had taken statistical courses at the undergraduate level while 2% did not take any subject in statistics. There were no statistical significant differences for training course of statistics taken while the researchers being employed at ARC in 42% and 58% respectively, while 100% of researchers agree that, the biometrics-training course will improve scientific research. 92 % 0f the researchers have not participated in a workshop, training course or conference in the

field of statistical science, while 2% have participated. The result showed that 58%, there was an encourage for training in statistical analysis by agency while 42% said was not an encouragement. In general the training courses in biometrics face the need of agricultural capacity building and build strong statistician/ biometrician through the research and development.

Table 4. Showed the number and training course of biometrical needs and its activation in scientific research

	How many training courses in statistics did you take while being employed			
N(%)	No	One	Twice	Third
	58	22	16	4
Period of Biometrics training courses needs				
N(%)	Every year	Every two years	Every three years	
	46	38	16	
What is the role played by universities and research institutions in the integration of biometrics in scientific research?				
N(%)	High	Little	Hesitant	Nothing
	30	36	10	24

Table 4 shows that 58 % of the researchers did not take any training course during research working while 22%, 16 % and 4% were trained for one, twice and third respectively in statistics/biometrics. As for Period of Biometrics training courses need, the results showed that, 46 % of the researchers needs the biometrics training courses to be held every year, while 38% and 16% needed to be held every two years and three years respectively, depend on the average of 100% approximately is 33%, which near to be (38%) and according to the cumulative percent 84 %. So the Biometrics training courses must be taken very two years. The result showed that the interactive role by universities and research institutions in the integration of biometrics in scientific research presented by 30% , 36%, 10% and 24, of high, hesitant and nothing respectively. Generally according to the cumulative 66 %, the extent of the interaction of research institutions and universities in role of biometrics in scientific research was very little.

Table 5. Indicates the statement of statistical subject and its problem and software

1-Statistics subject was taken at the undergraduate level	**N(%)**
Introduction to Statistics	40 (34)
Experimental design and analysis	46(39)
Biostatistics	14(12)
Operation research	1(0.90)
Statistical packages application	17(14)
2-What is most problems do you face in the field of statistical analysis?	**N(%)**
No problem	11(18%)
The concept of Applied Statistics	4(7%)
Statistical packages	25(42%)
Data processing and get the results	9(15%)
Statistical analysis	2(3%)
Interpretation of results	9(15%)
3.Which statistical analysis packages do you commonly used?	**N(%)**
Statistical System Analysis (SAS)	13(16%)
Genstat	16(20%)
Statistical Packages For Social Science (SPSS)	6(8%)
IRRISTAT	13(16%)
Mstatc	29(36%)
Others	3(3.75)

Through the results of study. Were found that, the distributed of searchers were 64%, 36% of male and female respectively and there no significant different at 5% and the educational level were 10%, 34% and 56% of Bachelor, Master

and Doctoral degree respectively. In general the highest percentages of statistics subject were taken at undergraduate level was 34% of introduction to statistics and 39%, 12%, 0.9%, and 14% of experiment design and analysis, Biostatistics, operation research and statistical packages application respectively, at 0.05 level of statistical significant. 25 % of the problems was faced in the field of statistical packages while 9 % in data processing and get the results and its interpretation and 11% there was not faced any problem some. 36 % of researchers commonly used Mstatc statistical analysis packages while 20%, 16%, 16%,13% and 8% were used of Genstat, SAS, IRRISTAT and SPSS respectively.

10   CONCLUSIONS

This paper described briefly the content of biometric capacity building of agricultural scientific research is designed for different study groups. 92% it has emphasized the importance of the use of biometrics research, which could be applied in agricultural work and were emphasized that, 100% of researchers strongly agree the biometrics will improve scientific research. 56% showed, there were weaknesses of training in biometrics for agricultural scientists and graduate students. This paper relates the work experiences of the researchers and publications, the results indicated that, every 10-year, the researcher must publish at least four scientific paper. And most problems were focused in statistical packages, statistical analysis, data management and interpretation of results. Mstatc statistical software was commonly used. Generally 90% of researchers agree that, for establishment an institute of statistics research in biological studies in Sudan. This paper showed importance of to study role of Biometrics capacity building for developing an innovative agricultural research system in Sudan. Depend on question; what is the extent of the interaction of scientific institutions and universities in the activation of statistics in scientific research? This study invited biometrician and the agriculture scientists (AS) must be collaborative to real headway. Because, Biometrician can tell (AS), which parameters affect selection success and in response agronomist can specify exactly, what is most important for achieving their goals. 96% of researchers confirmed that, the role of the biometrics capacity building providing the statistical expertise, ensure the hypotheses being tested in a study and statistical methods are presented completely an improvements of integrated scientific research and capacity building for cater to everybody's needs and assisting agricultural researchers to build and strengthen their statistical capacities to enable them produce reliable, timely consistent and accurate economic and appropriate statistical tools to analyze experimental data. The training courses for the researchers working in ARC adapted to the need and possibilities of target group at improving the capacity of researchers and quality of research should put more stress on critical thinking skills.

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