

# The philosophy of biometry as a basic tool for the improvement of global biological research

Stergios Tzortzios\*

## Abstract

It is well known the meaning and importance of the biometry in the entire flow of any biological and environmental research -from the first experimental design, to the data collection and their organization, the data manipulation and their analysis, up to the results interpretation and their presentation. It is also well known the "stataphobia" (the fear of statistics) that exists in the researchers -especially the young ones- in their efforts to carry on serious research. Certain surveys on the publications done up today in many countries revealed the remarkable gap that exists between the research work published by the researchers of the developed countries and those of the developing and much more the underdeveloped ones. In this study a review of the today's status of the biological research in all the countries is undertaken in order to present the possible reasons of the existing gap, hoping to reveal the proper solutions for the desirable improvement. Relevant references have been presented by experienced scientists in many biological-biometrical conferences, organized in the developing countries, noting the serious need of help for the improvement in the effectiveness of their biological research. The recent remarkable development of new technologies sciences-Information, Communication and Technology (ICT) offer the capacity required to this purpose. An interesting effort has already started by a forum of scientists from many countries by organizing a complete site in the internet on a platform based on the Library of Alexandria, called Research Methodologies of the Library of Alexandria (RMLA), offering many lectures on special research matters and the availability for accepting certain questions on research matters. The International Biometric Society-IBS- is the appropriate scientific society that could act based on the line of its bylaws in order to help the research effectiveness in the developing countries aiming to the improvement of the global biological research

Former Professor-University of Thessaly, Volos – Greece

\*Corresponding author: e-mail:stzortz@uth.gr and stzortzios56@gmail.com

## Contents

1	Introduction	37
2	What is the current Status	38
2.1	A brief presentation of the publications presented in journals for all the countries in the world . . . . .	38
2.2	Some aspects presented in various biometric conferences and meetings. . . . .	40
3	Survey and evaluation of biometric approaches in the field of agriculture in Greece	41
4	Prospects expressed by some biometricians	41
5	Comments on the Journals of IBS	42
6	General Conclusions-What is that IBS could do...	43

## 1. Introduction

The relevance of each of the words in the title may be understood by members of the International Biometric Society as the main servants of the science of biometry. Nonetheless, it is obligatory for a review of the Society's effectiveness in dealing with the application of biometry to improve on biological research globally. It requires that we interrogate the data. It will then be obvious that:

- There is a remarkable gap between the relative number of publications presented by the researchers of

the developed, the developing and under-developed countries.

- Even in the most developed countries there is not the best possible collaboration between statisticians and researchers in the fields of biological, agricultural and environmental sciences.
- It is a general admission that the current system of teaching biometry is not of the effectiveness expected-especially in developing countries.
- Collaboration between researchers of the various countries in biological research is lower than should be expected.

It is very urgent the call of the World's Organizations (e.g. FAO) for the proper actions of the scientific societies to make intensive efforts for the best possible research in the fields of environment-food production and supply-human health.

It is biometrician's duty to help the biological researchers in organizing their research from the first step of research experimental design, to data collection and its proper organization, data analysis and interpretation and the presentation and publication of results.

The current situation shows the importance of the necessary collaboration among and between biometricians

and researchers of the different scientific sectors in order to approach the research goals to the best and the most fruitful result. This is the subject of this paper - to emphasize the importance of this very serious matter and to make some proposals to IBS on the reorganization of its services and activities to best effect- based on the real meaning of its bylaws.

The Sciences have been created with their main task to create knowledge aimed at improving people's (health and welfare) standards of living. The politicians and the Governments require the knowledge derived from the sciences in order to make the proper decisions for the best possible welfare to their people.

Biometry's task -as a science- is to offer knowledge from its work in "measuring life" (as the word biometry is a Greek double word coming from the words "bio" which means life and "metro" which means measure.). According to the International Biometric Society's bylaws the task of the Society is the generation of knowledge in statistical applications in biological research, such as in the fields of the sciences of agriculture, medicine and environment.

The effect of these three sciences in the people's life is of the greatest importance. The chain of the influence of the environment to the form and quality of the agricultural production and the effect of both of them to the people's health and welfare consists in an integrated system that is the basic substance of the human life. Therefore this defines the importance of biometry as the responsible science from which the people require its proper contribution to their lives.

## 2. What is the current Status

Questions arise whether the today's performance of the IBS organization as an International Society offers the best possible contribution to the biological research globally. But the various calls for help in research collaboration from all the developing countries don't support this. On the contrary, urgent ascertainments on the need for changes in the methodology of teaching biometry -as applied research methods and statistics in scientific sectors - and on the collaboration in the practice, are quite often outputs in IBS conferences, especially in those of the IBS Regions and Groups of the developing countries.

In the following an attempt is presented to get an idea about the research done in the last years in all the countries in the three sciences- environment, agriculture, health-medicine, through their publications in the period from 1996 to 2013 and make the comparisons between them:

### 2.1 A brief presentation of the publications presented in journals for all the countries in the world

All the studies refer to the period 1996-2013

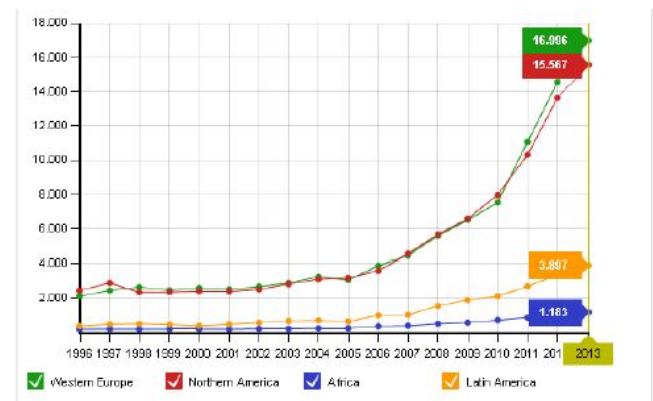
**A.**The documents of ALL the countries presented in journals

In the subject area of "Agricultural and Biological Sciences miscellaneous" The number of publications range from for USA down to 1 or 2 and up to 50 in the 110 developing countries (out of 220 in total), with the respective number of Citations per document ranging from 29 to 0 or 1 up to 5, and the H-Index from 287 to 0 or 1 up to 10.

In the subject area of "Environmental Sciences Miscellaneous" the number of publications range from 54000 (for USA) and around 10000- 20000 for five more developed countries down to 1- 10 in 140 developing countries (out of 214 in total), with the respective citations per document from some thousands or hundreds for the developed countries down to 0 or single digit numbers for developing countries.

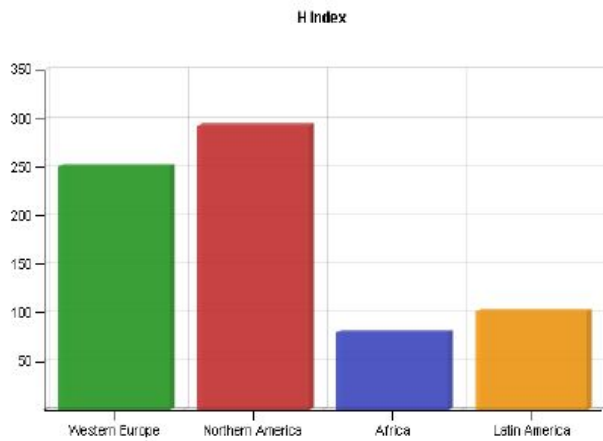
In the subject area of "Health Professions Miscellaneous" the number of publications range from some hundreds to the most developed 23 countries down to 0- 50 for the rest of the 126 countries presented no comments for the citations.

**B.**A comparison between the continents for their published research

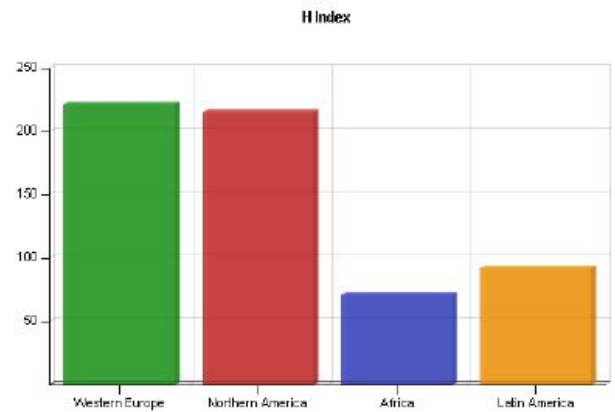


**Figure 1.** Comparison W Europe-N America-Africa-Latin America for Documents

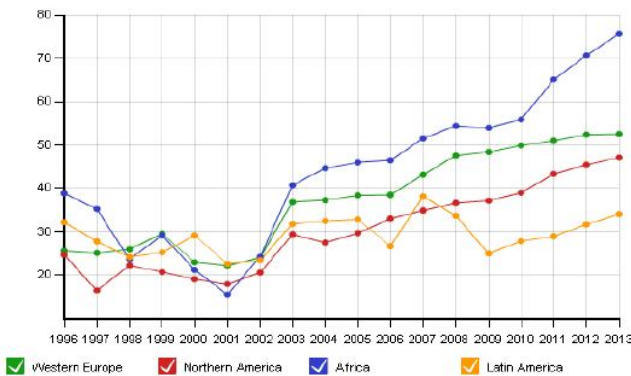
Figures (Fig. 1-3: Agricultural Research, Fig. 4-6: Environmental Research, Figure 7-10: Health Research) show the great difference between the continents, and more particularly between the developed and developing countries in the number of publications and their H-Index (one of the measures of publication quality). However, it can be emphasized that there is increasing interest in the developing world in collaboration with colleagues from other countries in order to increase the quantity and quality of their biological research.



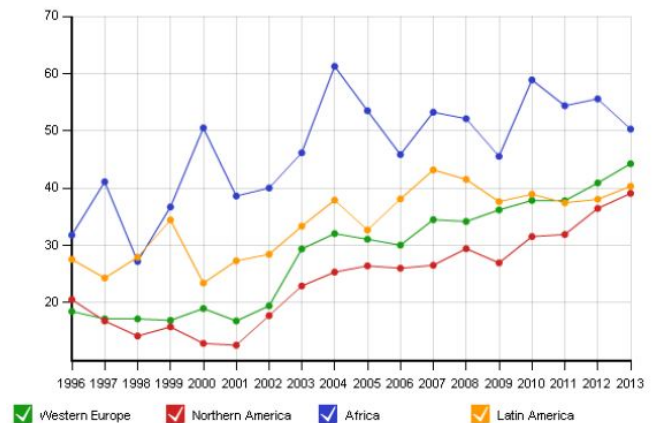
**Figure 2.** Comparison W Europe-N America-Africa-Latin America for H-Index



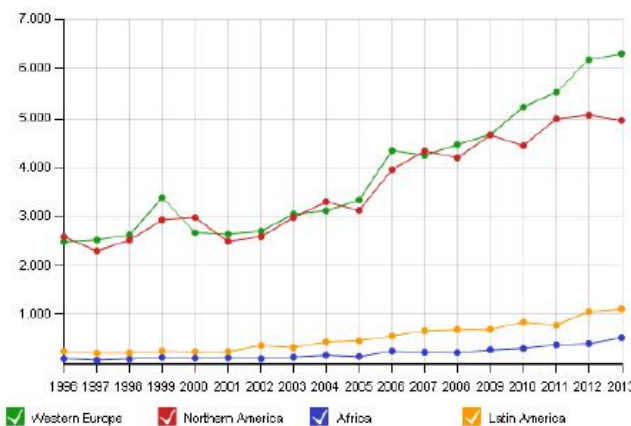
**Figure 5.** Comparison W Europe-N America-Africa-Latin America for H-Index



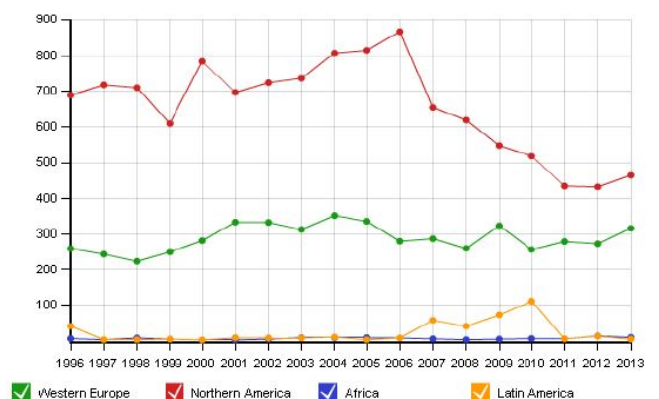
**Figure 3.** Comparison W Europe-N America-Africa-Latin America for International collaboration



**Figure 6.** Comparison W Europe-N America-Africa-Latin America for International collaboration



**Figure 4.** Comparison W Europe-N America-Africa-Latin America for Documents



**Figure 7.** Comparison W Europe-N America-Africa-Latin America for Documents

## 2.2 Some aspects presented in various biometric conferences and meetings.

From a very extensive search undertaken through many biometric conferences and meetings organized by various IBS regions mainly in the developing countries it was discovered what is very well presented in the following reports:

In the African conference of 1999 in Sudan in her speech J. Riley (1998) presented on “Strengthening biometry and statistics in agricultural research: Review of the CTA study”. It referred to a study done between 1995 and 1998 by the Technical Centre for Agricultural and Rural Cooperation (CTA) and Rothamsted Experimental Station to examine the reasons underpinning the problems encountered by scientists in African, Caribbean and Pacific countries (ACP) in incorporating good biometric quality in their research work.

Four desk studies were conducted:

- **Book study:** This study surveyed a wide range of statistical textbooks in English and French and their suitability for use in developing countries. They were reviewed and listed with categorizations ranging from ‘easy to understand, suitable for non-statisticians learning basic statistics’ to ‘advanced methodologies, suitable for research statisticians.’
- **Survey of international agricultural research centre (IARC) biometricians:** This study surveyed biometricians in the Consultative Group on International Agricultural Research (CGIAR) centres and queried the extent of their interactions with national agricultural research institutes (NARIs).
- **Survey of NARI professional biometricians** This survey queried the training levels of these biometricians, their available equipment and software.
- **Survey of Pacific Researchers:** This desk study examined more thoroughly a range of scientists in the Pacific region to substantiate the questionnaire survey.

In order to explore more deeply the reasons why scientists may not have good biometric skills or support, a case study was made of a national agricultural research service in an African country.

This three-week study involved an assessment of the position in the organisation of the biometrics personnel, a study of the efficiency of the services provided by them to the scientists and recommendations for future developments of the group.

Among the findings were the following:

1. The lack of relevance of many national and international biometric training courses was shown and their relationship with the paucity of ACP scientific research publications.

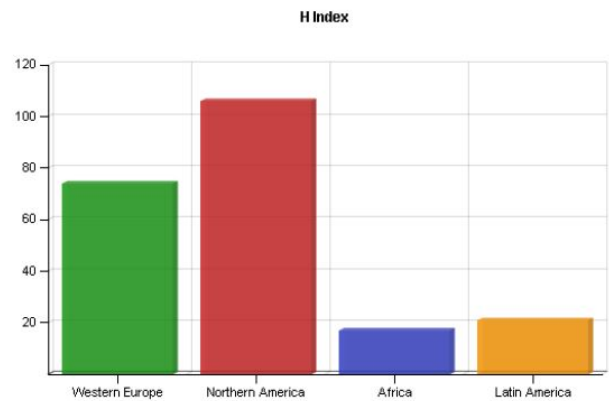


Figure 8. Comparison W Europe-N America-Africa-Latin America for H-Index

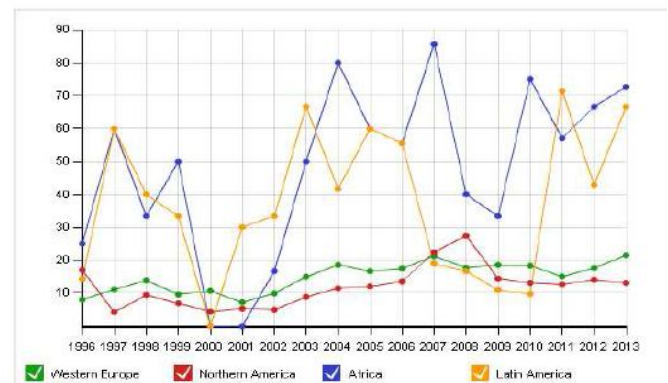


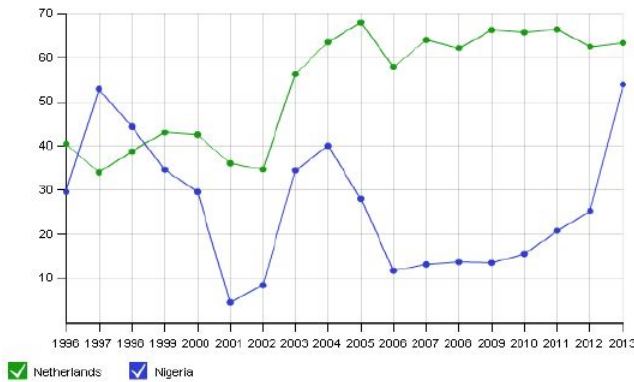
Figure 9. Comparison W Europe-N America-Africa-Latin America for International collaboration

2. Biometricians are encouraged to address practical agricultural problems and to interact with scientists using fewer technical terms to promote biometric understanding.
3. The NARI had already been subject to a major restructuring programme to modernise its approaches in relation to globalisation and market reform.
4. The need for biometricians to develop skills in multidisciplinary areas is essential, both to be equipped to respond to the changing needs proposed by the NARI restructuring programme and to ensure continued job prospects. Time must be made available for the biometrician to talk to scientists and to plan collaborative work programmes.

**The Conclusions** Together with the biometrician it was proposed a strategy to provide:

- improvements in the skills of the biometrician, in-





**Figure 10.** A Comparison between Netherlands-Nigeria for their International Collaboration (in percentage of documents with more than one country)

volving short attachments to biometricians in European universities,

- training courses provided by IARC biometricians (from which the NARI biometrician would gain knowledge) and
- the identification of key scientific personnel to go to the IARC centres for training in specific biometric topics. In this way, skilled biometric resource persons would be available in the scientific departments, alleviating pressure from the NARI biometrician who could concentrate on the provision of more advanced biometric advice.
- Whilst all institutes are different, there are common factors underlying the lack of progress in improving biometric skills.
- The first of these is the need to upgrade regularly with new techniques. Whilst training attachments are fruitful, they are expensive and it is becoming more cost effective with increased access to the Internet to find material on these techniques at a range of websites.
- The second factor was to be aware of the changes in research directions as globalisation and environmental concerns become more important, and to have the skills to manage these changes by updating one’s biometric knowledge with the most appropriate skills to support the new directions.
- The desire to learn every new technique should not be encouraged, but to develop expertise in key methods appropriate for the clients’ priority research, which will develop the biometrician’s own confidence and encourage others’ confidence in him/her.

As a general conclusion: It is better to manage well a little knowledge than to mismanage a lot of knowledge.

### 3. Survey and evaluation of biometric approaches in the field of agriculture in Greece

To get an idea about the biometric deficiencies in the Greek agricultural research a project was undertaken (in 2002-2003) by the Lab. of Biometry/University of Thessaly (Prof. S. Tzortzios) on the “Survey and evaluation of biometric approaches in the field of agriculture” in Greece at first stage and in collaboration with another European small country. A first remarkable conclusion was the notable difference between the various basic sectors of agriculture in broad sense (e.g. plant science and production, animal science and production, food technology, engineering and natural resources, forestry, agricultural economics and management) on the following main biometrical approaches: (a) ways of Data Management, Collection, Organization and Manipulation; (b) Methods of Statistical Analysis-processing; (c) the Experimental designs used; (d) the computer equipment-Software used.

It was somewhat unsurprising due to the natural differences in their research subject and material from basic points of view; but at the same time it could be a very helpful tool to all of them mutually in case each one of them knew the work done by the others and they could find ways of exchanging their knowledge and experience. It is probably the duty of the Labs of Biometry in each research centre to help the biological scientists by offering their collaboration in all the steps of their research.

### 4. Prospects expressed by some biometricians

Since 1983, Marvin Zelen in his Invited speech in the IBS Conference (Biometrics © 1983 International Biometric Society) of the title “Biostatistical Science as a Discipline: A Look into the Future” noted: “The field of biostatistics is enjoying unparalleled developments. Never before have members of our profession been in such demand. Current applications are significantly influencing the direction of research in statistical methodology. It is not clear whether there is a discipline which can be termed ‘biostatistics’, but we are part of the emergence of a discipline which is termed ‘biostatistical science’.

It refers to the applications of statistics, probability, computing and mathematics to the life sciences, with the goal of advancing our knowledge of a subject-matter field in this area. This paper discusses the role of computing, some aspects of training, and future directions of biostatistical science. A special role is envisioned for the Biometric Society to be more active in problems associated with developing countries.

In another keynote talk of the title “Biostatisticians, Biostatistical Science and the future” in EMR2005 conference Marvin Zelen noted: “I prefer to use the term Statistical Science to describe the practice of Statistics.

By Statistical Science, I mean the application of statistics, probability, mathematics and computing to advance our understanding of a subject matter field. I refer to the practitioners of Statistical Science as Statistical Scientists - not Statisticians. The terms statistics and statisticians have an ancestry when statistics was concerned with “political arithmetic”.

When the main field of application is in the biomedical sciences or agronomy we may often describe this activity as Biostatistical Science and its practitioners as Biostatistical Scientists. Nearly all of us have ready access to enormous communication and computational capabilities which were undreamed of a few decades ago. Many of us are on the Internet every day. This has changed the way we practice our science. Chief amongst these is the globalization of the way biostatistics is practiced.

For example we have not fully taken advantage of the potential of our communication resources to educate our biostatistical scientists. I propose that our profession assemble courses on the internet which would be freely available. Many faculty have favorite courses which could be made widely available.”

In the EMR2011 Conference, Professor Ronald E. LaPorte in a invited speech on the title “Building Global Capacity in Statistics” reported (for the “Supercourse” team):

- “World wide there are over 300 times more clinicians than there are statisticians. There are 20 times more morticians than those trained in statistics. In many developing countries there are no statistical training programs. This is at a time when there has been an explosion of data. There is a critical need for more individuals to be trained in statistics in developed and developing countries alike. Ideally we would like to build more Masters and Ph.D. programs in developing countries. However, this is not practical as there typically is not the expertise for teaching, and in these days the costs are prohibitive. We have taken a deferent approach for work for development in statistics and other areas. Our goal is not to produce PhDs in statistics, but rather to build awareness and interest in statistics for students. We want to double the training in statistics worldwide in the next 5 years.
- In most medical, and nursing schools worldwide in 4-6 year training students might have 15 minutes training in statistics. The reason that there is a paucity is that few faculty can teach statistics. We are changing this. Our approach is simple, we have a network of over 50,000 faculty interested in global health and prevention from 174 countries. From this network we have collected 4800 top quality lectures, 75 from Nobel Prize winners. We make the lectures available in a free open source library

([www.pitt.edu/super1/](http://www.pitt.edu/super1/)).

- We feed the lectures back to the faculty and the world, and they are then able to teach in areas that may not be their primary areas of expertise, as they have top quality, up to date lectures.
- We have already doubled the training of global health in the world. There are 31 different languages represented in the supercourse. In the past year our lectures have taught over 6 million people. We have distributed these lectures to all medical, public health and nursing schools in the world.
- We propose to build a statistical supercourse where we collect the top lectures of statistics and make these available for free. We currently have about 30 statistical and research design lectures available.
- The last two years, responding to an invitation by Ronald LaPorte I (as an IBS member and EMR President) had a good collaboration with Professor Ronald LaPorte and his colleagues in an effort to develop an International Library on research methodologies –the so called RMLAas a basic source of knowledge to the young scientists-researchers of the developing countries. To this purpose some months ago we contacted the President of IBS –Dr John Hinte - with our proposal to include the RMLA in the links of IBS for which we were given the IBS Commission’s approval for they found the idea quite interesting. We hope it will help IBS to better offer its contribution to the improvement of the biological research globally.

## 5. Comments on the Journals of IBS

Borrowing some of the information presented in Billard’s paper (1996) “The Roads Travelled: Our 50-Year Journey” (in “Advances of Biometry-50 Years of the International Biometric Society”) the following are considered as comments of a great interest:

- Having said that in apparent and real defense of our mathematically oriented members, I do agree (Billard notes) and sympathize with our members who are primarily trained in biology or agriculture or the like but who depend on statistical procedures as the primary tool in the design and hence the analysis and interpretation of experiments in their substantive field.
- Their contentious complaint is that Biometrics papers are far too mathematical to be read, and that furthermore they appear to be written solely from a theoretical standpoint, with the authors subsequently casting around for an example to which the theory can be applied after it has been developed.

- Let's quote from C. I. Bliss in his 1958 account of the first decade of the Biometric Society and in particular his review of the role of Biometrics: One [of] the periodic complaints of our biological members [is] that the journal is becoming too 'high brow' statistically for them to understand, and the counter-complaint of the Editor that good biological, less technical manuscripts are hard to come by, despite numerous pleas for material.
- After all, editors cannot accept papers that are not submitted for publication.
- Well, it may have been 40 years since the Belgium proposal in 1953, but in 1993 agreement was reached to move ahead with plans for a new journal called the Journal of Agricultural, Biological, and Environmental Statistics (JABES) As the name suggests, the journal
- ... emphasises applications of statistics in agriculture, biological, and environmental sciences ... [seeks] articles of immediate and practical value to the applied workers in these fields ... to develop the interface between statistics and the biological sciences .....only applied papers will be considered [note the specific exclusion of theoretically focused papers] ..... expository, review and survey articles addressing broad-based statistical issues in the biological sciences will be valuable...
- To organize more IBS conferences in the areas of the developing countries, e.g. Africa, South America,...
- To make suggestions to the IBS Regions to develop specific collaborations with researchers of the developing countries.
- To decide the disposal of a special budget for post-graduate and postdoctoral biometric studies to make their research in the developing countries.
- To make suggestions to the IBS Regions to accept in their conferences mainly papers referred to biometric applications in the three basic sectors of the IBS , e.g. medicine, agriculture, environment, (the pure statistical papers could be presented as posters or a few selected in a special session.)
- To do the same suggestions to JABES to accept only or mainly applied biometrical papers for publication.
- To organize a Global Committee and Sub-committees for the yearly collection of the research done on each of the three basic sectors in order to announce the general conclusions to the proper International Organizations (and maybe to the respective Governments).
- To create internet links with other Scientific Libraries of the Life Scientific Societies in order to be kept aware about their research interests and organize the relevant collaborations.
- To construct the IBS site in a such way so that most of the as above information can be straightforwardly available to and announced for all the researchers and all the interested World Organizations.
- To maintain links with the IT scientific Societies e.g. BioIT, WFITA for their contribution to a better utilization of the multi-factorial projects information from the life sciences research globally.

### Evaluation of the publications

- If one goes through the papers presented in the IBS conferences and the publications in the IBS journals one shall realize that in the Practical Applications of Statistics in the biological research, and more particularly in the fields of agriculture and environment, are not more than 50% of the total, although-according to the IBS bylaws they should be nearly to 100%.
- In the journal of "Biometrics" it is much lower
- It is very strange particularly in regards to the journal of JABES -which was created on the purpose of giving the solution to the problem of "Biometrics" after all those comments and suggestions made by many IBS members since some decades ago.

## 6. General Conclusions-What is that IBS could do...

- To assign to the Education Committee the work of the construction of a proper teaching programme –as a guide to the Schools, based on the most interesting biometrical practical applications to biological sciences according to the most important scientific interests nowadays. ....