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Biometry in the Third World (1)

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Summary

The aim of this paper is to give an overview of the present situation of biometry in the Third World.
It includes a brief analysis of the directories of the Biometric Society (section 2), some results of a survey of agronomic research and teaching institutions in the Third World (section 3), and some conclusions and suggestions (section 4).

Résumé

Cet article a pour but de faire le point de la situation de la biométrie dans les pays du Tiers Monde.
Il comprend une étude des listes de membres de la Société Internationale de Biométrie (paragraphe 2), les résultats d'une enquête réalisée dans les pays en voie de développement, au niveau des institutions de recherche et d'enseignement agronomiques (paragraphe 3), et quelques conclusions et suggestions (paragraphe 4).

1. Introduction

„Needs of biometry in the Third World" was one of the main themes of the 11th International Biometric Conference held in Toulouse, France, from 6 to 10 September 1982. Three papers were presented to this conference as a basis for a general discussion (2, 6, 7). This paper summarizes and supplements the contents of the first of these.

2. Analysis of directories of members of the Biometric Society.

2.1 Sources

Directories of members of the Biometric Society were published fairly regularly at intervals of 3 to 5 years between 1949 and 1975, and then starting again in 1982. These directories have been analysed to discover the distribution of members in different countries and groups of countries.

The numbers of members arrived at by this method have then been compared with the total populations of these countries or groups of countries, using population figures from the *United Nations Statistical Yearbook*.

2.2. Findings

The findings are summarized in tables 1 and 2. Figures are given only for 1949, 1957, 1965, 1975 and 1982. The different countries are grouped together as follows:

Africa:	all the African countries;
America 1	Canada and the USA;
America 2:	other North American, Central American and South American countries;
Asia-Oceania 1	Japan, Australia and New Zealand;
Asia-Oceania 2.	other countries of Asia and Oceania, including the Peoples' Republic of China and the Asiatic part of the USSR,
Europe:	all the European countries, including the European part of the USSR.

The group comprising

America 1 + Asia-Oceania 1 + Europe,

is conventionally considered to represent the „developed" countries, while the group comprising:

Africa + America 2 + Asia-Oceania 2,

is considered to represent the „developing" countries.

It would of course have been possible to make smaller subdivisions, but this would probably not have led to very different results.

2.3. Comments

1 Tables 1 and 2 clearly show the disparity between developed and developing countries. There are several points which are worthy of note here.

Table 1 shows that in 1957, the developing countries accounted for only 10% of the membership of the Biometric Society, even although these countries had more than two thirds of the world's population. 25 years later, in 1982, this percentage had fallen to 6%, even although these countries by then had more than three quarters of the world's population. Further, table 2 shows that from 1957 to 1982, the situation in the developing countries hardly changed at all (0.10 member of the Biometric Society per million

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TABLE 1

Number of members of the Biometric Society in different groups of countries

Groups of countries (see 2.2 above)	1949	1957	1965	1975	1982
America 1	570	623	1 425	2 137	3 204
Asia-Oceania 1	38	125	169	244	443
Europe	209	557	921	1 344	1 787
Developed countries	817	1 305	2 515	3 725	5 434
Africa	3	26	30	21	30
America 2	26	97	87	159	241
Asia-Oceania 2	54	28	60	63	68
Developing countries	83	151	177	243	339
World	900	1 456	2 692	3 968	5 773

TABLE 2

Number of members of the Biometric Society per million inhabitants in different groups of countries

Groups of countries (see 2.2 above)	1949	1957	1965	1975	1982
America 1	3.5	3.3	6.7	9.0	12.8
Asia-Oceania 1	0.4	1.2	1.5	1.9	3.2
Europe	0.4	1.0	1.5	2.0	2.6
Developing countries	1.0	1.5	2.7	3.6	5.1
Africa	0.01	0.1	0.1	0.05	0.06
America 2	0.2	0.5	0.4	0.5	0.6
Asia-Oceania 2	0.04	0.02	0.03	0.05	0.03
Developing countries	0.05	0.08	0.08	0.08	0.10
World	0.40	0.50	0.80	1.00	1.30

inhabitants in 1982, as against 0.08 in 1957), while in the same period there was a large increase in membership in the developed countries, with a three to fourfold increase in the number of members of the Biometric Society per million inhabitants.

To illustrate this disparity, it can be reckoned that if developed countries were to have the same ratio of members to population as the developing countries (0.10 member per million inhabitants), then countries with 10 to 15 millions inhabitants such as Australia, Belgium and the Netherlands would only have one or two members, while countries with 50 to 60 millions inhabitants such as France, the United Kingdom and West Germany would have 5 or 6 members, and the USA would only have 20 to 25 members!

If the Biometric Society is taken to be representative of biometry in the world as a whole, then it must be concluded that the *Third World has been excluded* from the development of biometry in recent years.

2. It should also be noted that this classification of countries into six groups does not show up the „internal" disparities in both the developing and developed countries.

Thus, it appears that the figure of 5.1 members per million inhabitants in the developed countries in 1982 results from an average of more than 12 members for the USA and Canada and an average of about 3 members for the other countries in this group (table 2). However, it should be added that this last average results from figures of 7 to 8 members or more per million inhabitants in countries such as Australia and New Zealand, Austria, the United Kingdom, West Germany and Switzerland, while the membership figure for the countries in this group is generally not greater than one member per million inhabitants.

Further, it should be noted that of the 339 members in developing countries in 1982 (table 1), 179 or more than 50% were in fact located in Brazil, so that if Brazil is excluded from the reckoning, the figures of 241 for America 2 and 339 for all developing countries become 62 and 160 respectively.

3. The wide gap between developed and developing countries is not of course unique to the Biometric Society.

Thus in 1982, 80% of members of the International Statistical Institute belonged to the developed countries (as defined above), with only 20% belonging to developing countries, this despite the Institute's structure, which ensures systematic representation of the national statistical services of different countries and thus necessarily ensures better representation of the different regions of the world. Even so, when membership of the International Statistical Institute is calculated per million inhabitants in the same way as has been done for the Biometric Society in table 2, these figures show a discrepancy of a factor of 15 between the developed and developing countries (the comparative factor for membership of the Biometric Society being 50).

This situation has already been underlined in various other reports prepared for the International Statistical Institute (3,4).

3. A survey of biometry in developing countries

3.1 Organization

1 The survey was carried out by writing to the heads of 873 agronomic research and teaching institutions in 107 countries.

Their addresses were taken from Burkett's *Agricultural Research Index*(1). This index is certainly not perfect as a basis for such a survey, but it seemed to be the most comprehensive list available to us.

The survey covered all the countries of Africa, America (excluding the USA and Canada), Asia (excluding Japan) and Oceania (excluding Australia and New Zealand), i.e. all countries considered to be developing countries (section 2.2). The survey was also addressed to international organizations with headquarters in these countries.

2. In collaboration with various Belgian colleagues and colleagues from other countries, a questionnaire was prepared which covered the general features of the institutions to whom it was addressed, the existence (if any) of specialized biometric and/or statistical and/or computation services, the extent of these services, and the material and documentation available to them.

3. Questionnaires were prepared in French and English as appropriate, and sent by ordinary post in November 1981. 160 replies were received by 28 February 1982.

In March 1982, personal reminders were sent to some 30 biometricians with whom we had previously had contact either directly or indirectly and whose institutions had not replied. Another 42 replies were received between March and July 1982, mainly as a result of these reminders(1).

4. The total of 202 replies received up till 31 July 1982 covered 71 different countries: 34 African countries, 17 American countries and 20 countries of Asia and Oceania.

Although the response rate of only 23% may seem rather low, the proportion of countries from which replies were received was relatively large, amounting to 66%. Further, the countries from which replies were received between them represent nearly 85% of the population of developing countries.

3.2. Analysis

1. 29 of the 202 replies were discarded after a first, critical examination. Those discarded included:

8 replies from institutions whose headquarters are in Europe and not in Third World countries, and describing working facilities available in Europe and not in the developing countries;

3 replies which duplicated other replies (partial replies from research stations belonging to organizations from whom we had already received more complete replies);

5 replies from commercial or production companies, e.g. companies engaged in producing seed stock;

6 replies which stated that no biometric and/or statistical and/or computation services existed, without giving any further information;

7 replies which were too fragmentary to be considered.

2. Analysis of the remaining 173 replies mainly consisted of calculating percentages and averages. These calculations were made for all kinds of institutions together, and also for two subsets of institutions consisting of the „small" and „large" institutions, these two subsets being virtually equal in size.

Large institutions (72 replies) were taken to be those with a total staff of more than 200, of whom at least 40 had a university education or equivalent. The small institutions (73 replies) included institutions which did not come into the first category, but with the exception of those which did not volunteer any information about their personnel and so could not be placed in either category, and with the exception also of some very small institutions with a total staff of less than 20 and/or with less than 5 people with a university education or equivalent.

3.3. Findings

1. The findings are summarized in table 3 in the form of percentages and averages for all kinds of institutions together and for the two subsets described above.

The number of replies taken into consideration in calculating the overall percentages or averages is also stated in each case, as certain questions were sometimes not answered or received answers which were difficult to interpret.

2. The figures under the headings *geographical distribution, status* and *type* of institution hardly need to be commented on. It should, however, be noted that a very large proportion (about 75%) of the total number of institutions are national or international institutions.

The figures for *total personnel* and *personnel with university education* show that the large institutions are on average some nine times larger than the small institutions. It should also be noted that some of these „large institutions" are in fact the total research and teaching staffs of the ministries of agriculture of certain countries.

The total number of personnel for all of the replies considered was nearly 130 000 of whom some 25 000 had a university education or equivalent.

3. As regards *specialized departments,* i.e. specialized biometric and/or statistical and/or computation departments, there are evident differences between „large" and „small" institutions. It can also be seen that in the 55% of cases where such departments exist, on average they employ less than 2% of the total staff of the institution (13 people out of 770) and have about 4% of the people with a university education or equivalent (6 people out of 150). These percentages are much higher in the „small" institutions than in the „large" ones.

In addition, however, just over half of the replies (54%) stated that besides these specialized departments or where such departments do not exist, certain staff members devote a large amount of their time to biometric, statistical or computational work, although it is difficult to put a precise figure on the volume of this work.

Further, certain institutions (6%) stated that recourse was had to external facilities for biometric and/or statistical work. Overall, however, the proportion of institutions which do no work at all in these fields (i.e.

(1) Some other replies arrived after the rest had been analysed.

TABLE 3

Main findings of the survey: percentages and averages for all replies together (Tot.), small institutions (S), large institutions (L), and numbers of replies (n)

Characters	Total	S	L	n
Geographical distribution (%)				173
Africa	46	53	36	
America	17	14	22	
Asia-Oceania	37	33	42	
Status of institutions (%)				161
International institutions	7	7	9	
National institutions	68	70	64	
Regional or local institutions	25	23	27	
Type of institutions (%)				171
Teaching	1	—	—	
Research	44	49	38	
Teaching and research	55	51	62	
Personnel				
Total personnel (average number of people)	770	170	1 450	153
Personnel with university education or equivalent (average number of people)	150	30	280	156
Specialized departments				
Institutions with one or more specialized biometric and/or statistics and/or computation departments (%)	55	42	75	172
Total staff of these departments (average)	13	8	17	93
Personnel with university education or equivalent (average)	6	4	8	92
Computers				
Institutions with one or more computers (owned or rented) (%)	33	28	39	168
Institutions with one or more computers (owned or rented) or with access to one or more computers	59	52	71	170
Proportion of computers with maximum memory capacity of 64 K-bytes	32	37	28	85
Main compilers available (%)				82
Fortran	85	82	89	
Cobol	59	54	61	
Basic	43	50	36	
PL/1	23	7	36	
Algol	13	11	11	
Main packages of statistical programs available (%)				84
SPSS	33	18	35	
BMD	23	21	24	
SAS	21	11	30	
No statistical package available	37	36	39	
Journals available				
Biometrics (%)	36	21	53	166
Biometrika (%)	20	9	33	162
Biometrics and Biometrika (%)	19	9	30	162
One or more other biometric and/or statistical journals (%)	24	14	39	166
No biometric and/or statistical journal available (%)	61	79	41	161
Total number of biometric and/or statistical journals available (average)	4	4	4	62
Books available				
No book on biometry and/or statistics available (%)	8	6	3	159
Number of books on biometry and/or statistics available (average)	94	52	148	103

which do not have any specialized departments or specialist personnel or which do not use outside help) is still relatively large: 14% of „small" institutions and 7% of „large" institutions.

4. As regards *computers*, there are differences between „large" and „small" institutions, both in hardware and software. It should also be noted that software not mentioned in table 3, in particular Genstat and Glim, are used by less than 10% of the institutions having one or more computers.

5. As regards *journals* and *books*, careful examination of the figures in table 3 shows that of the various biometric and statistical journals available, Biometrics is almost always the first and Biometrika the second. Note also that the averages given for journals and books available only refer to institutions which take at least one journal or have at least one book (similarly, the figures given above for personnel of specialized departments only refer to institutions which possess such departments, and the figures for availability of computer programs only refer to institutions which own, rent or otherwise have access to one or more computers).

Also as regards journals, it appears that collections of Biometrics and Biometrika are generally fairly extensive; in 75% of the institutions which hold issues of these journals, they go back for more than 10 years.

3.4. Comments

1. In summary, from the figures given in table 3, we may draw the following picture of biometry in the Third World as a whole, at least as far as agronomic research and teaching institutions are concerned.

The „average" institution has a staff of 770, of whom 150 have an university education.

In one case out of two, this institution does not have a specialized biometric, statistical or computation department. Where such a department does exist, it occupies one sixtieth of the institution's total staff and one twenty-fifth of its university-trained personnel.

In two cases out of five, this institution does not own, rent or have access to a computer. In one case out of five, this institution owns, rents or has access to only a very small computer (i.e. with a maximum memory capacity of 64 K-bytes). In two cases out of five, this institution owns, rents or has access to a larger computer. Even where such an institution has access to a computer, then in more than one case in three it does not have any special statistical software.

Finally, in three cases out of five, this „average" institution does not have any biometric or statistical journal. In one case out of five, it only has Biometrics, and in one case out of five also it has Biometrics and one or more other biometric or statistical journals, usually Biometrika. This institution also has at least some books on biometry or statistics in nearly every case.

2. This picture of biometry in the Third World, which of course must be varied to suit particular circumstances, may appear to be very pessimistic. Our impression is that on the contrary it ought to be considered as definitely more optimistic than the actual situation warrants.

As mentioned above, in several cases the heads of institutions stated merely that no biometric, statistical or computation department existed, without volunteering any other information (section 3.2). It is also probable that the non-existence of such departments is the reason for a large proportion of the non-replies, so that the replies received in fact represent a biased sample of the population under consideration.

As further mentioned above, reminders were sent to biometricians with whom we had previously had contact (section 3.1), which means of course that they were sent to institutions with some kind of biometric department. Thus although these reminders had the advantage of increasing the number of replies received, they also had the disadvantage of accentuating the systematic error which has just been referred to.

3. Taking account of these additional factors, a more realistic picture of the situation could reasonably be said to be only half as optimistic as indicated by table 3. Such a view would lead, for example, to the supposition that among agronomic research and teaching institutions in developing countries, institutions with a staff of 1000, including 200 university-trained personnel, possess a *biometric, statistical or computation department in only 25 to 30% of cases,* have *access to data processing in only 30% of cases* and have *recent literature on biometry or statistics in only 20% of cases* (by recent literature is meant one or more journals).

This judgement is of course open to question, but the results obtained nevertheless seem to firmly establish that in 1982, *the majority of agronomic research and teaching institutions in the Third World, even quite large institutions, operated without any biometric, statistical or computation department, without regular literature in this field and without the aid of data processing.*

4. Conclusions and suggestions

1. The two surveys described above clearly show how far behind the developing countries are compared to the developed countries in the field of biometry. These two surveys, particularly the first one, also show that far from narrowing, this gap is rapidly widening.

This situation is all the more deplorable since despite having minimal resources, developing countries have very great needs in this field. As well as having problems similar to those of developed countries, the developing countries also have special problems of their own, as described by Pearce (6) and Preece (7).

This gap between developed and developing countries is doubtless not unrelated to the gap between the theory and practice of biometry and statistics which is apparent to some people; research work presently being carried out, the resulting publications and even the teaching based on it are in many cases increasingly removed from concrete reality (3,4).

2. However, if we are to be constructive it is not sufficient to point out or even deplore the present situation; we must also try to do something about it.

To this end, the following suggestions are offered as examples of action which could be taken at three different levels: international scientific organizations and societies such as the Biometric Society and the International Statistical Institute, individuals, and academic authorities.

3. *International organizations and societies* should do more to encourage contact between members from different countries, especially developed and developing countries, by,

- publishing a list of members at regular intervals, with the full address of each member and an index of members in different countries;
- always publishing lists of participants at international conferences and meetings, and making that authors' names always appear on the summaries of papers read;
- giving as much attention as possible to practical matters in journals, in particular by publishing articles which draw a synthesis;
- encouraging the use of different languages, both at international conferences and meetings and in journals;
- encouraging exchanges of teachers and researchers, in particular with Third World countries, and setting up special funds for this;

and perhaps also by:

- organizing parallel sessions during international conferences and meetings, some theoretical and others more practical (e.g. case studies);
- encouraging regional conferences or seminars to deal with certain more specific topics, e.g. concerning a continent or group of countries;
- allowing reduced rates or special facilities for payment for members from the Third World or certain Third World countries, both as regards subscriptions and participation costs for regional or international meetings and conferences.

4. *Individuals* should make efforts to be more open and available, both in scientific terms and as regards external contacts, by:

- acquiring better knowledge of „foreign" languages (i.e. other peoples' languages!);
- expressing themselves as clearly as possible in their own language, so that „other peoples" will have

as little difficulty as possible in understanding the „foreign" language;

— at international conferences and meetings, presenting summaries, slides, transparencies, etc. in two or more languages, or simply in a different language from the oral presentation;

— devoting more time to concrete problems encountered by researchers in other disciplines, e.g. biologists, agronomists and veterinarians, even if time has to be taken from the individual's own research;

— devoting some time, or more time, to the Third World.

To illustrate this last point, it is sufficient to refer to the most recent figures given in table 1, from which it can be shown that the potential of Third World countries (339 biometricians) would be doubled if each of the 5 434 biometricians in developed countries devoted only three weeks each year (6% of their time) to developing countries.

As regards the problems of oral presentation (i.e. presentation methods and difficulties of comprehension of foreign languages), reference may usefully be made to observations by Finney (5).

5. *Academic authorities* (e.g. deans of faculties, heads of departments, etc.) play a crucial intermediary role between individuals (e.g. lecturers, researchers, consultants, etc.) and international organizations and societies. It is these „academic authorities" who directly or indirectly control the allocation of many grants, decide on promotion and the careers of individuals, and determine the policies of scientific organizations, the programmes of international meetings, the contents of journals, etc. For example, it is they who decide on the relative merits of journal articles which take either a more practical or theoretical view, and thus influence potential contributers to journals. They also decide on the relative worth of different experience in a person's curriculum vitae, whether a teaching or consultancy post in the Third World is worth more than a piece of original research or a scientific publication, etc.

An awareness of the problem among these „academic authorities" is therefore necessary if solutions are to be found to the present situation of *growing underdevelopment in the Third World* compared to developed countries (regarding here biometry alone).

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