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Statistical Research and African Vital Statistics

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The revolutionary advances which have taken place since 1946 in the statistical determination of the vital characteristics of African populations are not widely known and merit greater publicity. Since the dawn of history the numbers of African persons in different areas of Africa, their rates of growth, vital conditions, their state of nutrition, the degree of pressure of population on food resources have been subjects of speculation. The developments in the technique of statistical sampling which have taken place in the last 25 years have placed an instrument in the hands of statisticians which is steadily and progessively opening up these hitherto hidden fields of research.

The customary method of determining the total population of a literate society is the census enumeration. Other population characteristics, sex, age distribution, marital status, etc., are similarly obtained while vital statistics are derived from universal registration of births and deaths. Among the pre-literate societies of Africa neither of these methods is suitable. In general, the African cannot complete a census schedule, and the number of enumerators required to do this for him and to secure reliable answers to the questions asked renders such a task impossible. The areas to be covered by a census are usually of vast extent and the administrative and financial resources too slender to perform the task adequately. Universal registrations of births and deaths of African populations is still more difficult not only for the foregoing reasons but also because the African in general can attach no value to the possession of a birth or death certificate. Accepting the possibility of overcoming the latter difficulty, the organisation of accurate statistics of deaths by cause of death could not be obtained from such a registration system until the practice of calling in a medical practitioner to treat fatal illnesses was widely adopted.

Birth rates and death rates require two population totals namely either total births or total deaths and the total population concerned. Several African countries have been unable to obtain satisfactory figures after anything up to half a century's efforts to introduce a vital registration system. By a properly designed sample survey these totals can be determined simultaneously at minimum cost and utilisation of scarce administrative resources.

The progress made by statistical science in the theory and practical application of sampling has afforded a means of overcoming these obstacles. There is a widespread belief that the sampling method is at its best an inferior substitute for the older methods. Such a belief is entirely erroneous. Thus a one per cent. sample of the enumeration districts of the 1950 population census of Japan yielded results within 7 months of the census date and gave a population estimate which differed from the final census figure by only 1 part in 800! In fact, no census of population can achieve absolute accuracy. It is probable that if it were possible to take a number of simultaneous censuses of a given population there would be considerable variation in the final results. The difficulties of obtaining reliable census results in the more advanced countries are often overlooked. Furthermore several advanced countries have not yet been able to achieve a completely satisfactory birth and death registration system. There is a tendency to expect from sampling surveys a statistical standard higher than that achieved by the older methods of determining vital events. A well-designed sample survey not only gives a very accurate estimate of the required total but provides the means of determining the limits within which the true figure would probably lie at given levels of likelihood. Such limits cannot be determined in the case of a census enumeration.

A well-designed sample can produce better results than a census in many African territories because the work can be tailored to the administrative resources of the country. By concentrating limited trained personnel and finances on the tasks of obtaining accurate quantitative information from a limited number of Africans better results can be obtained from a well-designed sample than are secured by applying the same limited resources to obtain the same information on the extensive scale demanded by a census. A sample survey will not yield

useful information where the number of sample units is too small. Consequently a census must be employed if detailed figures of every district and population characteristics are required. There is a tendency for African territories to combine a census and a sample survey, the former to get the main population totals and to form the basis of sampling and the latter to determine more detailed population characteristics such as age groups and vital statistics.

Among other advantages the sampling method makes a minimum demand on the numbers and time of the personnel employed. The volume of work to be handled is reduced and thus more time can be spent in selecting and training field officers and in obtaining accurate and reliable information from the persons included in the sample. The cost of the sample is considerably less than that of the census because of the smaller staff required, the reduced amount of travelling involved and the reduction in the time required in completing the field work and the tabulation and analysis of the results.

While the foundations of the modern theory of sampling were being explored a number of crude attempts at sampling were made in Africa in small districts (*e.g.*, in Nyasaland in 1926) and the importance of obtaining accurate demographic statistics of African populations has long been recognised by the Central African Statistical Office. During World War II the classical paper on sampling in India contributed to the Royal Society by Dr. Mahalanobis came to my notice and plans were made for the application of these principles in Southern Rhodesia on the earliest possible occasion.

In 1947 a paper containing proposals for a sample census of the African Population of Southern Rhodesia was submitted for consideration to the United Nations Sub-Commission on statistical sampling and was very well received. To test the practicability of the plans and the soundness of the theoretical assumptions contained in the paper, Dr. C. A. L. Myburgh conducted a pilot survey in the Hartley District of Southern Rhodesia towards the end of 1947. The results of this survey which were published in Population Studies, December, 1948, provided a firm foundation on which to lay plans for the first full-scale sample survey of the African population. About the same time a plan was drawn up for similar surveys to be held in each of the territories of Central Africa in turn, with the object of building up a time series of vital statistics for each territory at three-yearly intervals, but unfortunately the more ambitious scheme was not adopted. Sir Edgar Whitehead, Minister of Finance in Southern Rhodesia, and Dr. Morris, Secretary for Health, were quick to appreciate the value of the work and funds were made available for a full scale survey in 1948.

On the experience gained by Dr. Myburgh, the first full-scale sample survey of the African population of Southern Rhodesia was held in the winter of 1948. No statistical text-books on the subject were written at the time and the plans were based on statistical theory, on the papers of Dr. Mahalanobis to the Royal Society and on papers published in scientific journals. Members of the United Nations Sub-Commission on Sampling were extremely interested in the survey and on completion of the work Dr. Deming, a world authority on sampling, wrote:—

"You have performed a piece of work that will be recognised as an extremely important development, namely, you have taken a census by sampling in a spot where sampling was never used before, in fact, where census data were almost non-existent. You designed a plan aimed at a certain amount of error and hit it very closely. The total cost of your survey was ridiculously low. Perhaps the most important comment is not in your letter at all. I refer to the fact that whereas you know your errors no one heretofore was much concerned about error. Certainly no one heretofore ever knew what the errors in the census were."

The sample survey was designed to determine for each Native district of Southern Rhodesia the total African population within fiducial limits of 10 per cent.; the *de facto* population, the sex and age distribution in the groups under 1 year, 1 year to puberty, over puberty; the total live births in the past year; the deaths in the past year, deaths of infants under 1 year; the number of children born to each woman over puberty and the number still surviving. On the whole the fiducial limits for the total of all districts was only 2.8 per cent. The additional cost of the survey (*i.e.*, extra payments to government officers, to specially recruited staff and

for transport, subsistence, etc.) was only £5,600. This is obviously only a fraction of the money required to organise a full-scale census or a nation-wide system of registration.

The 1948 sample survey of Southern Rhodesia attracted widespread interest and I was invited to submit a paper on sampling problems in Africa to the meeting of the United Nations Sub-Commission on sampling in Geneva in 1949. Statisticians from Norway, Jugoslavia, and the French territories took great interest in the work. Preliminary results were published in the Economic and Statistical Bulletin of Southern Rhodesia in 1948 and in Population Studies in 1949 and 1951. The final report containing full details of the methods used and a technical appendix has had a wide circulation and has been reprinted several times.

Since 1948 a sample demographic survey of the African population of Northern Rhodesia has been taken and in 1953 a second sample survey of Southern Rhodesia designed to cover the whole country in three years was organised. In East Africa sample surveys have been organised in connection with the 1948 census of the African population. A full-scale sample survey of the inhabitants of the Anglo-Egyptian Sudan is shortly to be taken in that country and the plans have been drawn largely on the experience gained from the Southern Rhodesia survey. Many smaller regional sampling enquiries have taken place in Africa but no other surveys on a national scale have been completed. In addition to the field of demography a sample survey of African agriculture was held in Southern Rhodesia in 1949, and the sample technique in this field is now being actively applied in many African territories.

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