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Professor P.C. Mahalanobis and the Development of Population Statistics in India

Prasanta Chandra Mahalanobis was born on the 29th June 1893 in a wellknown Brahmo family of Calcutta. He had his early education in the Brahmo Boys' School in Calcutta from where he passed the Entrance examination in 1903. He passed the B. Sc. with honours in Physics in 1912 from the Presidency College, Calcutta. He joined King's College, Cambridge, next year for higher studies and research. He took Part 1 of the Mathematics Tripos in 1914 and Part II of the Physics Tripos, with a first class, in 1915. He joined the Indian Educational Service in 1915 and retired as the Principal of the Presidency College in 1948. He was the General Secretary of the Visva Bharati, 1921-31, and Honorary Secretary of the Indian Statistical Institute, 1931-1972. He also worked as the Head of the Post-graduate Department of Statistics, Calcutta University, 1941-45 and as the Statistical Adviser to the Government of Bengal/West Bengal, 1945-48. He was a Member of the Planning Commission during 1955-67, and was the Honorary Statistical Adviser to the Cabinet, Government of India, from 1949 till his death on 28 June 1972. In addition to these, he held other very important positions.

Mahalanobis was born in an age when versatility was the hallmark of scholarship. It is therefore not unexpected that Mahalanobis would refuse to be limited to the confines of any narrow field. He had in fact received recognition from many eminent persons and learned bodies for his contributions to Mathematics, Physics, Meteorology, Hydrology, Anthropometry, Biometry, Agronomy, Economics, Sociology, Demography, State-craft etc., in addition to Development Planning and theoretical and applied statistics, including multi-variate analysis, operations research, business statistics, sampling theory and survey methods. About him, Jawaharlal Nehru had said, ". . I have been deeply struck by his broad and comprehensive approach to National Development and his astonishing energy. He is full of ideas and it is always a pleasure to discuss any subject with him." His ideas easily overflowed from any one subject to other allied ones and he did usually take a comprehensive view of the central subject.

Mahalanobis had displayed a sustained interest in the development of Demography. His contributions in this field are well-known. His approach is well illustrated by one of his recent manuscripts where in he says :

> "Because demography is concerned with human affairs and human populations it is possible, in principle, to consider demography as a sub-field of many other subjects,

...provided the scope of any particular subject-field like anthropology, genetics, ecology, economics, sociology, etc., is defined in a sufficiently compreheneive manner. While not denying the possibility of considering demography as a sub-field of one or another subject, at least for certain special purposes, it is suggested that demography should be logically viewed as the totality of convergent and inter-related factors and topics which (although these could be, spearately, the concern of many different subjects like genetics and anthropology, sociology, education, psychology, economics, social and political affairs etc.) jointly, together with their mutual inter-actions, form the determinants as well as the consequences of growth (or decline), changes in composition, territorial movements, and social mobility of population in different geographical regions or in the world as a whole, at any given period of tims, or over different periods of time. Such a view would supply an aggregative, inter-related, and mutually interacting system of all those factors which have any influence over, or are influenced by, demographic or population changes over space and time."[43]

Mahalanobis also thought of a fourfold classification of demograpy :

"First, formal demography, which would cover natality, nuptiality, mortality and immigration. (Then) a closely associated second group, namely, the statistical techniques and methods of collection of demographic and population data, processing of the same, examination of the reliability of the results and drawing of valid inferences from the data. This second group would also include the use of mechanical and electronic computers'for compilation, tabulation and analysis of data and also for simulation studies and exercises with mathematical models of demographic and population processes. A third subject-field (deals with) the biological aspects of population covering anthropology and genetics. There is a very wide overlap between demography and population studies, with sociology, social psychology, education, economics, political affairs, or ecology, geography and natural sciences. This (fourth) part may be conveniently called social demography."[43]

To Mahalanobis, the best course to learn and develop statistics was by actually handling a large valume of data. Those familiar with the history of Indian census would recall that collection of anthropological and, to a limited extent, anthropometric data formed a part of the census effort. Among different types of statistical information, anthropometric data were perhaps nearest to his heart at the beginning of his career ; after all he was a physicist and objective measurement was to him the basie tool. Mahalanobis' first paper[1] came out in 1922 when be was 28 years old. It was a 96 page statistical analysis of the data on Anglo-Indian statures obtained by N. Anandale, the then Director of the Zoological and Anthropological Survey of India. This was a remarkable paper in many ways, and exhibited his abilities, as a statistician, to cross-examine the data, to extract the essential information by appropriate statistical methods and to suggests further lines of research. During the twenties he worked on not only the Anglo-Indian but also on Bengalee, Chinese, and Swedish anthropometric data[3-7-9]. He did some useful statistical work on meteorological and reverine data[5]. A note on the seasonal variations in the incidence of certain diseases in Calcutta was published in 1926." He studied the seasonal fluctuations in some of the nutrients in the diets served to hostel students of Calcutta colleges (1938-39) and also set up comparisons with standard requirements.[19] On the basis of nearly 6,500 hospital cases of delivery during the

period 1850-1901, he and Das studied (1934) the secular and seasonal variations in child births, still births, seperately for males and females, maternal deaths and sex-ratio at birth.[13] Interestingly, he made use of the concept of generational interval to propose a new theory of Ancient Indian Choronology, and estimated 27 years as the generational interval for Brahmins and Kayasthas of Bengal.

In the thirties, he extended his activity in another direction; this was to attract others to the field of statistics. The first thing necessary was to raise Statistics to a prestigious status, from the hitherto humble position, in India. Mahalnobis' untiring efforts secured the blessings and active cooperation of a number of eminent persons from different walks of life, and a statistical society, the Indian Statistical Institute, was established in 1931 at Calcutta. Subsequently, branches were opened in other important cities. It is possible that Mahalanobis was imbued with Rabindranath Tagore's example of founding the Visva Bharati which gave concrete shape to his *Weltanschauing.* Taking the cue from the Poet, Mahalanobis was able to make his Institute a visiting and meeting place of scientists from all over the world ; this enhanced the prestige of the Institute and, with it, of Statistics. His experience as Secretary of the Visva-Bharti during 1921-31 must have stood him in good stead when in 1931 he became the founder-secretary of the Indian Statistical Institute.

Mahalanobis quickly realised that there cannot be anything more frustrating to a statistical researcher than the non-existence of any publication outlet for his findings. To encourage statistical workers, actual and potential, he therefore started the statistical journal, *Sankhya,* in 1933. He assumed personal financial responsibility for its publication, as the Institute was unable to find the necessary resources. Mahalanobis founded in 1935 the Statistical Publishing Society primarily for taking over the publication of the *Sankhya.* The Eka Press, which printed the *Sankhya,* had in fact to be housed for some time in his ancestral home at Calcutta.

To attain a real status in India, Statistics had to receive recognition as a sufficiently important discipline by the Indian scientific community. Mahalanobis' attempt to secure this recognition by way of a separate section on Statistics in the Indian Science Congress was not successful. But Mahalanobis was not to be subdued so easily. He accepted the challenge, and organized the first Indian Statistical Conference in 1938 under the chairmanship of Dr. (afterwards Sir) Ronald Fisher. Altogether four such conferences were held at the same place, usually at the same time, as the annual sessions of the Science Congress. The Science Congress Association revised their earlier attitude and admitted Statistics as an important scientific discipline in 1942, when a joint section for Mathematics and Statistics was started. This was followed by full statistical sections since 1945. Demography received special attention in all the four Statistical Conferences and separate sessions on the subject were organised. From the beginning, Mahalanobis recognised the immense potentialities of the method of sampling. Frank Yates, the well-known statistician, in his broadcast from the all-India radio in 1951, emphatically noted that Mahalanobis 'recognised more clearly than most, that if more world censuses were to be properly carried out in the iess developed countries, the use of sampling method would be essential'. In the thirties, demographic enquiries were not, even in the advanced countries, as common as they are now.. Even then, Mahalanobis, commenting in 1937 in the controversy between B.P. Adarkar and K.C.K.E. Raja on the former's paper[50] on the future trend of population growth in India, stated, "A census (or

complete enumeration) method of studying differential fertility is impracticable in India because of vast numbers. Recourse to a sample survey method is, therefore, inevitable." He felt that a probing enquiry into the growth of population entailed a very deep study of differential fertility by community, occupation, economic stratification etc.

He reiterated the question of differential fertility in 1946 before a special conference of 14 or 15 scientists arranged by the Population Association of America; he said, "Population in India is widely differentiated in ethnic composition, geographical and climatic conditions, social and cultural stratification, as well as by differences in economic status. Differential fertility therefore assumes a far more complex picture in India than anywhere in the world. Ethnic, geographical, socio-cultural and economic differences give a four-fold patterning with many complicated interactions. It is essential therefore to study different population groups separately."[26]

He attached special importance to the study of population growth in relation to the effect of changes in social attitude in regard to widow-remarriage[18] and also of improvement in malarial and maternal mortality due to public health measures. It is possible that his attention to the topics of widow remarriage and also inter-caste marriage on which he worked quite early might have been drawn at least subconsciously by the history of such events among his forebears. His early interest in population questions is evident in his participation in the (1946) annual scientific conference of the Milbank Memorial Foundation and the technical discussions he had held with F. Notestein, I. Tauber, and Kingsly David about the possibility of initiating investigations of growth of India's population in collobora-tion with the population research group in Princeton.

Mahalanobis worked steadily in the field of population sampling. As a resnlt of his informal discussions with officials in the Department of Education, Health and Lands at Delhi in 1944, the Government constituted an expert committee, with Sir Theodore Gregory, Prof. P. C. Mahalanobis, Prof. K. B. Madhva and Dr. K. C. K. E. Raja as Members and Mr. M. W. M. Yeatts as Chairman, to examine and advice the Government on the available data relating to the growth of population. The Government also decided that the enquiry be "based on the Indian Statistical Institute" where the statistical work could be carried out. On the basis of these ISI studies, the Committee came to the conclusion that fairly satisfactory age and life tables and population projections could be obtained on the basis of the Y-sample, and the Committee recommended the derivation of such tables. This Y-sample, named after Yeatts, the 1941 Census Commissioner, had been obtained by extracting every 50th individual enumeration slip from the entire material. This sample was meant for possible use in lieu of the full census material which could not be tabulated due to the exigencies of the War. The Committee obtained 100 per cent of Bihar slips and recommended the use of that material for experiments in sample methods. The Committee recommended the preparation and maintenance of a house list for use as a sampling frame, and also a sampling enquiry for the estimation of vital rates.

Mahalanobis was able to secure for the Instiiute three huge items of population work. For the first time in the history of the Indian census such a huge volume of data, of the 1941 census 2 per cent Y-sarnple, was transferred to punched (Hollerith) cards for the preservation

of information. Methods for controlling coding and punching as well as other operational errors were devised for this purpose.

Another project was the derivation of the "age-tables" by mechanised tabulation. Civil condition, or marital status, and literacy status tables by age-groups, involving adjustments for digital biases in age returns, were obtained for each district separately for males and females. Also, for the first time in Census history, age tables for individual years of age were obtained for each district separately for males and females. This extensively tabulated material was meant for actuaries and demographers for the study of biases in age reporting (and their geographical variations) and the development of suitable methods for age-grouping and graduation. Methods of measuring the overall precision of a sample table, including the one of stratification after selection, were devised in this connection. Tables on means of livelihood (principal/subsidiary) for the self-supporting and partly dependent males and females were obtained. Another table obtained only for the Province as a whole involved industry group, class of worker and three broad age groups. The Registrar General published some of the age and means of livelihood tables.

The third item was experimental sampling studies on the Hazaribag (Bihar) full census material. Relative efficiencies of systematic samples of individuals, households, enumeration blocks, and villages were studied in respect of several demographic and economic characteristics for different sampling intervals, different methods of estimation, and different preselection arrangements of slips. Some technical papers were published and the Report (in two volumes) on experimental sampling studies was submitted to the Registrar General.

In India, the Government is the major producer, financier and user of census and other statistics. Mahalanobis had, therefore, realised that, in the interest of modernization of the statistical system in the country, he could become much more effective by entering the arena of this system, without however losing his identity as a professor and independent research worker. This unorthodox position he did achieve by some peculiar combination of scientific ability and inimitable tact, and became in an honorary capacity the Statistical Adviser to the Governments of pre-independence Bengal nnd post-independence India. Later, he functioned a member of the Planning Commission while retaining his status as an independent scientist. At his initiative, a Central Statistical Unit was srarted in Delhi when he took up the appointment of the Statistical Adviser to the Cabinet in 1949. Initially, for more than two years, this Unit was entirely staffed from and run by the Indian Statistical Institute of which he was the Founder Director. Two years later this Unit was canverted into the Central Statistical Organisation (CSO). K. R. Nair, the then Director of the CSO, wrote in 1963, "Looking back on its origin and growth over the years, there is little doubt that the CSO will always owe a deep debt of gratitude to Professor P. C. Mahalanobis not only for his pioneering efforts to bring it into existence but also for the sustained, almost parental interest he has taken in its growth,"

Mahalanobis worked steadfastly for international cooperation through various UN and other bodies. He started the International Statistical Education Centre at Calcutta. He prepared and edited on behalf of the International Statistical Institute the section on Statistics in the UNESCO publication on University Teaching of Social Science.[34] He was the Chairman of the Committee on statistical education of the Institute. In the 1951 session of the Insti-

tute, he presented a paper on professional training in Statistics[30]. He attached great importance to international contacts for exchange of scientific ideas and encouraged Indian participation in International Conference, Seminars, etc. He himself attended some thirty international conferences on various subjects—population, statistics, mathematics, economics, operational research, income and wealth, economic development, conservation and utilization of resources, science and technology, and international cooperation and partnership. His keenness is shown by the fact that at the age of 76 years he collaborated with Bhattacharya[45] to produce a paper, for the London (1969) Conference of the International Union for the Scientific Study of Population on population growth in India and Pakistan. Remarkably, even at the age of 78 years he could produce two papers, one on sample survey [4D] and the other on disparities in levels of living[48] for two different international conferences.

His draft of the Second Plan Frame[41] marked a departure from the previous one ; its comprehensive approach took into due account the inter-connexions among various compon ents. His idea, reiterated in the Asian Population Conference, to secure simultaneous ad vancement in all directions, income, population, industry, ogriculture etc., required for its follow up, the necessary supporting statistical data both for planning and evaluation. He was conscious of serious lacunae in these statistical information and realised with greater force the existence of these gaps during his tenure as the Chairman of the National Income Dommittee set up by the Goverument of India in 1949. His answer to this problem was the National Sample Survey (NSS) which was set up by the Government in 1950 at his initiative. As the Honorary Statistical Adviser and Member of the Planning Commission in charge of Perspective Planning and Statistics, he had to watch and guide the developments of the NSS. In consonance with his multi-directional approach, the NSS chose a multi-pnrpose and multi-subject frame of reference, and the survey"design was gradually so evolved as to permit study of the inter-connections between the various components of the socio-economic picture of the country, including in particular, regional estimates. The NSS has in the main been a popu-;lation survey in a comprehensive sense, although there has also been a sizeable effort on the estimation of crop acreage and'production. This is so because the NSS data relate to house holds; to the individuals constituting the household, and sometimes to the group of housholds comprising the village or the village population. The NSS had been providing data in which the unit of tabulation and analysis could be the "individual" as is common in demography and less commonly the "household," the urban block, and the village.

With people's welfare in mind, ,MahaIanobis desired that adequate consideration be given to the level of, and improvement Jn,.the community facilities. He therefore introduced in the NSS the "village statistics" ; for example, data were obtained on the distance of the (sample) village from the" nearest post office, school, hospital, maternity home, doctor, midwife and family planning centre. These data could be related to the information collected on detailed socio-economic characteristics of the (sample) households and persons residing in the village. Again, he wanted that continual consideration be given to levels of living of different household types as indicated by their consumption expenditures ; as a result this formed a subject of investigation in all the NSS round. On the production side, data were collected on household enterprises, agricultural and others. Household land holdings, of crucial importance, were also surveyed. Labour force, employment, unemployment and, to some extent, internal migration, were frequent topics for enquiry. In addition to the collection of usual demographic information, the NSS has obtained data on current mortality,

fertility, fertility history, and knowledge, attitude and practice (K.AP) of family planning. All the above information were on a nation wide scale, restricted at times to rural or to urban India. An interesting analysis of the NSS population data by Mahalanobis and Das Gupta[32] gave special prominence to the existence of "recall lapse" in the data. From the study of sex-ratio at birth of different marriage cohorts it was concluded that "there was a tendency to forget the birth of female children born in earlier years." There was evidence of lapse of memory about the death of infants; older marriage cohorts exhibited substantially smaller infant death rates. The paper also dwelt on age at marriage, birth intervals, etc.

Mahalanobis was the Chairman of the Family Planning Communication Action Research Committee of the Government, He claimed in 1971 that he had been a convinced advocate of birth control in India for more than fifty years. He was convinced that a retardation of the rate of growth of population would be of help in speeding up economic development. In this connection, he stated that out of the total additional income which accured to the country during the decade 1950-61 "nearly half was used to give the new additions to the population the same per capita consumption as the population had in 1950-51," About birth-control, he had said that it is "'necessary to recognise that there is no evidence, of any scientific value, to show that efforts to promote birth-control have any short time effect in either increasing the use of contraceptives, or in reducing the birth rate in the course of four or five year or so. Promotional efforts, however, may have long term effects ; and may also be of value in making social and psychological conditions more favourable for birth control. In any case, whether or not there is any short-term effect in reducing birth rate, it would be wise to promote the use of contraceptives on rational lines, and also to pursue experimental programmes, with scientific controls, to study the effect of such programmes on the birth rate ; it wouid not be wise to expect that such programmes would lead to any appreciable reduction in the actual growth of population in India during possibly the next 25 or 30 years."[46_47]

According to him. "some evidence is available to indicate that, in India, an increase in the income of the poorer people leads to an increase in the size of the family ; and also that this tapers off after a certain critical level of income is attained, and is followed by a reduction in the size of the family at higher levels of living. When a sufficient number of people reach the critical income, there would be a gradual decrease in the average birtn rate with further increase in income."[46_17] He was seized with this problem of the relationship between income and fertility in 1946, if not earlier.[28] "Progress of industrialization may, therefore, act as a brake on ths birth rate by improving levels of living, by promoting urbanization and breaking up the joint family, and by making psychlogical attitudes more favourable for use of contraceptives. In rural areas, there would *bs* normally no difficulty, in a joint family, in looking after an additional child who may also be of some economic help in household enterprises. A married couple living by themselves in an industrial area may however, find it difficult to look after young children ; all the more so, if both husband and wife have outside jobs, or wish to participate in social, cultural or political activities in their leisure time. (Thus) married couples living in industrial area, away from joint family households may have greater incentives in using contraceptives to avoid the inconvenience and dfficulties of bringing up a large number of children. Rapid industrialization, with increase of income and urbanization, may be the most effective means, in the long run

of reducing the rate of growth of population, which would have a feedback effect, as each reduction in population growth would be of immediate help in promoting economic growth". Mahalanobis got some confirmatory evidence in favour of this thesis after going through an NSS Report on economically active population. "Some sesults of considerable demographic interest emerged in the course of this study. It was found for example that larger the size (population) of the town, smaller was the size (i.e. average number of persons) of households. Also the average size of households was smaller in occupations other than agriculture. This indicates that increasing industrialization and urbanization in India may act as a cheak on growth of populatian."[38]

Mahalanobis attached very great importance the establishment of a scientific tradition in the country. He argued: The transformation of the advanced countries to their present stage has been brought about by the acceptance of a scientific and rational view of life and nature. The scientific view has already permeated in a large measure the administrative organizations of the advanced countries. The scientific revolution, the social revolution and the industrial revolution are three aspects of the modernization of every society; these three aspects may be distinguished but cannot be separated. The rate of economic growth in every country is determined both directly and indirectly by the rate of progress of science and technology; directly through the utilization of the results of research and development, and indirectly through institutional changes brought about by the increasing influence of the scientific outlook and tradition.[46]

Turning to the Indian scene, Mahalanobis pointed out, "India has a medieval and authoritarian structure of society and the tradition of science is not yet strong. The power of government officials is increasing as an inescapable result of the pervasive anthoritarian character of Indian society". The absence of the scientific tradition appeared to him to be the main stumbling block. Because of this absence, there is lack of ability on the part of administrators and of scientists in senior positions to recognize and encourage pioneering work. Any new line of research for which a precedent cannot be found in the advanced countries would necessarily be suspect in a society which is still dominated by the principle of authority. For the same reason, science teaching and research tend to become highly imitative of what is being done in the advanced countries. Sometimes even their enquiry schedules (questionnaires), tabulation programmes and field procedures which are monifestly unsuitable for Indian conditions are copied. To what extent population studies in India can be freed from undue Western influences and research biases and hankerings for Western plaudits by being in conformity, blindly or otherwise, with Western ideas and procedures, is a question clearly implied in his approach to the development of scientific outlook in India.

Mahalanobis was a person marked for his originality. Of him, Sir Ronald Fisher said, "I need hardly say that I refer to the emergence of a statistically competent technique of Sample Survey, with which I believe Professor Mahalanobis' name will always be associated. What at first strongly attracted my admiration was that the Professor's work was not imitative." Seng went one step further when, after reviewing the work of Malanobis, he suggested, that "the experience of India will serve as a guidance and as an example worthy of imitating." In 1938, HoteUing had said, in almost the same tenor, "No technique of random sample has, so far as I can find, been developed in the United States or elsewhere, which can compare in accuracy or in economy with that described by Professor Mahalanobis."

Mahalanobis was no blind supporter of Western ideas. He recognized that the concept of 'unemployment', as used in the advanced countries, where the majority of earners received regular wages or salaries, was unsuitable for India, because regular wage earners formed a very small fraction of the labour force in this country. In India most earners "are engaged in household enterprises or work on their own account and do not have jobs and cannot lose them. They can never be unemployed. But they may not have enough work". The West-ern concept would be meaningless in their case. Discussing concepts and definitions of unemployment and underemployment appropriate for India, Mahalanobis said, "Those who have jobs carrying daily or monthly wages or salaries are, of course, employed; and those who had jobs of this type but lost them or are seeking such jobs are unemployed." For the rest, he suggested -three different approaches based on the concepts of a hypothetical or normal "full working-time", hypothetical or normal ''output per unit of time", and "normal earnings[1]'. He pointed out the existence of a subjective element in all these approaches and also of interpretational difficulties. He felt that collection of data on the basis of different approaches and a careful analysis of the observations would be of great value in formulating adequate concepts and tools for the measurement of unemployment.[37]

Mahalanobis, however, did wholeheartedly accept the Western outlook, the outlook of science. He pointed out that the tradition of science requires, and in fact consists of, the acceptance of the principle of objective validity of scientific knowledge. Observations and experiments (or inferences therefrom) made by one person require to be repeated and varifled by other persons. Inter-personal agreement between observations or experiments is the guarantee of the objective validity of scientific knowledge. "In the absence of social aware ness and appreciation of the scientific objectivity among a sufficiently large number of civil servants or political leaders, the need of validity has not yet been accepted in the official statistical system in India. Official statistics in India is treated as an integral part of the administrative system which is regulated by the principle of authority. Approval of statisti cal estimates at a high level of-authority is accepted as a substitute for validity. In many cases there is continuing opposition to independent cross-checks for the validity of the data. Officials have the feeling that two independent estimates, which might differ would be confusing and, in fact, unthinkable; therefore independent cross-checks in statistics should be eliminated."[46]

His concern for the welfare of the human population was not limited to India alone. "Without the progress of equality and improvement in the level of living, at least beyond the poverty line, for one quarter of the population of the world who live in South Asia, there would be grave repercussions on the rest of the world. The problem of the underdeveloped country is, in one sense, of greater concern to the advanced countries, because international rivalries and tensions arise from the desire to establish spheres of influence over underdeveloped areas. The very existence of underdeveloped regions would be, therefore, a continuing threat to world security, and world peace. A quick transformation of the underdeveloped countries into industrialized economies would ... reduce the sphere of conflicting interests; and hence decrease the tension between East and West."[46] He argued, "With the progress of industrialization of a country it would automatically follow that its own natural resources would be increasingly exploited by itself. With increasing industrialization it is also inescapable that commercial and economic relations with other countries would increasingly tend to become as between equals."[35] His concern for the human species did not leave him even in his death-bed. As reported by his wife he referred while on death-bed, to the message, common to all great religions, namely that the entire human race should be considered a single entity. Much of the present human miseries flowed from the failure of man to act according to this message.

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